



# PEMEX – PP LUM A Project

**ImXport Services Corp.**

**Installation, Operation, and Maintenance Manual**

**for the**

**Nautilus Model  
340LA-80**

**Marine Crane**

**Serial Number: 23407C**

Purchase Order No.: 0018987					OSI Doc. No.: 23407 IOMM	
Rev. No.	Submittal Date	Revision	Prep By	OSI Checked	OSI Approved	Client Approval
A	30 Nov. 07	Official Release	D. Stein	D. Payan	S. Bergeron	







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# Vendor Data Book

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Volume: 1

## Nautilus Crane Model 340LA-80

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## Nautilus Crane Model 340LA-80

### FOREWORD

Oil States Industries Houma, LA is pleased with the high quality of workmanship observed in the design, manufacture and testing of your Nautilus Crane. Maximum crane performance and utilization can be maintained only by PROPER OPERATION and equally as important, PROPER MAINTENANCE. In return, you will assure yourself a long lifespan of reliable operation and service.

Should, on the other hand, anything arise requiring service, Oil States Industries Service Department will provide you the assistance or quality maintenance you may require.

### INTRODUCTION

Specifications and information in this manual are current at the time of printing. Oil States Industries reserves the right to change and/or amend these specifications at any time without notice.

This manual has been prepared to assist you in the operation and maintenance of your Nautilus Crane. However, correct and prudent operation of a crane rests with the operator who must thoroughly understand the operation of the crane and the necessary maintenance requirements. The first scheduled maintenance of your Nautilus Crane starts from day one of operation.



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### SYMBOLS



“Danger” symbol indicates a procedure, condition or statement that, if not properly observed, will absolutely result in serious equipment damage, physical injury and/or possible death.



“Warning” symbol indicates a procedure, condition or statement that, if not properly observed, could result in serious equipment damage, physical injury and/or possible death.



“Caution” symbol indicates a procedure, condition or statement that, if not properly observed, may result in possible equipment damage, physical injury and/or possible death.



“Safety Alert” symbol indicates a precautionary statement. Attention is required in order to avoid possible personal injury.



**NOTE:** THIS IS THE SYMBOL FOR SPECIAL OPERATING OR MAINTENANCE INSTRUCTIONS.



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## Nautilus Crane Model 340LA-80

### SERVICE ASSISTANCE & ORDERING INFORMATION

24 Hours a Day

#### INTRODUCTION

This section contains information for ordering replacement parts for the equipment.



**NOTE:** CERTIFIED OEM REPLACEMENT PARTS CONTAIN NAUTILUS PART NUMBERS. INFORMATION ON PARTS NOT LISTED IN THIS MANUAL MUST BE RECEIVED FROM OSI NAUTILUS CRANE FOR PROPER VALIDATION AS NON-OEM PARTS MAY NOT MEET PERFORMANCE STANDARDS. ANY REPAIRS MADE WITH NON-OEM PARTS COULD EFFECT SAFE OPERATIONS OF THE CRANE AND CAUSE POSSIBLE PERSONNEL INJURY.

#### PARTS DELIVERY

To ensure prompt delivery of parts, be sure to give the correct name, address, town, state and country to which the parts are to be shipped. Include the Zip Code, if applicable, and specify the type of shipment. If the type of shipment is not specified, parts will be shipped by the best available means as determined by Oil States Industries.

#### PARTS AND SERVICE INQUIRIES

If difficulty is encountered with the repair of any assembly / component or if replacement parts are needed for any reason, contact the Oil States Industries Parts and Service Department for assistance at the following:

***Oil States Industries***

1180 Mulberry Road  
Houma, LA 70363 USA

Telephone: (985) 868-0630

Toll Free: (800) 247-5530

Fax: (985) 851-0778



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## Nautilus Crane Model 340LA-80

### Section 1.0 General Description



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## Nautilus Crane Model 340LA-80

### Section 1.1 API Certificate



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**American  
Petroleum  
Institute**



## **Certificate of Authority to use the Official API Monogram**

**License Number: 2C-0007**

**ORIGINAL**

The American Petroleum Institute hereby grants to

### **OIL STATES INDUSTRIES**

**1180 Mulberry Rd.  
Houma, Louisiana**

the right to use the Official API Monogram® on manufactured products under the conditions in the official publications of the American Petroleum Institute entitled API Spec Q1® and **API Spec 2C** and in accordance with the provisions of the License Agreement.

In all cases where the Official API Monogram is applied, the API Monogram should be used in conjunction with this certificate number: **2C-0007**

The American Petroleum Institute reserves the right to revoke this authorization to use the Official API Monogram for any reason satisfactory to the Board of Directors of the American Petroleum Institute.

**The scope of this license includes the following product:** Offshore Pedestal Mounted Cranes

No Exclusions are Identified as Applicable to this Quality Management System

**Effective Date: NOVEMBER 8, 2004**  
**Expiration Date: NOVEMBER 8, 2007**

American Petroleum Institute

Director of Certification Programs

To verify the authenticity of this license, go to [www.api.org/composite1ist](http://www.api.org/composite1ist).



**Certification Programs**

1220 L Street, NW  
Washington, DC 20005-4070  
USA  
Telephone 202-962-4791  
Fax 202-682-8070  
Email [certification@api.org](mailto:certification@api.org)  
[www.api.org/certification](http://www.api.org/certification)

*Facility ID #: 62  
Automatic Notification - Extension Letter*

December 26, 2007

Oil States Industries  
1180 Mulberry Rd.  
Houma, LA 70363  
USA

**Attention:** Juergen Lugowski

**Re:** License 2C-0007

API's goal is to complete the renewal process to coincide with the expiration date of your license. However, the process has been delayed because of one or more of the following items:

- Your audit has not been scheduled and/or performed
- Incomplete or delayed submission of your renewal application
- Your audit report has not been received or your report/response is pending review by API Staff
- API has not received your response to an audit or manual review letter

**The expiration date of your current license(s) has been extended until February 08, 2008**

If your organization has not submitted the required documentation, please do so at this time. However, if your audit has not been scheduled and/or performed, an API auditor will contact you shortly. Please note that we will notify you of the results of all pending reviews within a few weeks.

API would like to thank you for your patience and cooperation during the licensing renewal process.

Regards,

**API Certification Programs**







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## Nautilus Crane Model 340LA-80

### Section 1.2 API 2C Placard

<b>API SPEC 2C</b>		
SIXTH EDITION 2004		
		DATE MANUFACTURED
		NOVEMBER 2007
PRODUCED UNDER	2C-0007	QUALITY PROGRAM
MANUFACTURER'S MODEL NO.	340LA-80	
DESIGN SERVICE TEMPERATURE	MIN. 32	DEG. F.
	MAX. 115	
MANUFACTURER SERIAL NUMBER	23407C	
MANUFACTURED BY	 OIL STATES INDUSTRIES, INC. NAUTILUS MARINE CRANES	
ADDRESS	HOUMA, LOUISIANA 70363	



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## Nautilus Crane Model 340LA-80

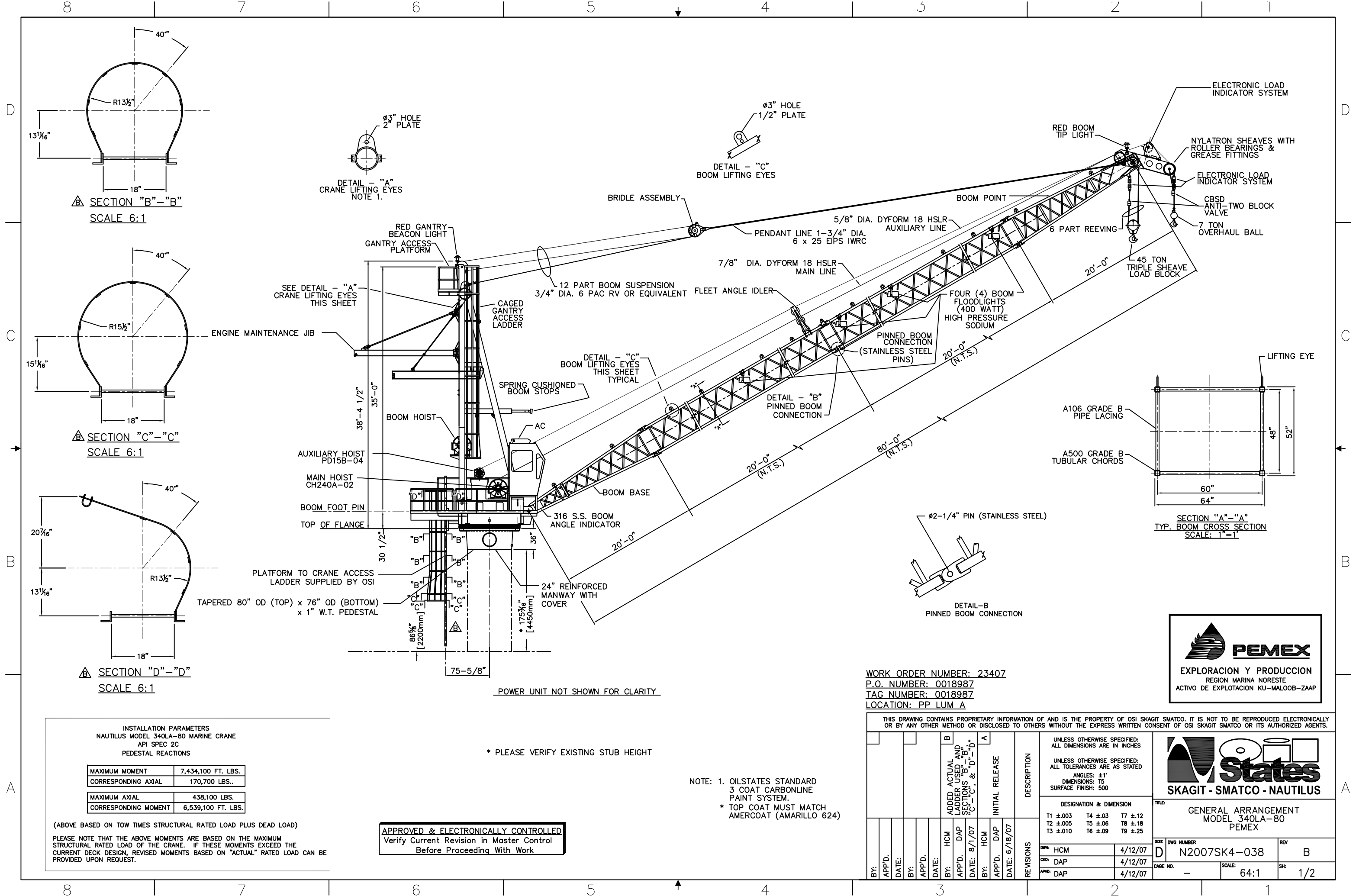
### Section 1.3 Crane General Arrangement Drawing N2007SK4-038



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SECTION "B"-"B"  
SCALE 6:1

SECTION "C"-"C"  
SCALE 6:1

SECTION "D"-"D"  
SCALE 6:1

SECTION "A"-"A"  
TYP. BOOM CROSS SECTION  
SCALE: 1"=1'

INSTALLATION PARAMETERS	
NAUTILUS MODEL 340LA-80 MARINE CRANE	
API SPEC 2C	
PEDESTAL REACTIONS	
MAXIMUM MOMENT	7,434,100 FT. LBS.
CORRESPONDING AXIAL	170,700 LBS.
MAXIMUM AXIAL	438,100 LBS.
CORRESPONDING MOMENT	6,539,100 FT. LBS.

(ABOVE BASED ON TOW TIMES STRUCTURAL RATED LOAD PLUS DEAD LOAD)

PLEASE NOTE THAT THE ABOVE MOMENTS ARE BASED ON THE MAXIMUM STRUCTURAL RATED LOAD OF THE CRANE. IF THESE MOMENTS EXCEED THE CURRENT DECK DESIGN, REVISED MOMENTS BASED ON "ACTUAL" RATED LOAD CAN BE PROVIDED UPON REQUEST.

APPROVED & ELECTRONICALLY CONTROLLED  
Verify Current Revision in Master Control  
Before Proceeding With Work

WORK ORDER NUMBER: 23407  
P.O. NUMBER: 0018987  
TAG NUMBER: 0018987  
LOCATION: PP LUM A



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						B				A	
						ADDED ACTUAL LADDER USED AND SECTIONS "B", "B", "C", "C", & "D" - "D"				INITIAL RELEASE	
										DESCRIPTION	
										UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS ARE IN INCHES	
										UNLESS OTHERWISE SPECIFIED: ALL TOLERANCES ARE AS STATED	
										ANGLES: ±1°	
										DIMENSIONS: T5	
										SURFACE FINISH: 500	
										DESIGNATION & DIMENSION	
										T1 ±.003    T4 ±.03    T7 ±.12	
										T2 ±.005    T5 ±.06    T8 ±.18	
										T3 ±.010    T6 ±.09    T9 ±.25	
										TITLE	
										GENERAL ARRANGEMENT	
										MODEL 340LA-80	
										PEMEX	
										SIZE	
										D	
										N2007SK4-038	
										REV	
										B	
										CAGE NO.	
										—	
										SCALE:	
										64:1	
										SH:	
										1/2	

NOTE: 1. OILSTATES STANDARD  
3 COAT CARBONLINE  
PAINT SYSTEM.  
\* TOP COAT MUST MATCH  
AMERCOAT (AMARILLO 624)

\* PLEASE VERIFY EXISTING STUB HEIGHT

POWER UNIT NOT SHOWN FOR CLARITY



D

C

B

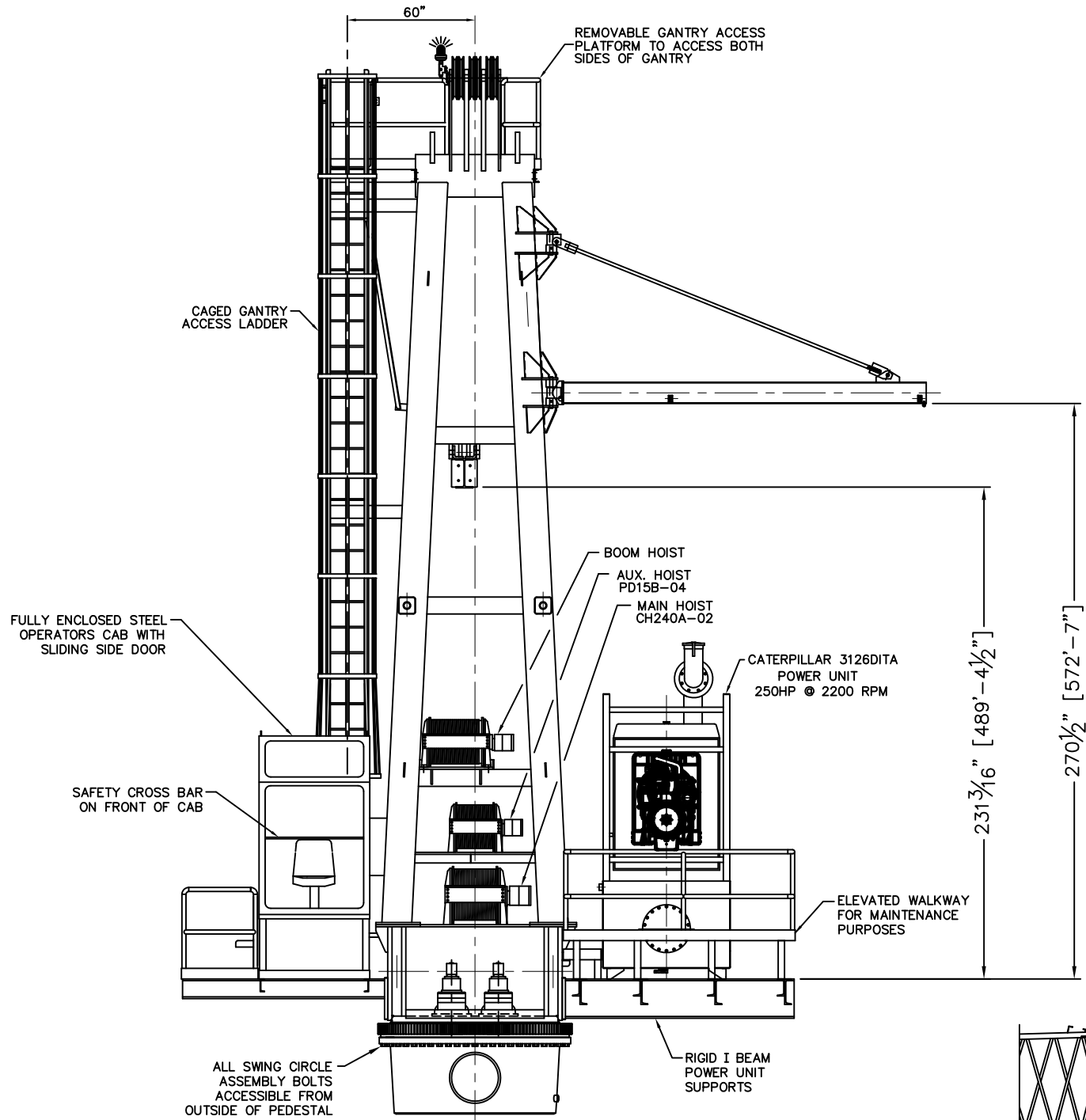
A

D

C

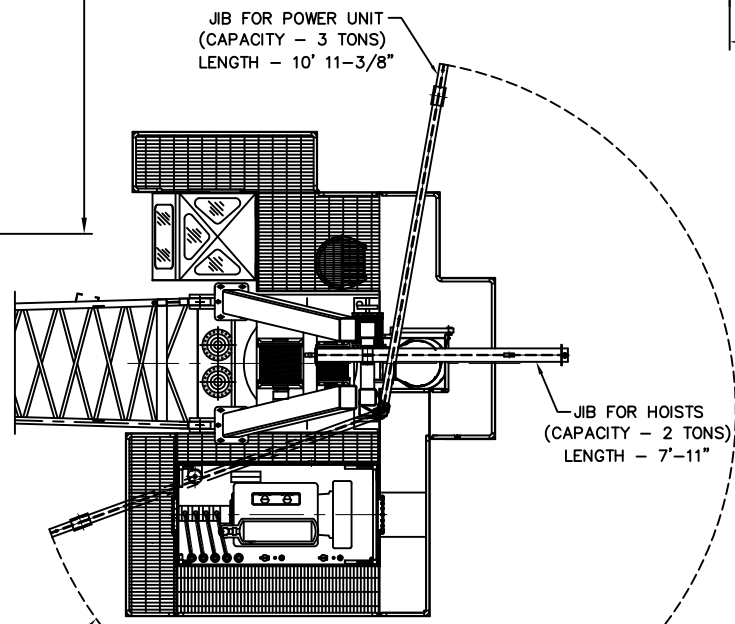
B

A

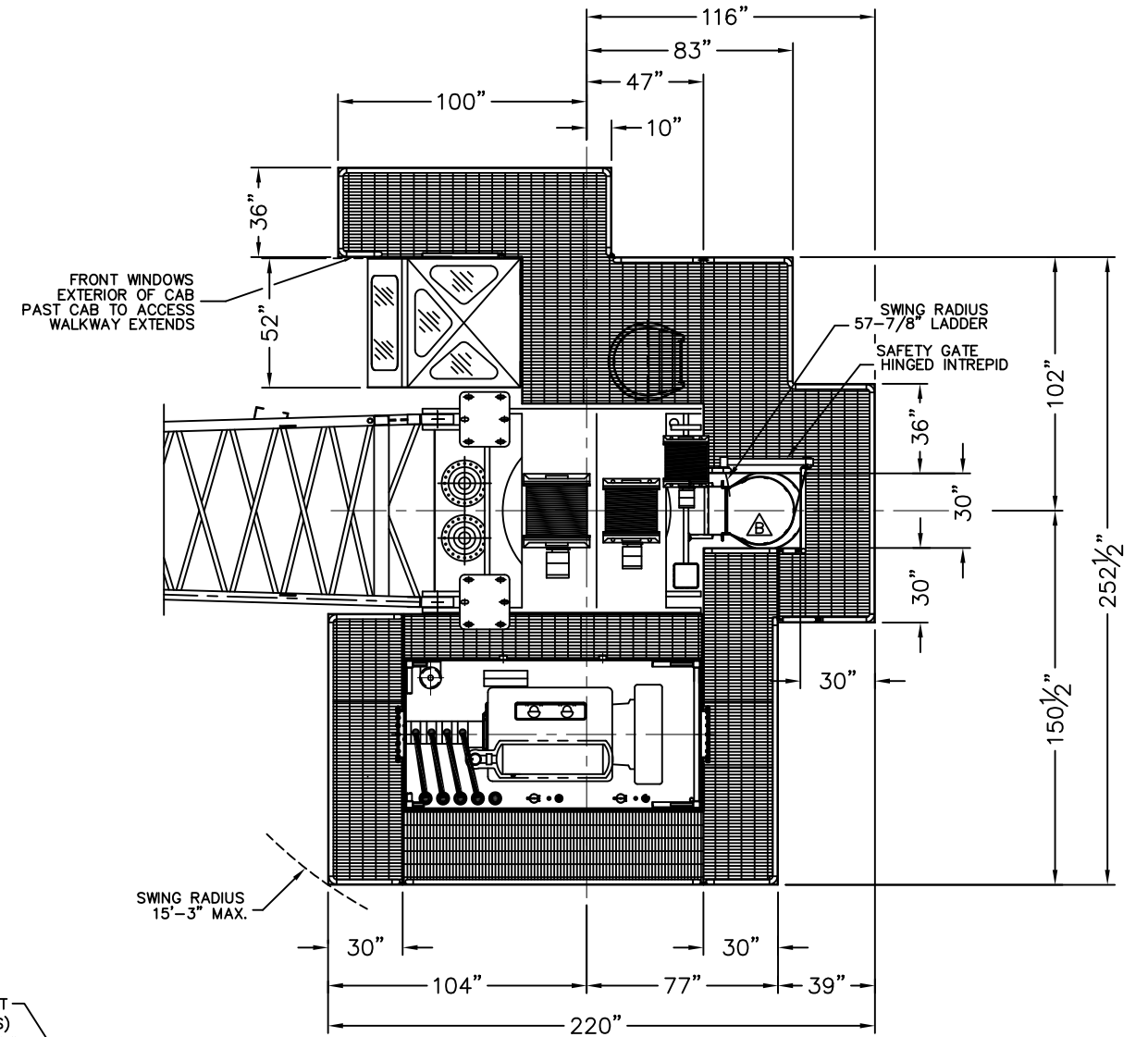


FRONT ELEVATION  
(BOOM NOT SHOWN)

APPROVED & ELECTRONICALLY CONTROLLED  
Verify Current Revision in Master Control  
Before Proceeding With Work



PLAN VIEW  
JIB #1 SWING



PLAN VIEW  
(GANTRY NOT SHOWN FOR CLARITY)

WORK ORDER NUMBER: 23407  
P.O. NUMBER: 0018987  
TAG NUMBER: 0018987  
LOCATION: PP LUM A

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UNLESS OTHERWISE SPECIFIED:  
ALL DIMENSIONS ARE IN INCHES  
UNLESS OTHERWISE SPECIFIED:  
ALL TOLERANCES ARE AS STATED  
ANGLES:  
DIMENSIONS:  
SURFACE FINISH:



DESIGNATION & DIMENSION  
T1 ±.003 T4 ±.03 T7 ±.12  
T2 ±.005 T5 ±.06 T8 ±.18  
T3 ±.010 T6 ±.09 T9 ±.25

TITLE:  
GENERAL ARRANGEMENT  
MODEL 340LA-80  
PEMEX

DWG: HCM 4/12/07  
CHK: DAP 4/12/07  
APP: DAP 4/12/07

SIZE DWG NUMBER REV  
D N2007SK4-038 B  
CAGE NO. 32:1 SCALE: 32:1 SH: 2/2







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## Nautilus Crane Model 340LA-80

### Section 1.4 Lifting Load Capacity Chart (English) N2007SK3-061

**NAUTILUS**

MARINE CRANES  
HOUMA, LOUISIANA 70363  
(985) 868-0630

MODEL 340LA-80  
SERIAL NUMBER 23407C  
PEMEX



		MAIN HOIST				AUXILIARY HOIST			
		SIX PART REEVING				SINGLE PART REEVING			
		LOW SPEED		HIGH SPEED					
RADIUS (FT)	BOOM ANGLE (DEG)	ONBOARD LIFT (LBS)	OFFBOARD LIFT (LBS)	ONBOARD LIFT (LBS)	OFFBOARD LIFT (LBS)	ONBOARD LIFT (LBS)	OFFBOARD LIFT (LBS)	PERSONNEL LIFT (LBS)	RADIUS (FT)
18	81	82,556	60,000	60,660	60,000	8,870	8,870	3,098	18
20	79	82,556	60,000	60,660	60,000				20
25	76	82,556	60,000	60,660	60,000				25
30	72	82,556	60,000	60,660	60,000				30
35	68	82,556	60,000	60,660	60,000				35
40	64	82,556	55,042	60,660	55,042				40
45	60	73,293	48,362	60,660	48,362				45
50	56	65,390	43,093	60,660	43,093				50
55	51	58,897	38,765	58,897	38,765				55
60	47	53,509	35,173	53,509	35,173				60
65	41	49,009	32,173	49,009	32,173				65
70	36	45,152	29,601	45,152	29,601				70
75	29	41,769	27,346	41,769	27,346				75
80	20	38,559	25,206	38,559	25,206				80
85	0	35,550	23,200	35,550	23,200				85

DESIGN CONDITIONS	
METHOD USED	DEFAULT DYNAMIC
HOOK DROP	208 FT
MIN HOOK SPEED (MAIN LOW SPEED)	22.33 FPM
MIN HOOK SPEED (MAIN HIGH SPEED)	40 FPM
MIN HOOK SPEED (AUX.)	212 FPM

DESIGN CONDITIONS	
METHOD USED	DEFAULT DYNAMIC
HOOK DROP	208 FT
MIN HOOK SPEED (MAIN LOW SPEED)	22.33 FPM
MIN HOOK SPEED (MAIN HIGH SPEED)	40 FPM
MIN HOOK SPEED (AUX.)	212 FPM

**NOTE:**

- 1) OFFBOARD LIFTS BASED ON SWL\*Cv
- 2) Cv IS THE VERTICAL DYNAMIC COEFFICIENT DETERMINED BY THREE METHODS
  - \* VESSEL SPECIFIC METHOD – USED FOR DETERMINING RATINGS FOR FLOATING PLATFORM / VESSEL
  - \* GENERAL METHOD – USED FOR DETERMINING RATINGS FOR FLOATING PLATFORM / VESSEL OR FIXED PLATFORM
  - \* DEFAULT DYNAMIC METHOD – OFFBOARD LIFTS FROM FIXED PLATFORM (Cv=2.0)
- 3) SHEAVE EFFICIENCY CONSIDERED.
- 4) THE ABOVE RATINGS ARE NET RATINGS AS THE MAIN LOAD BLOCK WEIGHT OF 1,500 LBS AND THE AUXILIARY OVERHAUL BALL WEIGHT OF 210 LBS HAVE ALREADY BEEN SUBTRACTED TO DETERMINE "NET" CAPACITY.
- 5) REFERENCE MANUAL FOR REEVING DIAGRAMS.
- 6) REFERENCE INFORMATION CHART FOR REEVING DETAILS.
- 7) ALL RATINGS IN ACCORDANCE WITH API SPECIFICATION 2C (SPEC 2C), SIXTH EDITION, SEPTEMBER 2004.

TAG NO.: 0018987  
P.O. NO.: 0018987

REV: A  
P/N: N2007SK3-061



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## Nautilus Crane Model 340LA-80

### Section 1.5 Lifting Load Capacity Chart (metric) N2007SK3-086

**NAUTILUS**

MARINE CRANES  
HOUMA, LOUISIANA 70363  
(985) 868-0630

MODEL 340LA-80  
SERIAL NUMBER 23407C  
PEMEX



		MAIN HOIST				AUXILIARY HOIST				
		SIX PART REEVING				SINGLE PART REEVING				
		LOW SPEED		HIGH SPEED						
RADIUS (M)	BOOM ANGLE (DEG)	ONBOARD LIFT (Kg)	OFFBOARD LIFT (Kg)	ONBOARD LIFT (Kg)	OFFBOARD LIFT (Kg)	ONBOARD LIFT (Kg)	OFFBOARD LIFT (Kg)	PERSONNEL LIFT (Kg)	RADIUS (M)	
5.5	81	37,447	27,216	27,515	27,216	4,023	4,023	1,405	5.5	
6	79	37,447	27,216	27,515	27,216				6	
8	76	37,447	27,216	27,515	27,216				8	
9	72	37,447	27,216	27,515	27,216				9	
11	68	37,447	27,216	27,515	27,216				11	
12	64	37,447	24,967	27,515	24,967				12	
14	60	33,245	21,937	27,515	21,937				14	
15	56	29,660	19,547	27,515	19,547				15	
17	51	26,715	17,583	26,715	17,583				17	
18	47	24,271	15,954	24,271	15,954				18	
20	41	22,230	14,593	22,230	14,593				20	
21	36	20,481	13,427	20,481	13,427				21	
23	29	18,946	12,404	18,946	12,404				23	
24	20	17,490	11,433	17,490	11,433				24	
26	0	16,125	10,523	16,125	10,523				26	

DESIGN CONDITIONS	
METHOD USED	DEFAULT DYNAMIC
HOOK DROP	63.40 M
MIN HOOK SPEED (MAIN LOW SPEED)	6.83 MPM
MIN HOOK SPEED (MAIN HIGH SPEED)	12.16 MPM
MIN HOOK SPEED (AUX.)	65 MPM

**NOTE:**

- 1) OFFBOARD LIFTS BASED ON SWL\*Cv
- 2) Cv IS THE VERTICAL DYNAMIC COEFFICIENT DETERMINED BY THREE METHODS
  - \* VESSEL SPECIFIC METHOD – USED FOR DETERMINING RATINGS FOR FLOATING PLATFORM / VESSEL
  - \* GENERAL METHOD – USED FOR DETERMINING RATINGS FOR FLOATING PLATFORM / VESSEL OR FIXED PLATFORM
  - \* DEFAULT DYNAMIC METHOD – OFFBOARD LIFTS FROM FIXED PLATFORM (Cv=2.0)
- 3) SHEAVE EFFICIENCY CONSIDERED.
- 4) THE ABOVE RATINGS ARE NET RATINGS AS THE MAIN LOAD BLOCK WEIGHT OF 680 Kg AND THE AUXILIARY OVERHAUL BALL WEIGHT OF 95 Kg HAVE ALREADY BEEN SUBTRACTED TO DETERMINE "NET" CAPACITY.
- 5) REFERENCE MANUAL FOR REEVING DIAGRAMS.
- 6) REFERENCE INFORMATION CHART FOR REEVING DETAILS.
- 7) ALL RATINGS IN ACCORDANCE WITH API SPECIFICATION 2C (SPEC 2C), SIXTH EDITION, SEPTEMBER 2004.

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REV: A  
P/N: N2007SK3-086



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA







PEMEX – PP LUM A  
Project

ImXport Services Corp.

# Vendor Data Book

P.O. # 0018987

Serial # 23407C

Volume: 1

## Nautilus Crane Model 340LA-80

### Section 1.6 Crane Acceptance Test Procedure & Report



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1180 MULBERRY ROAD  
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# FACTORY ACCEPTANCE TEST PROCEDURE AND REPORT

Nautilus Model 340LA-80 Marine Crane  
Tag # PA-1003 Grua de Pedestal  
for

ImXport Services Corp.  
Pemex-PP LUM A Project

Serial Number: 23407

Date: November 30, 2007

  
(Oil States Industries, Inc. Representative) 12/01/07

 12-01-07  
ARMANDO CASTILLO  
(ImXport Services Corp. Representative)

  
(ABS Representative)







## SECTION 0 – Pre-Final Acceptance Test Inspection:

Verify the following prior to initiation test procedure

Accept	Not Accept	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Diesel Tank (Filled to minimum of ¼ of a tank)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Oil Reservoir (Filled to minimum of ¾ of a tank)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engine Lube Oil (Between high & low marks on dipstick)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engine Coolant Level (Filled to the top of radiator)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	All walkways & ladders present (Access ladder not installed due to height limitations on test stand)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	All safety gates, chains, handrails, and safety cables are present.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Load chart in operator's cab is in clear view of the operator and compare to latest approved load chart for correctness.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Visual inspection of engine <ul style="list-style-type: none"> <li>Fluid levels within acceptable ranges</li> <li>Engine free of leaks (Hydraulic, Diesel, coolant and engine oil)</li> <li>Radiator free of damage</li> <li>All hoses protected against chaffing</li> </ul>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Verify load test weight calibration certificates
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Verify stopwatch s/n: <u>SS-454</u> calibration certificate
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Verify infrared thermometer s/n: <u>SS-552</u> calibration certificate

## SECTION 1 – Gauges:

Accept	Not Accept		Working Pressure		Relief Pressure	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	0-5,000 psi Hydraulic Pressure (Main Hoist)	2400	PSI	3000	PSI
<input checked="" type="checkbox"/>	<input type="checkbox"/>	0-5,000 psi Hydraulic Pressure (Aux. Hoist)	2400	PSI	3000	PSI
<input checked="" type="checkbox"/>	<input type="checkbox"/>	0-5,000 psi Hydraulic Pressure (Boom)	2500	PSI	2800	PSI
<input checked="" type="checkbox"/>	<input type="checkbox"/>	0-3,000 psi Hydraulic Pressure (Swing)	500	PSI	1200	PSI
<input checked="" type="checkbox"/>	<input type="checkbox"/>	0-600 psi Hydraulic Pressure (Pilot)	450	PSI	500	PSI
<input checked="" type="checkbox"/>	<input type="checkbox"/>	0-100 psi Hydraulic Pressure (Pilot Ret.)	10	PSI		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	0-100 psi Hydraulic Pressure (Return)	12	PSI		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	0-200 psi Engine Oil Pressure	60	PSI		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	0-200 psi Air Pressure	110	PSI	150	PSI
			Indicator Reading		Max Working Temp.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engine Water Temperature	>60	C	120	C
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Oil Temperature	>60	C	70	C
			Idle		Full Throttle	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engine Tachometer	760	RPM	2367	RPM
			Level Reading			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Oil Level	7/8			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Diesel Fuel Level	1/3			
			Indicator Reading		Test Load	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Load Indicator (Main)	37,400	Kg	37,700	Kg
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Load Indicator (Aux)	4,200	Kg	4,012	Kg
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Fire Extinguisher (2)				



## SECTION 2 – Function Test the Following:

Accept      Not  
Accept      Accept

### Crane Systems:

- |                                     |                          |                                     |
|-------------------------------------|--------------------------|-------------------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 360° Continuous Rotation            |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Dynamic Swing Brake (Foot Actuated) |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Free Swing Capability               |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Swing Park Brake (Push Button)      |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Swing Lock                          |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Attention Horn                      |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Windshield Wipers                   |

### Crane Safety Systems – (Anti- two block and Boom Kickout Systems):

- |                                     |                          |  |
|-------------------------------------|--------------------------|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Main Hoist Anti-Two Block *  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Auxiliary Hoist Anti-Two Block *                                       |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | High Angle Kickout (Rotate Boom to Actuate)                            |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Low Angle Kickout (Rotate Boom to Actuate)                             |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Low Boom Angle Kickout Override (Press Button After Low Angle Kickout) |

### Engine Systems:

- |                                     |                          |  |
|-------------------------------------|--------------------------|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Engine Throttle (Foot Actuated)  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Engine Manual Fuel Shutdown Cable (Pull to Actuate)                            |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Engine coolant system      72 ° C Measured at radiator while engine is running |

### Engine Safety Systems:

- |                                     |                          |   |
|-------------------------------------|--------------------------|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Emergency Manual Engine Air Intake Shutdown Cable (Pull Cable to Actuate) |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Low Engine Lube Oil Pressure Shutdown **                                  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | High Engine Coolant Temperature Shutdown System **                        |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Engine Automatic Over Speed Shutdown System ***                           |

\* = Simulated by Hoisting block and Aux ball into valve.

\*\* = Simulated by using a ball valve to dump engine oil pressure.

\*\*\* = Simulated by manually adjusting the speed valve sensor to trip.

## SECTION 3 – Electrical:

Accept      Not  
Accept      Accept

- |                                     |                          |  |
|-------------------------------------|--------------------------|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Boom Floodlights * (Ensure floodlights cannot be damaged by normal operations) |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Boom Tip Beacon (1 Red) *  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Gantry Beacon (1 Red) *  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Power On Light (1 Green) *   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Cab Light *  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Circuit Breaker *  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Air Conditioner *  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Power Unit Light *   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Walkway Light *  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Hoist Light *  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Instrument light (Red) *   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Red pilot light for Low Oil Press. Alarm **                                    |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Red pilot light for Hydraulic Oil Temp. **                                     |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Red pilot light for High Coolant Temp. **                                      |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Gai-Tronics  |

\* = Tested by actuating the applicable switch in the operator's cabin.

\* = Tested by manually actuating pressure / temp. Switch on power unit.

#### SECTION 4 – Baseline Pressure Readings with No Load:

FUNCTION	STARTING BOOM ANGLE (Degrees)	ENDING BOOM ANGLE (Degrees)	CRACKING PRESSURE NO LOAD (PSI)	FULL SPEED PRESSURE NO LOAD (PSI)
Boom Up:	60	64	300	500
Boom Down:	60	61	1,000	1,300
Main Hoist Up:	60	60	100	600
Main Hoist Down:	60	60	1,000	1,500
Aux. Hoist Up:	60	60	100	800
Aux. Hoist Down:	60	60	600	1,700
Swing CW:	60	60	300	500
Swing CCW:	60	60	200	800

#### SECTION 5 – Performance Speeds

**Main Hoist Speed:** (Calculated Time Hoisting Up w/ Section 6 Main Hoist Test Lift # 1.)

Time measured with stopwatch s/n: SS-454

1.48 Meters per sec.

**Aux Hoist Speed:** (Calculated Time Hoisting Up w/ Section 7 Main Hoist Test Lift # 1.)

Time measured with stopwatch s/n: SS-454

7.13 Meters per sec.

**Swing Speed:** (Two Complete Revolutions in Both Directions w/ Section 7 Main Hoist Test Lift # 1.)

Time measured with stopwatch s/n: SS-454

720° 1:24.68 Clockwise

720° 1:29.20 Counter-clockwise

**Boom Speed:** (With No Load)

Time measured with stopwatch s/n: SS-454

0° to 80° 3:29.21

#### SECTION 6 – Hoist Brake Test:

Test performed by closing hoist brake needle test valve and hoisting the hoist down against the brake until the hydraulic system goes over relief – a visual inspection is performed to ensure hoist does not turn during procedure

Accept	Not Accept		Relief Pressure	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Main Hoist Brake	<u>3,000</u>	PSI
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Aux Hoist Brake	<u>3,000</u>	PSI
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Boom Hoist Brake	<u>2,800</u>	PSI

## SECTION 5: Load Test

### Main Hoist - Low speed: 6 - Part Reeving

Main Hoist - Low speed: 6 - Part Reeling																	
Lift No.	Initial Radius (ft)	Ending Radius (ft)	Onboard Lift (Kg)	Test Load (Kg)	Percent of Rated Load	Main Hoist Cracking Pressure (PSI)		Main Hoist Full Speed Pressure (PSI)		Swing Cracking Pressure (PSI)		Boom Cracking Pressure (PSI)		Load Cell (Kg)	10 ft. Speed Chain (sec)	Speed Chain Average (sec)	Hook Speed (mps)
						Up	Down	Up	Down	CCW	CW	Up	Down		1.	2.	3.
1	12	12	37,447	37,788	101%	2,000	700	2,400	1,000	500	300	2,500	900	37,400	20.61	20.42	0.90
2	12	12	37,447	49,754	133%							2,600	900		20.07		
3	20	19	22,230	22,140	100%	1,300	800	1,800	1,200	800	400	1,400	1,000	23,200	20.57		

## Main Hoist - High speed: 6 - Part Reeving

Main Hoist - High speed:																	
6 - Part Reaving																	
Lift No.	Initial Radius (M)	Ending Radius (M)	Onboard Lift (Kg)	Test Load (Kg)	Percent of Rated Load	Aux. Hoist Cracking Pressure (PSI)		Aux. Hoist Full Speed Pressure (PSI)		Swing Cracking Pressure (PSI)		Boom Cracking Pressure (PSI)		Load Cell (Kg)	10 ft. Speed Chain (sec)	Speed Chain Average (sec)	Hook Speed (mps)
						Up	Down	Up	Down	CCW	CW	Up	Down				
4	15	15	27,515	27,851	101%	1,600	800	2,000	1,100	700	100	1,500	1,100	28,700	1.	12.34	1.48
															2.	12.28	
															3.	12.57	

**Aux. Hoist:** 1 - Part Reeving

Aux. Hoist: 1 - Part Reeving																	
Lift No.	Initial Radius (M)	Onboard Lift	Test Load (Kg)	Percent of Rated Load	Aux. Hoist Cracking Pressure (PSI)		Aux. Hoist Full Speed Pressure (PSI)		Swing Cracking Pressure (PSI)		Boom Cracking Pressure (PSI)		Load Cell (Kg)	10 ft. Speed Chain Average (sec)	Speed Chain Average (sec)	Hook Speed (mps)	
					Up	Down	Up	Down	CCW	CW	Up	Down					Up
5	15	4,023	4,012	100%	1,920	600	2,400	1,400	600	100	500	800	4,200	1.	2.58	2.57	7.13
6	15	4,023	4,974	124%							800	800		2.	2.55		

**CERTIFIED TEST WEIGHTS (Kg)**

CERTIFIED TEST WEIGHTS (Kg)										
Lift No.										
1	37,788	=	Slings	A	E	G	I			
			544	+	1,043	+	17,123	+	6,822	+
2	49,754	=	Slings	B	D	E	F	G	I	
			544	+	4,119	+	8,287	+	17,123	+
							603	+	6,822	+
3	22,140	=	Slings	D	I	3 pl				
			236	+	8,287	+	12,256	+	1,361	
4	27,851	=	Slings	B	F	C	H	I		
			236	+	4,119	+	603	+	4,051	+
							6,586	+	12,256	
5	4,012	=	Slings	A	F	3 PL	5rd wt			
			64	+	1,043	+	603	+	1,361	+
							941			
6	4,974	=	Slings	B	F	1rd wt				
			64	+	4,119	+	603	+	188	





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## Nautilus Crane Model 340LA-80

### Section 1.7 Crane Critical Component Log

Crane Model ..... 340LA-80  
Serial Number ..... 23407C

Manufacture Date ..... November 2007

Engine ..... N47787-017  
Serial Number ..... 9ZR03784  
Model Number ..... 3126  
Arrangement Number ..... 132-4383

Main Hoist ..... N47022-002  
Serial Number ..... 0701464  
Auxiliary Hoist ..... N46059-003  
Serial Number ..... 0764629  
Boom Hoist ..... N46430-009  
Serial Number ..... 0701460

Main Load Block ..... N46831-243  
Serial Number ..... 0754704  
Overhaul Ball ..... N46832-001  
Serial Number ..... 0749708

Ballring ..... N46397-002  
Serial Number ..... 301575-A3

Swing Drive Assembly:  
Motor 1 ..... N45375-001  
Brake 1 ..... N47199-002  
Gearbox 1 ..... N47103-004  
Pinion 1 ..... N61503-001  
Motor 2 ..... N45375-001  
Brake 2 ..... N47199-002  
Gearbox 2 ..... N47103-004  
Pinion 2 ..... N61503-001



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## Nautilus Crane Model 340LA-80

### Section 1.8 Information Chart

<b>NAUTILUS</b> MARINE CRANES HOUMA, LOUISIANA 70363 (985) 868-0630		<b>INFORMATION CHART</b> (LATTICE BOOM)		 OIL STATES INDUSTRIES, INC.	
		SERIAL NUMBER : 23407C			
		CRANE MODEL : 340LA-80			
		PURCHASE ORDER NUMBER : 0018987			
		TAG NUMBER : 0018987			
<b>MAIN LIFTING CONFIGURATION:</b>		<b>AUXILIARY LIFTING CONFIGURATION:</b>			
<b>WIRE ROPE INFORMATION:</b>		<b>WIRE ROPE INFORMATION:</b>			
TYPE:	DYFORM 18-HSLR	TYPE:	DYFORM 18-HSLR		
SIZE:	7/8" [22.2mm]	SIZE:	5/8" [15.87mm]		
BREAKING STRENGTH:	87,600 lbs [39,734Kg]	BREAKING STRENGTH:	45,400 lbs [20,593Kg]		
LENGTH:	1,608 FT [490.12M]	LENGTH:	361 FT [110.03M]		
<b>HOOK INFORMATION:</b>		<b>HOOK INFORMATION:</b>			
MAXIMUM TRAVEL:	208 FT [63.40M]	MAXIMUM TRAVEL:	208 FT [63.40M]		
*RADIUS		*RADIUS			
MAX:	85 FT [25.91M]	MAX:	85 FT [25.91M]		
MIN:	18 FT [5.48M]	MIN:	18 FT [5.48M]		
**MAXIMUM HIGHSPEED		**MAXIMUM SPEED:	212 FPM [65MPM]		
SETTING:	40 FPM [12.16MPM]				
**MAXIMUM LOWSPEED					
SETTING:	22.33 FPM [6.83MPM]				
<b>BOOM (LUFFING) LIFTING CONFIGURATION:</b>					
<b>WIRE ROPE INFORMATION:</b>					
TYPE:	6 X 25 EIPS IWRC				
SIZE:	3/4" [19.05mm]				
PARTS OF LINE:	12				
BREAKING STRENGTH:	58,800 lbs [26,672Kg]				
LENGTH:	840 FT [256M]				
<b>BOOM PENDANT LINE INFORMATION:</b>					
TYPE:	6 x 19 EIPS IWRC				
SIZE:	1-3/4" [44.45mm]				
PARTS OF LINE:	2				
BREAKING STRENGTH:	306,000 lbs [138,799Kg]				
LENGTH:	35 FT [10.66M]				
<b>NOTES :</b>					
* RECOMMENDED LIMITS.					
** THE HOOK POSITIONED AT THE SUPPLY BOAT ELEVATION AND THE PLATFORM / VESSEL AT OPERATIONAL CONDITIONS					



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## Nautilus Crane Model 340LA-80

### Section 2.0 Installation Manual



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## Nautilus Crane Model 340LA-80

### Section 2.1 Warning



Failure to use proper ballring fasteners could result in property damage, severe personal injury or death.

Replacement fasteners must meet the specific requirements of API Specification 2C, Section 14.5, Sixth Edition.



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## Nautilus Crane Model 340LA-80

### Section 2.2 Bolt Torquing Procedure



**NOTE: Ballring to Pedestal** use 1-1/2"-6UNC Grade 8 Bolts.

**Ballring to Turret** use 1-1/2"-6UNC Grade 8 Bolts.

**ALL BOLTS TO MEET API 2C REQUIREMENTS**



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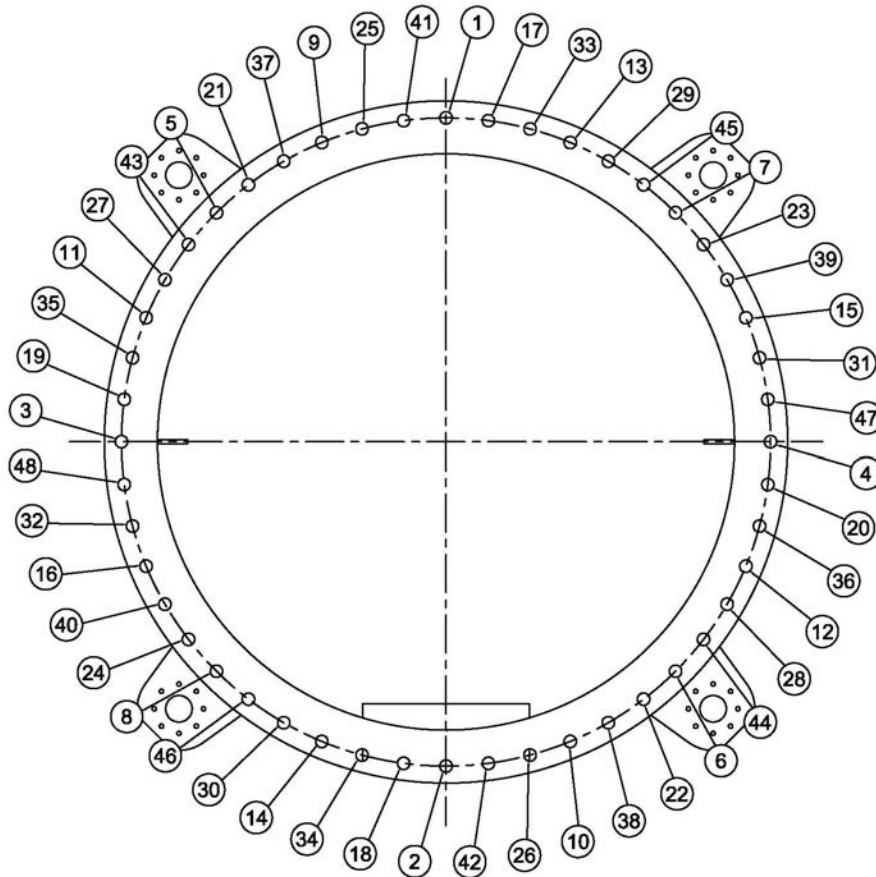
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## Nautilus Crane Model 340LA-80

### Section 2.2.1 Ballring to Pedestal



1. Do not use oil or grease (Hydraulic oil only).
2. Diagram shows the sequence bolts are to be tightened.
3. Bolts are to be torqued in increments of 50, 80 and 100% of the maximum torque value of 1,900 ft-lbs.
  - a.) First iteration torque to 950 ft-lbs.
  - b.) Second iteration torque to 1,520 ft-lbs.
  - c.) Final iteration torque to 1,900 ft-lbs.



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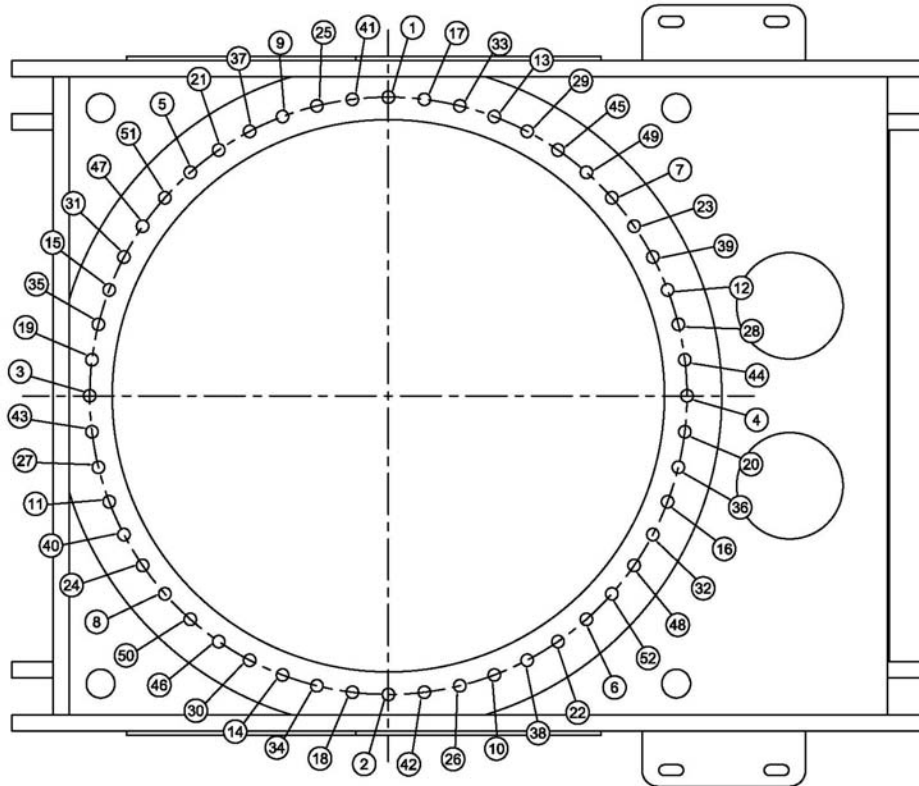
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## Nautilus Crane Model 340LA-80

### Section 2.2.2 Ballring to Turret



1. Do not use oil or grease (hydraulic oil only).
2. Diagram shows the sequence bolts are to be tightened.
3. Bolts are to be torqued in increments of 50, 80 and 100% of the maximum torque value of 1,900 ft-lbs.
  - a.) First iteration torque to 950 ft-lbs.
  - b.) Second iteration torque to 1,520 ft-lbs.
  - c.) Final iteration torque to 1,900 ft-lbs.



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## Nautilus Crane Model 340LA-80

### Section 2.3 Torque for Plated Fasteners



DO NOT APPLY to Crane Mounting Bearing

Threads must be free of debris, damage and coated with hydraulic oil or a light machine oil. The torque values are not valid for threads coated with grease or anti-seizing compound.

GRADE 8			
NOMINAL BOLT SIZE (IN)	MINIMUM (FT/LBS)	MID-RANGE (FT/LBS)	MAXIMUM (FT/LBS)
3/8 - 16	33	35	37
1/2 - 13	76	80	84
9/16 - 12	104	110	115
5/8 - 11	161	170	178
3/4 - 10	266	280	294
7/8 - 9	437	460	483
1 - 8	646	680	714
1-1/4 - 7	1,292	1,360	1,428
1-3/8 - 6	1,691	1,780	1,869
1-1/2 - 6	2,242	2,360	2,478

GRADE 5			
NOMINAL BOLT SIZE (IN)	MINIMUM (FT/LBS)	MID-RANGE (FT/LBS)	MAXIMUM (FT/LBS)
3/8 - 16	21	23	24
1/2 - 13	62	65	68
9/16 - 12	76	80	84
5/8 - 11	104	110	115
3/4 - 10	190	200	210
7/8 - 9	285	300	315
1 - 8	418	440	462
1-1/4 - 7	798	840	882
1-3/8 - 6	1,045	1,100	1,155
1-1/2 - 6	1,387	1,460	1,533

FASTENER MARKINGS		
	GRADE 5	GRADE 8
BOLT SAE J429		
NUT SAE J995	OR	OR



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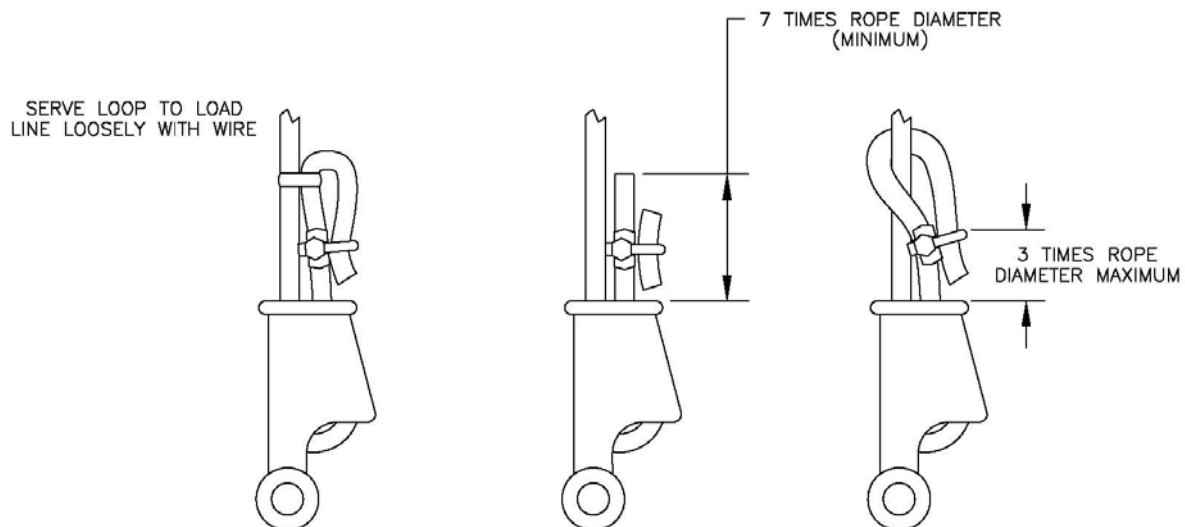
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## Nautilus Crane Model 340LA-80

### Section 2.4 Recommended Anchoring of Wire Rope at Dead End



**Allowable methods for securing Dead Ends of Wedge Socket attachments**



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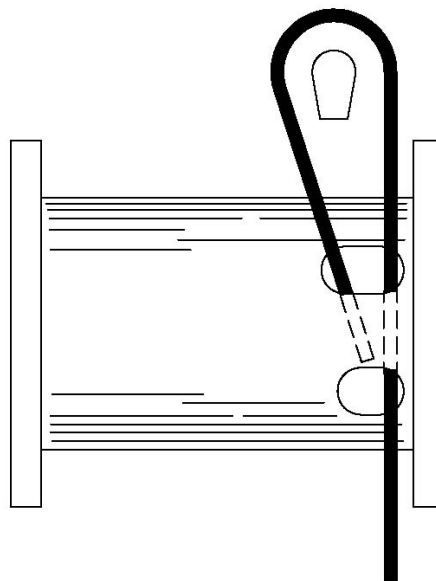
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## Nautilus Crane Model 340LA-80

### Section 2.5 Anchoring Wire Rope

Main Hoist CH240A – 7/8" Wire Rope  
Auxiliary Hoist PD15B – 5/8" Wire Rope  
Boom Hoist CH230B – 3/4" Wire Rope



Insert Cable Anchor Small End First

Anchoring wire rope on the hoist is very easy. Take the free end of the wire rope and insert it through the small opening of the anchor pocket. Loop the wire rope and push the free end about  $\frac{3}{4}$  of the way back through the pocket. Install the wedge, then pull the slack out of the wire rope. The wedge will slip into the pocket and secure the wire rope into the drum.



The cable anchor alone on hoists are not designed to hold rated loads. Therefore, a minimum of 5 wraps of cable must be left on the drum barrel to achieve rated load.



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### Section 2.6 Wire Rope Break-In Procedure

After properly installing the new rope, run the new rope through the crane operating cycle several times under a light load at a reduced line speed.

Progressively increase the loads until reaching the entire range of expected lifts.

As you increase the loads, run each load weight from light to maximum expected load at least six times before proceeding, especially when the crane operator will make a series of heavy lifts with new ropes.

This allows the rope to adjust gradually to working conditions, enables the strands to become settled and allows for slight stretching and diameter reduction to occur.



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### Section 2.7 Reeving Diagrams



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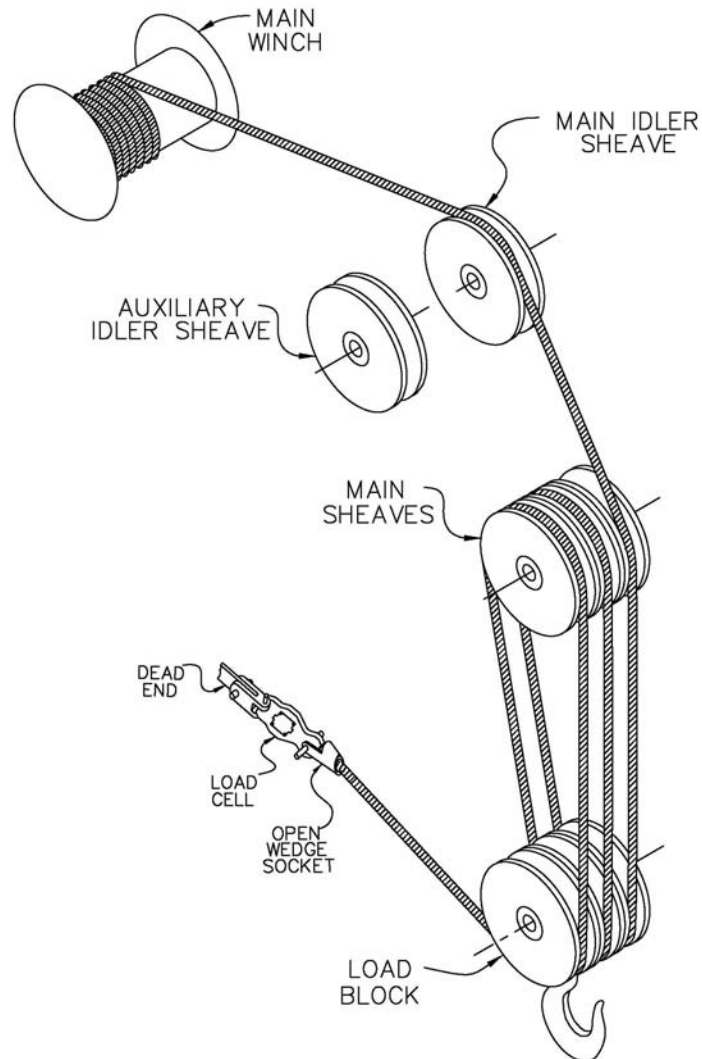
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### Section 2.7.1 6 Part Line







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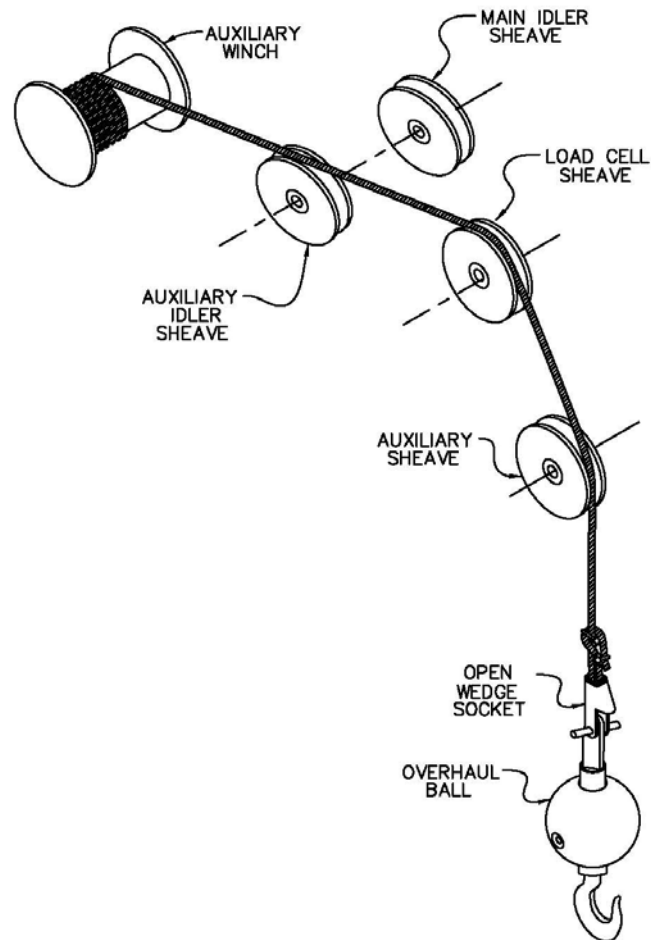
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### Section 2.7.2 1 Part Line









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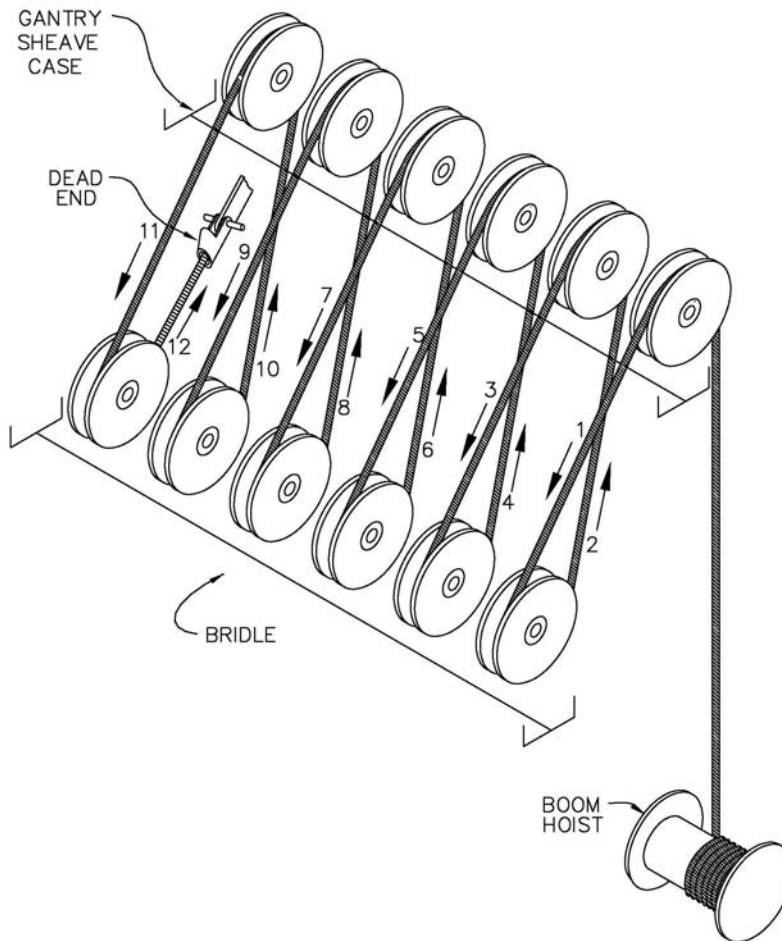
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### Section 2.7.3 12 Part Line



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### Section 2.8 Spacer Kits



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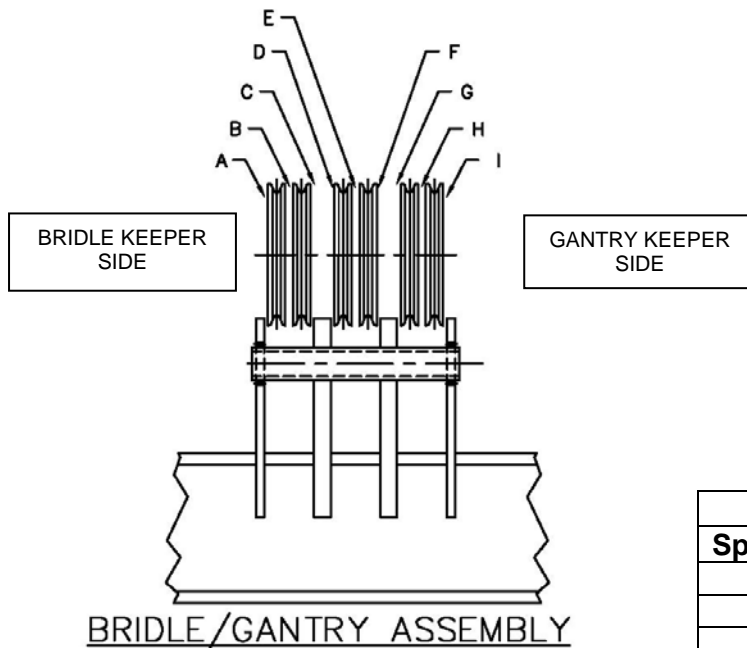
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### Section 2.8.1 Bridle / Gantry



Bearing Retainers				
Width	O.D.	I.D.	Material	Qty.
1/4"	4-1/2"	3"	NYL	24

Gantry Sheave Case				
Spacer	Thickness	O.D.	I.D.	Material
A	3/16"	5"	3"	NYL
B	1/2"	5"	3"	NYL
C	3/16"	5"	3"	NYL
D	3/16"	5"	3"	NYL
E	7/16"	5"	3"	NYL
F	3/16"	5"	3"	NYL
G	3/16"	5"	3"	NYL
H	1/2"	5"	3"	NYL
I	3/16"	5"	3"	NYL

Bridle Sheave Case				
Spacer	Thickness	O.D.	I.D.	Material
A	3/16"	5"	3"	NYL
B	7/16"	5"	3"	NYL
C	3/16"	5"	3"	NYL
D	3/16"	5"	3"	NYL
E	7/16"	5"	3"	NYL
F	3/16"	5"	3"	NYL
G	3/16"	5"	3"	NYL
H	7/16"	5"	3"	NYL
I	3/16"	5"	3"	NYL



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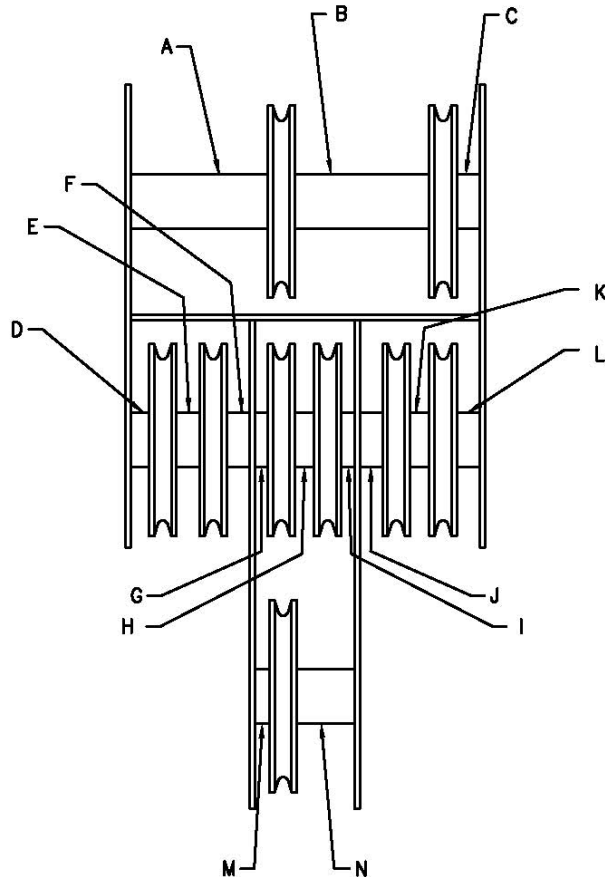
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## Nautilus Crane Model 340LA-80

### Section 2.8.2 Boom Point



**Bearing Retainers**

Qty.	Thickness	O.D.	I.D.	Material
12	1/4"	4-1/2"	3"	NYL

Spacer	Thickness	O.D.	I.D.	Material
A	12-9/16"	5"	3"	NYL
B	8-9/16"	5"	3"	NYL
C	4-5/8"	5"	3"	NYL
D	-"	-	-	-
E	3-1/16"	5"	3"	NYL
F	3/16"	5"	3"	NYL
G	-	-	-	-
H	3-1/8"	5"	3"	NYL
I	3/16"	5"	3"	NYL
J	-	-	-	-
K	3-5/16"	5"	3"	NYL
L	3/16"	5"	3"	NYL
M	5/8"	5"	3"	NYL
N	3-5/8"	5"	3"	NYL



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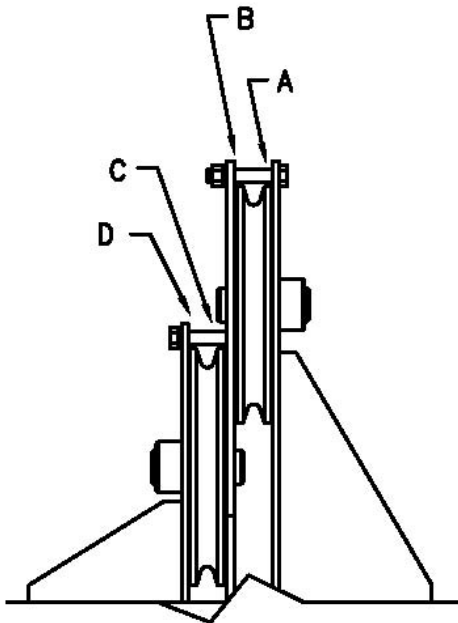
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### Section 2.8.3 Boom Mid-Section Idler



Bearing Retainers				
Width	O.D.	I.D.	Material	Qty.
1/8"	3-3/4"	2-1/2"	NYL	4

Spacer	Thickness	O.D.	I.D.	Material
A	1/16"	4-1/2"	2-1/2"	NYL
B	1/16"	4-1/2"	2-1/2"	NYL
C	1/168"	4-1/2"	2-1/2"	NYL
D	1/16"	4-1/2"	2-1/2"	NYL



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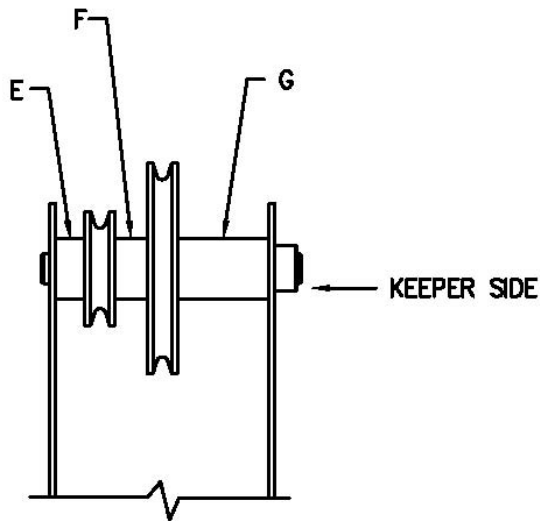
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## Nautilus Crane Model 340LA-80

### Section 2.8.4 Auxiliary Tip Idler



**Bearing Retainers**

Width	O.D.	I.D.	Material	Qty.
3/8"	2-5/16"	1-1/2"	NYL	2

Spacer	Thickness	O.D.	I.D.	Material
E	-	-	-	-
F	3/8"	3-1/2"	1-1/2"	NYL
G	7/16"	3-1/2"	1-1/2"	NYL



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### Section 3.0 Operation Manual



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## Nautilus Crane Model 340LA-80

### Section 3.1 Operation Guidelines

As the crane operator you should be qualified in accordance with the latest edition of API RP2D, Recommended Practice for Operation and Maintenance of Offshore Cranes. You must insure that riggers, signalmen and other personnel associated with your lift are suitably trained and informed. You must be completely familiar with the individual crane operating characteristics and controls since they often vary from crane to crane. You must be familiar with the individual crane operation and maintenance manual. It may identify features which are critical to the safe operation of the individual machine.

By their nature, cranes are dangerous to operate and are sensitive to mishandling. You must consider any factors that could reduce crane capacity including:

Load swing, hoisting impacts, wind conditions, sea state, experience of personnel, condition of equipment, proper rigging technique, difficulty in centering boom tip over load, etc.

Observe extreme precaution when hazards are present such as:

Limited visibility, blind lifts, helicopter activities, electrical lines, hazardous surroundings, personnel lifts, high boom angles, heavy lifts, hook near boom tip, poor weather conditions, etc.

In such conditions you must judge to what degree operations or capacities are to be limited or if operations should cease.

Always perform a pre-use inspection to ensure that hazards are not present (rope fouled or damaged, pins unsecured, fuel leak, corrosion present, boom dented, cracked weld, etc.). You must determine that the equipment condition is suitable before resuming operations.



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Be familiar with and completely understand the load chart. Be able to determine the crane's actual net lifting capacity. Beware that the winch or boom capacity may be far greater than the weight that can be safely lifted. Recall the most fundamental lift rules:

**A**lways know the load before it is lifted.

**B**oom angle / load radius must be known.

**C**apacity of equipment must be ample at the lift radius.

Operate all functions smoothly, avoiding jerking or sudden stops and starts. This will prevent damage or failure from shock loading.

### The swing function requires extra care:

- The speed of rotation is proportional to the engine RPM, hydraulic pump flow and the amount of control lever movement from the center position.
- Sudden motions with long booms or heavy lifts will cause the boom to bend sideways. This causes premature failure of the heel pin bearings and, if severe, could collapse the boom. Limit swing speed to prevent the load from swinging out beyond the intended radius (load swing) which may also endanger personnel. It is imperative that the starting and stopping of the crane be accomplished in a smooth manner.
- The operator shall be aware that the suspended load, once in motion, builds up inertia. Once a stopping point for the load is determined, the operator must plan his stopping method prior to reaching the final destination.
- When the crane is swinging with a load and the control lever is placed in the neutral position, the crane will continue to free-swing in the direction of motion. The crane is designed with a free-swing capability to assist the operator with alignment of the boom point and the load below in order to minimize side loading.



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- The operator has three choices to stop the swing motion of the crane:
  1. Allow the crane to coast to a stop.
  2. Gently depress or engage the dynamic swing brake pedal or lever (if the crane is equipped with this feature).



**This brake is capable of dynamic operation and has sufficient holding capability to cause major damage to the Boom and Swing Machinery in the event that it is applied suddenly. For this reason, caution is urged in the use of this brake for stopping the swing motion.**  
**The method described below using the swing control lever to control the swing is the preferred method of stopping the crane. However, do not abruptly engage the control lever in the opposite direction.**

3. Dynamic braking by “Back driving or Cross Controlling” the Left Hand swing control Joystick. This is accomplished by moving the swing lever into the neutral position and then slowly engaging the lever in the opposite direction of swing motion. This is considered the best method in which to stop the swing motion of the crane.

For example; if the crane is swinging to the left at high speed and the joystick is then centered, the crane will continue to “coast” to the left. Moving the joystick slowly away from the center to the right will apply a “braking torque” to the crane motion, hence stopping rotation more quickly.

The crane and it's associated Swing System machinery are protected from damage during this operation by means of the hydraulic relief valve mounted in the swing directional control valve. This valve will limit the amount of swing torque available during acceleration and deceleration of the crane. However, it is strongly recommended that swing motion should start and stop as slowly and smoothly as possible to avoid possible damage to equipment or injury to personnel from an abruptly swinging load.



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- The crane and load can be held in position against the wind by means of the dynamic brake pedal (if the crane is equipped with this feature). Please refer to the Crane Operation section regarding the dynamic brake actuator.
- The parking brake should only be applied when the crane swing motion has completely stopped. This brake should be engaged when the crane is not in use or left unattended for short periods of time. It is recommended that the crane be returned to the cradle for parking when left for long periods of time.
- When a house lock is supplied, it shall only be engaged after the swing motion of the crane has been brought to a stop. It is intended as a functional item as described in API 2C. House locks are not designed nor intended to be used as a means of securing the crane for sea-fastening, for transit purposes or securing the crane during storm conditions.

With telescopic boom cranes, set the boom length prior to lifting loads when possible. Note that you may not be able to extend the boom under load because of varying friction conditions.

Two-blocking, where the hook block contacts the boom tip, can cause the rope to break and the load to fall. This may result in equipment damage, injury or even death. It can occur when hoisting up, telescoping out, and sometimes, when booming down. Observe extreme precaution when the hook block is near the boom tip, when speeds are high or when two functions are operated simultaneously. Never rely on the anti-two-blocking as an operating tool, only a back-up safety device.

Observe extreme precaution at very high boom angles to prevent contact of the boom with the boom stop on rope supported booms. This can cause subsequent bending or collapse of the boom. Note that when unloaded the boom may "spring back" and contact the stop. Do not disable boom angle limiting devices. For cranes with hydraulic cylinder supported booms, do not stop the boom by fully extending the cylinder unless done very slowly. Impact forces of a fast moving boom could possibly break the cylinder and allow the boom to topple over backwards.

The boom angle is only an indication of operating radius and should be confirmed for critical lifts. Measure the load radius from the center of crane rotation.



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Do not operate the crane when temperatures are less than the minimum service temperature stated on the crane monogram. Steels become brittle at low temperatures and the crane may fail at loads well below the normal capacity.

Maintain the load directly below the boom tip. Side loads can cause the hoist rope to climb out of the sheave, resulting in damage to the rope, sheave, and pin, or even breaking of the rope. Side loading with long booms, heavy lifts, if severe, can cause the swing gear train to fracture (with loss of control) or even cause the boom to collapse. Off loads (the load is at a greater radius than the boom tip) tend to amplify the toppling effect of loads on the crane. This can overload the entire crane structure, notably the pedestal and swing bearing.

Take extra care to pay out rope in a smooth manner to prevent slack forming in the rope. Offshore hydraulic cranes, because of power lowering and high winch speeds, are particularly susceptible to rope fouling on the winch drum. Watch for trapped loops, bird nesting, etc. on the winch drum.



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### Section 3.1.1 About Load Charts

#### ONBOARD CONDITIONS

To be considered an onboard lift, the following conditions must be true:

The machine has a true vertical axis (a level machine with zero list, zero trim).

The load is directly below boom tip (zero offlead and zero sidelead). Note that a 2% design side lead accounts only for inertial affects of gently swinging the load - not for side loads.

The load is smoothly lifted from or landed upon a motionless surface (no hoisting impact such as jerking loads or suddenly stopping a falling load).

No wind, ice or other detrimental conditions are present.

#### OFFBOARD CONDITIONS

The offboard rated load can be lifted in specific conditions encountered when relative motion exists between the crane and the load to be lifted / landed. Such cases exist when the crane is on a stationary platform and the load is to be lifted / landed on a marine vessel. The specific conditions include significant wave height, offlead, sidelead and wind conditions.

In cases where sea conditions are not specified by the purchaser, wind, offlead and sidelead are taken as zero (see API SPECIFICATION 2C) and an offboard coefficient of 2 is used. Note that this condition is considered appropriate only when:

- Mild seas are encountered (example: maximum sea state of 4 in Gulf of Mexico).
- The vessel position is maintained to eliminate sidelead and offlead (due to drifting of the vessel away from the boom tip).



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The offboard coefficient is basically an impact factor used to insure that crane strength limits are not exceeded. For fixed platform cranes, it is calculated based on crane flexibility, hook speed up and vessel deck speed down. It is affected by wave conditions, vessel size, height of boom tip above the vessel, reeving parts of line and other factors. Assumptions are made of vessel size and statistical determinations are made to estimate vessel deck speed down.



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### Section 3.1.2 Maintenance & Inspection Guidelines

The crane must be regularly maintained and inspected by qualified personnel in accordance with the latest edition of API RP 2D Recommended Practice for Operation and Maintenance of Offshore Cranes.

Since pedestal cranes do not tip over, they are particularly subject to accidental overloads. For this reason, it is important to check for damage periodically: before critical lifts, and after suspected overloads.

Some components possess stored energy which can be released in an uncontrolled manner. Improper handling can result in injury, damage or death. It is important to carefully de-energize these components prior to performing any work. Examples include:

- **Elevated boom** – lower boom into rest prior to working on boom hoist, boom ropes, boom cylinder, bridle, etc. Block or support boom as required prior to disassembling boom to prevent collapse of unsupported sections.
- **Pressurized vessels** – bleed pressure off before disconnecting lines, etc.
- **Rotating machinery** – arrest all motion prior to commencing work.



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### Section 3.2 General Operation of Crane



Failure to follow procedures below could result in property damage, severe personal injury or death!

1. Always operate crane within the capacity rating (see your lifting chart). Know the weight of the load you are lifting.
2. Never operate with anyone under the load or swing over personnel.
3. Know and follow recommended hand signals
4. Do not leave crane unattended while load is suspended or crane is operating.
5. Parking brake should always be set before leaving crane.



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### Section 3.3 Operation Caution



Do not operate crane unless you thoroughly understand its controls and operation and required maintenance has been performed.

1. Check all scheduled maintenance items including proper lubrication of ballring and hydraulic oil level.
2. Check all pin connections and inspect ballring bolts for looseness and corrosion.
3. Start prime mover and check crane operation without load.
4. Always be certain that wire rope reeving is in correct position before operating crane.



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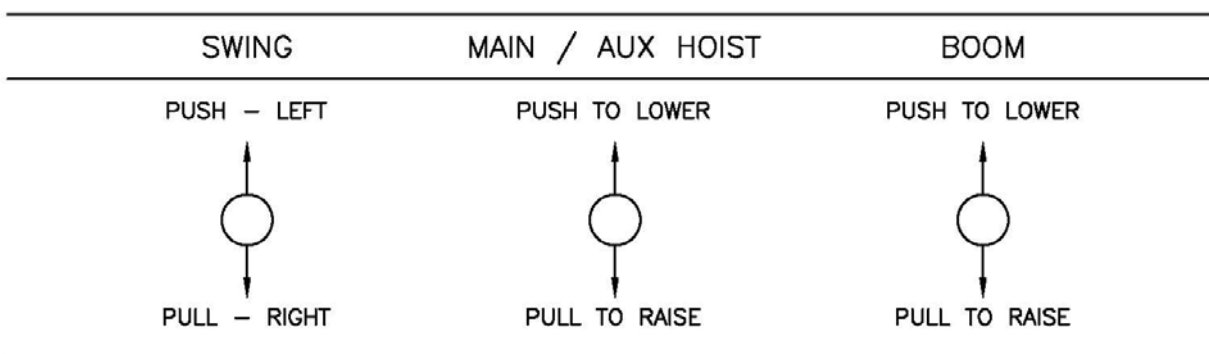
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### Section 3.4 Crane Operation

#### Lever Controls: Basic Three Lever Crane Control Diagram (Viewed from Operator's Station)



- 1. Swing Control**

Located to the left of the operator's seat. Push lever to swing crane to the left. The center (neutral) is to stop. Pull lever to swing crane to the right.
- 2. Main / Auxiliary Hoist Control**

Located to the right of the operator's seat. Push lever to lower load. The center (neutral) is to stop. Pull lever to hoist load.
- 3. Boom Hoist Control**

Located to the right of the operator's seat. Push lever to lower boom. The center (neutral) is to stop. Pull lever to raise boom.



During operation the control lever should be metered slowly when starting or stopping an operation to prevent harsh stresses on the hydraulic system and the equipment. All movements should be smooth; avoid jerking. Extra caution should be taken when boom is in a full horizontal position or when moving heavy loads.



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### 4. Main / Aux Hoist Selector Valve

Located to the right of the operator's seat. Twist knob to select hoist prior to start of operation.



**Caution: Do not switch hoist selector valve while hoists are in motion.**

### 5. Engine Foot Throttle Actuator

Engine power and speed is controlled using the foot pedal located on the right side floor of the control cab. Depress the pedal to accelerate the engine. Release to idle the engine. Pedal is spring loaded to idle.

### 6. Foot Dynamic Swing Brake Actuator

Located on the left side floor of the control cab. Gently depress the pedal to slowly stop swing of crane or to hold the crane in position against the wind. The preferred method to bring the crane to a slow smooth stop is described in the "Operation Guidelines". Please read and become familiar with these guidelines before operating the crane.



This brake is capable of dynamic operation and has sufficient holding capability to cause major damage to the Boom and Swing Machinery in the event that it is applied forcefully. For this reason, caution is urged in the use of this brake for stopping the swing motion. Refer to the "operation guidelines" in this manual.

### 7. Engine Kill Cable

Located on the wall to the left of the operator's seat. Pull lever to shut off fuel intake causing engine to shut down.

### 8. Emergency Engine Kill Cable

Located on the wall to the left of the operator's seat. Pull lever to shut off air intake causing engine to shut down.



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### 9. Manual High Speed Reset Valve

Located on the wall to the left of the operator's seat. When lifting a rated load heavier than a high speed rated capacity (see load chart) the Pressure Sensing Valve (PSV) will cause the hoist to automatically shift into low speed. Once the load has been released from the hook, the hoist can be switched back to high speed by pushing in the High Speed Reset Valve (MRV).

### 10. Parking Brake Valve

Located on the wall to the left of the operator's seat. Must be depressed to set the parking brake. Set the parking brake only when the crane has stopped swinging.



This crane is equipped with free swing capability. Crane must be completely stopped before engaging parking brake. Do not use parking brake to stop swing of crane.

### 11. Low Boom Angle Kickout Override Valve

Located on the wall to the left of the operator's seat. Handle must be depressed and held to override the Low Boom Angle Limit Valve.



**Warning: The boom low angle override button must not be used with a load on the hooks.**

### 12. Engine Start Button

Located to the left of the operator's seat. Push button to start engine.

### 13. Attention Horn Button

Located to the left of the operator's seat. Push button to sound horn.

### 14. Swing Lock Assembly

Located on the floor of the control station to the left rear of the operator's seat. Push lever down to engage the swing lock and pull upward to release.



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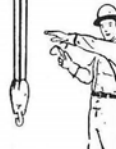







### Section 3.5 Crane Signals

**CRANE SIGNALS**


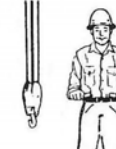




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**Nautilus Marine Cranes**  
Houma, Louisiana (985) 868-0630

 <p><b>USE MAIN HOIST</b> Tap fist on head; then use regular signals</p>	 <p><b>USE WHIP LINE</b> (Auxiliary Hoist) Tap elbow with one hand; then use regular signals</p>	 <p><b>RAISE BOOM</b> Arm extended, fingers closed, thumb pointing upward</p>	 <p><b>LOWER BOOM</b> Arm extended, fingers closed, thumb pointing downward</p>
 <p><b>MOVE SLOWLY</b> Use one hand to give any motion signal and place other hand motionless in front of hand giving the motion signal. (Hoist Slowly shown as example)</p>	 <p><b>RAISE THE BOOM AND LOWER THE LOAD</b> With arm extended, thumb point up, flex fingers in and out as long as load movement is desired.</p>	 <p><b>LOWER THE BOOM AND RAISE THE LOAD</b> With arm extended, thumb pointing down, flex fingers in and out as long as load movement is desired.</p>	 <p><b>SWING</b> Arm extended, point with finger in direction of swing of boom</p>
 <p><b>STOP</b> Arm extended, palm down, hold position rigidly.</p>	 <p><b>EMERGENCY STOP</b> Arm extended, palm down, move hand rapidly right and left.</p>	 <p><b>TRAVEL</b> Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel.</p>	 <p><b>DOG EVERYTHING</b> Clasp hands in front of body.</p>

**CRANE SIGNALS FOR TELESCOPING BOOM**

 <p><b>EXTEND BOOM</b> Both fists in front of body with thumbs pointing outward.</p>	 <p><b>RETRACT BOOM</b> Both fists in front of body with thumbs pointing toward each other.</p>	 <p><b>EXTEND BOOM</b> One Hand Signal. One fist in front of chest with thumb tapping chest.</p>	 <p><b>RETRACT BOOM</b> One Hand Signal. One fist in front of chest, thumb pointing outward and heel of fist tapping chest.</p>
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P.N. 45376      In Accordance with API SPECIFICATION RP2D



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## Nautilus Crane Model 340LA-80

### Section 3.6 Emergency Load Lowering Kit Instructions



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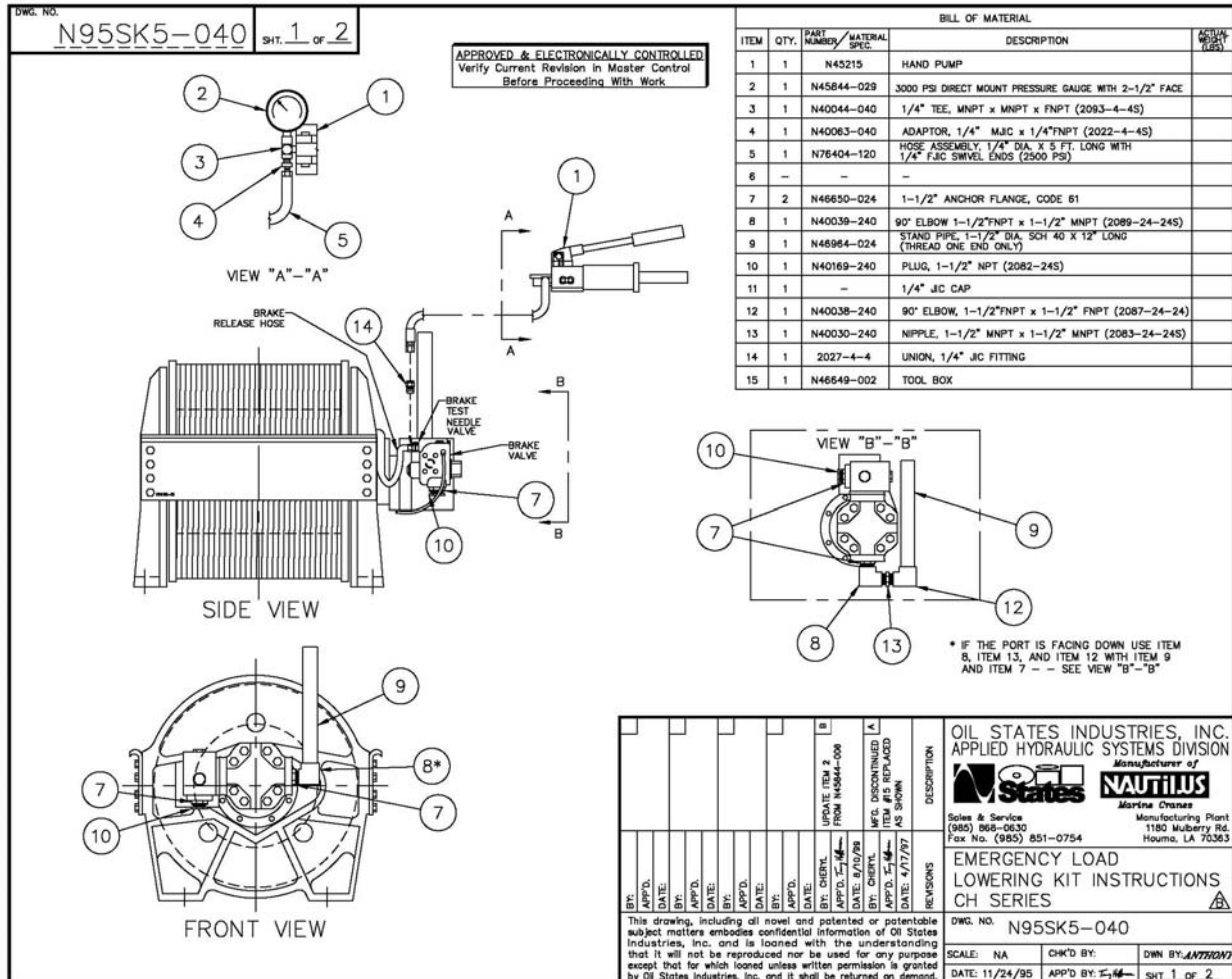
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## Nautilus Crane Model 340LA-80

### Section 3.6.1 CH Series Hoist



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## Nautilus Crane Model 340LA-80

### EMERGENCY LOWERING PROCEDURE

#### CH SERIES HOIST ONLY

1. DISCONNECT THE BRAKE RELEASE HOSE FROM THE BRAKE TEST NEEDLE VALVE, PUT 1/4" JIC CAP (ITEM 11) ON OPEN FITTING, REMOVE LOCKWIRE ON BRAKE TEST NEEDLE VALVE AND CLOSE VALVE. (REF. SHEET 1)
2. INSTALL 1/4" UNION (ITEM 14) IN BRAKE RELEASE HOSE DISCONNECTED FROM NEEDLE VALVE.
3. INSTALL PRESSURE GAUGE (ITEM 2), HOSE (ITEM 5), 1/4" TEE (ITEM 3) AND 1/4" ADAPTER (ITEM 4) ON HAND PUMP (ITEM 1). (REF. SHEET 1)
4. ATTACH HAND PUMP HOSE (ITEM 5) TO 1/4" UNION (ITEM 14).
5. REMOVE BOTH MAIN HOSES FROM THE MOTOR AND ATTACH A STAND PIPE TO THE MOTOR PORT ON THE OPPOSITE SIDE OF THE MOTOR FROM THE BRAKE VALVE USING ITEMS 7, 8 & 9. THE STAND PIPE MUST BE INSTALLED VERTICALLY. (REF. SHEET 1)
6. INSTALL 1-1/2" ANCHOR FLANGE (ITEM 7) ON BRAKE VALVE WITH PLUG (ITEM 10).
7. FILL THE STAND PIPE (ITEM 9) WITH HYDRAULIC OIL.

### !CAUTION!

THIS EMERGENCY LOWERING PROCEDURE OPENS THE MULTIPLE-DISC BRAKE WHILE LEAVING THE BRAKE VALVE CLOSED. SINCE GEAR TYPE MOTORS ARE NOT ZERO LEAK DEVICES, INTERNAL MOTOR LEAKAGE PERMITS THE LOAD TO SLOWLY ROTATE THE MOTOR EVEN THOUGH THE OUTLET IS BLOCKED BY THE CLOSED BRAKE VALVE AND THE PLUG (ITEM 10). THIS PROCEDURE WILL NOT WORK IF THERE IS LITTLE OR NO OIL IN THE MOTOR. ATTEMPTING TO USE THIS PROCEDURE WITH NO OIL IN THE MOTOR WILL CAUSE THE LOAD TO FREE FALL. THE PURPOSE OF THE STAND PIPE IS TO INSURE THAT THE MOTOR IS FULL OF OIL. THE STAND PIPE IS SIMPLY A LENGTH OF PIPE ABOUT ONE (1) FOOT LONG (31 CM), ATTACHED TO A 90° ELBOW. THE OTHER END OF THE ELBOW IS ATTACHED TO A SHORT FITTING SUITABLE FOR MOUNTING ON THE MOTOR PORT OR MANIFOLD. THE STAND PIPE IS INSTALLED WITH THE PIPE POINTED IN A VERTICAL POSITION. WHILE LOWERING, OIL SHOULD BE ADDED TO THE STAND PIPE AS NECESSARY. THE PIPE DIAMETER SHOULD BE EQUAL TO OR LARGER THAN THE MOTOR PORT DIAMETER.

8. WITH THE HAND PUMP, SLOWLY APPLY 500-750 LBS. HYDRAULIC PRESSURE TO THE BRAKE RELEASE PORT WHILE CONSTANTLY MONITORING THE DESCENT OF THE LOAD. RELEASING THE PRESSURE ON THE HAND PUMP WILL CAUSE THE BRAKE TO RE-APPLY AND STOP THE LOAD. IF A CHATTERING NOISE IS HEARD WHILE THE LOAD IS COMING DOWN, PUMP THE HAND PUMP TO A HIGHER PRESSURE (DO NOT EXCEED 1000 PSI) UNTIL THE NOISE STOPS. DO NOT TOUCH THE MOTOR OR STAND PIPE WHILE USING THIS PROCEDURE; THESE ITEMS BECOME VERY HOT.
9. WHEN LOAD LOWERING IS COMPLETED, REVERSE THIS PROCEDURE AND SAFETY WIRE THE BRAKE TEST NEEDLE VALVE OPEN.

OIL STATES INDUSTRIES, INC. APPLIED HYDRAULIC SYSTEMS DIVISION Manufacturer of <b>NAUTILUS</b> Marine Cranes Sales & Service 1180 Mulberry Road Houma, LA 70363 Phone: (803) 851-0754 Fax: (803) 851-7526	
EMERGENCY LOWERING PROCEDURE CH HOIST ONLY	
DWG. NO.	N95SK5-040
SCALE	NA
DATE	11/28/95
APP'D BY	PMZ
SHEET	2 OF 2

DESCRIPTION	REVISIONS
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	DATE: _____ BY: _____

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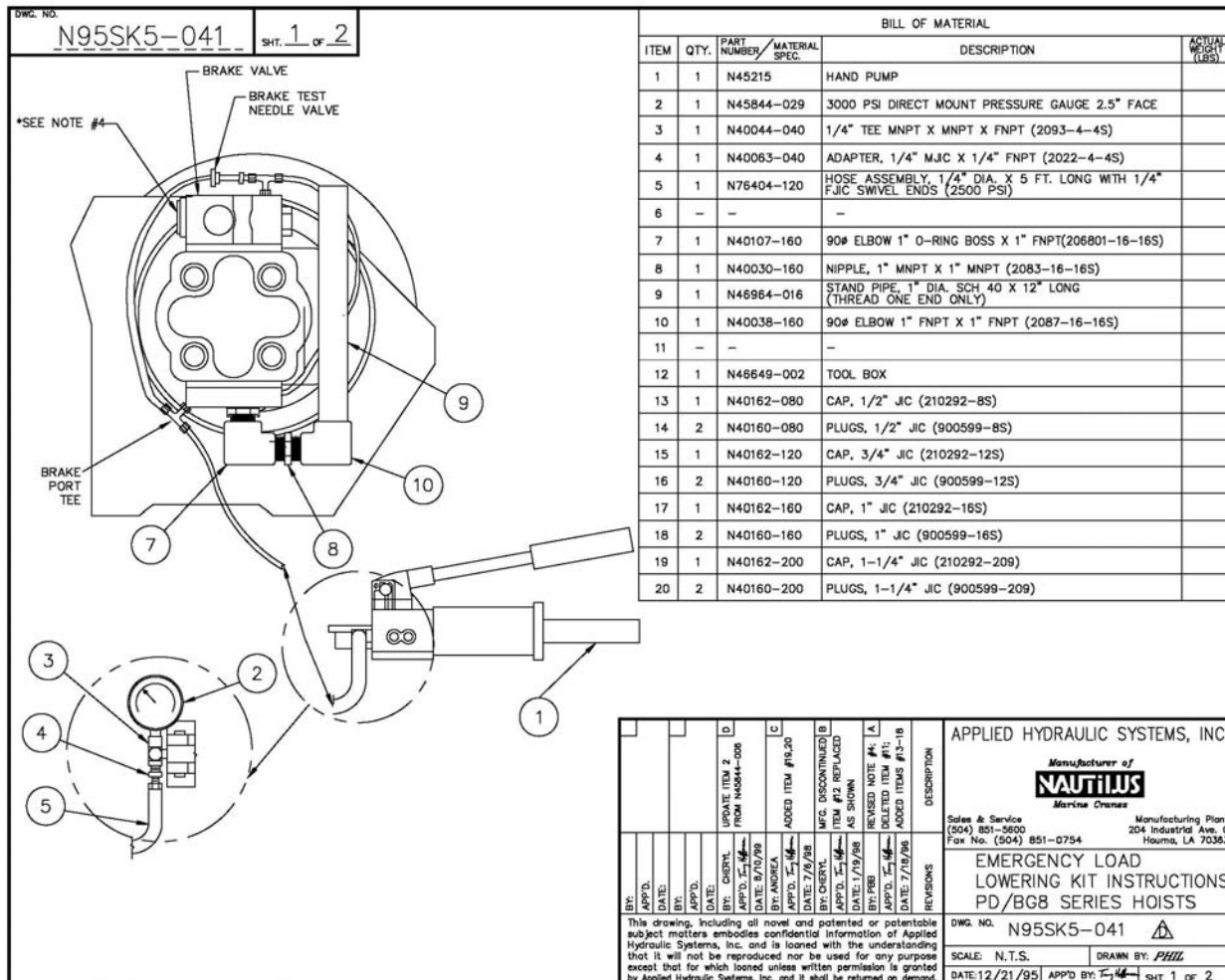
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## Nautilus Crane Model 340LA-80

### Section 3.6.2 PD Series Hoist



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# Nautilus Crane Model 340LA-80

## EMERGENCY LOWERING PROCEDURE

### PD/BG8 SERIES HOISTS

1. REMOVE THE LOCKWIRE ON THE NEEDLE VALVE HANDLE AND CLOSE THE BRAKE TEST NEEDLE VALVE TIGHTLY. (REF. SHEET 1)
2. INSTALL PRESSURE GAUGE (ITEM 2), HOSE (ITEM 5), 1/4" TEE (ITEM 3) AND 1/4" ADAPTER (ITEM 4) ON HAND PUMP (ITEM 1) - (REF. SHEET 1)
3. REMOVE BOTH MAIN HOSES FROM THE WINCH MOTOR AND ATTACH A STAND PIPE TO THE MOTOR PORT ON THE OPPOSITE SIDE OF THE MOTOR FROM THE BRAKE VALVE USING ITEMS 7, 8, 9 & 19. THE STAND PIPE MUST BE INSTALLED VERTICALLY. (REF. SHEET 1)
4. INSTALL PLUG IN BRAKE VALVE ACCORDING TO HOSE SIZE AT HOIST. FOR 1/2" HOSE - SEE ITEMS 13 & 14; FOR 3/4" HOSE - SEE ITEMS 15 & 16; AND FOR 1" HOSE - SEE ITEMS 17 & 18.
5. FILL THE STAND PIPE (ITEM 9) WITH HYDRAULIC OIL.
6. REMOVE THE JIC CAP ON BRAKE PORT TEE. (REF. SHEET 1)
7. CONNECT HOSE (ITEM 5) FROM HAND PUMP TO THE OPENING ON THE BRAKE PORT TEE. (REF. SHEET 1)

**!CAUTION!**

THIS EMERGENCY LOWERING PROCEDURE OPENS THE MULTIPLE-DISC BRAKE WHILE LEAVING THE BRAKE VALVE CLOSED. SINCE GEAR TYPE MOTORS ARE NOT ZERO LEAK DEVICES, INTERNAL MOTOR LEAKAGE PERMITS THE LOAD TO SLOWLY ROTATE THE MOTOR EVEN THOUGH ITS OUTLET IS BLOCKED BY THE CLOSED BRAKE VALVE AND THE PLUG (ITEM 11). THIS PROCEDURE WILL NOT WORK IF THERE IS LITTLE OR NO OIL IN THE MOTOR. ATTEMPTING TO USE THIS PROCEDURE WITH NO OIL IN THE MOTOR WILL CAUSE THE LOAD TO FREE FALL. THE PURPOSE OF THE STAND PIPE IS TO INSURE THAT THE MOTOR IS FULL OF OIL. THE STAND PIPE IS SIMPLY A LENGTH OF PIPE ABOUT ONE (1) FOOT LONG (31 CM), ATTACHED TO A 90° ELBOW. THE OTHER END OF THE ELBOW IS ATTACHED TO A SHORT FITTING SUITABLE FOR MOUNTING ON THE MOTOR PORT OR MANIFOLD. THAT STAND PIPE IS INSTALLED WITH THE PIPE POINTED IN A VERTICAL POSITION. WHILE LOWERING, OIL SHOULD BE ADDED TO THE STAND PIPE AS NECESSARY. THE PIPE DIAMETER SHOULD BE EQUAL TO OR LARGER THAN THE MOTOR PORT DIAMETER.

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Box No. (504) 851-0754

EMERGENCY LOWERING

## EMERGENCY LOWERING PROCEDURE

PD/BG8 HOISTS SERIES

DRWG. NO. N95SK5-041 

SCALE: NTS	DRAWN BY: <i>PHIL</i>
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DATE: 11/28/95 APPD BY: T. J. H. SHT 2 OF 2

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## Nautilus Crane Model 340LA-80

### Section 4.0 Maintenance Manual



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## Nautilus Crane Model 340LA-80

### Section 4.1 Maintenance Introduction

**Maximum crane performance is maintained by proper upkeep and maintenance.**

This maintenance section provides guidelines for proper upkeep of the crane. The maintenance of your crane falls into two areas:

1. Routine inspection and service
2. Scheduled maintenance

Routine inspection and service should be performed each day the crane is operated or each 8 hours of operation. The routine inspection and scheduled maintenance of your engine, generator\*, winch, hydraulic pump, load and moment indicator system\* are specified in the manufacturer's maintenance operation manuals. See "Index" for the location of these manuals.

\* These manuals are included only when these options are installed on crane.



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## Nautilus Crane Model 340LA-80

### Section 4.2 Maintenance Precaution



Before maintenance, adjustment or repair is started on a crane, take the following precautions:

1. Place crane where it will cause the least interference with other equipment or operations in the area.
2. Shut power off and put control in neutral
3. Set the mechanical swing lock if your crane has a swing lock.
4. Set swing parking if your crane is equipped with a manually operated parking brake.
5. Lower boom, if possible, onto boom rest.
6. Lower load block and overhaul ball if needed.
7. Prior to hydraulic system maintenance, bleed off all pressure in each hydraulic circuit. Operate each control lever in a back and forth motion to bleed off the hydraulic circuit pressure.
8. Prior to electrical system maintenance, insure power is off and disconnects are open. Physically disconnect the power supply to the electrical system.



After adjustments and repairs have been made, the crane shall not be returned to service until all guards have been re-installed, trapped air removed from hydraulic system if required, safety devices reactivated and maintenance equipment removed.

When crane is not in operation for extended periods of time, lubrication of ballring should still be performed at least every three months and thorough inspection of the wire rope(s) made.



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## Nautilus Crane Model 340LA-80

### Section 4.3 Routine Inspection & Service / Daily Function Test

#### Routine Inspection and Service

Check each day crane is in operation (before operating)

Upperstructure / Gantry Connection Pins	
Upperstructure / Gantry Connection Bolts	
Sheave Pins (Main / Auxiliary / Bridle / Gantry)	
Boom Foot Pins	
Ballring / Ballring Bolts	
Wedge Socket Connections	
Hoists & Wire Ropes (Main / Auxiliary / Boom)	
Boom Pendant Lines	
Hydraulic Hoses	
Pin Keepers & Bolts	
Hydraulic Oil Level	
Engine Fuel Level	
Engine Oil Level	
Engine Coolant Level	
Electrical Swivel	
Boom Sections (Connection Pins)	
Load Block (Safety Latch)	
Overhaul Ball (Safety Latch)	

#### Daily Functional Test

Perform functional tests each day crane is operated

Test Main Anti-Two Block Function by raising Load Block	
Test Auxiliary Anti-Two Block Function by raising Overhaul Ball	
Test Parking Brake Valve	
Test Boom Low Angle Kickout Assembly	
Test Electrical Components	
Activate Engine Kill Cable	
Test Swing Lock function	



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## Nautilus Crane Model 340LA-80

### Section 4.4 Notes & Precautions

The following maintenance schedule outlines the minimum frequency for thorough inspection, lubrication and changing specific items.

The lubrication frequency is the maximum length of time between lubrications. The necessary lubrication frequency is dependant on the environmental conditions. Over lubrication of non-sealed fittings (sheave pins, valve spools, wheel bearings, etc.) will not harm the fittings or components but under lubrication will definitely lead to a shorter lifetime. Grease fittings that are worn and will not hold the grease gun or those that have a stuck ball must be replaced.

On plug-type check points, the oil levels are to be at the bottom edge of the fill point.

An extensive wire rope inspection should be made at least every 100 hours of operation or every three (3) months. A comprehensive explanation of the wire rope inspection is given in the API Recommended Practice 2D (RP2D). Inspect the wire rope for any types of deterioration: distortion, corrosion, broken strands, etc. The listed lubrication frequency is the maximum length of time between lubrications. The necessary lubrication frequency is dependant on the environmental conditions.



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## Nautilus Crane Model 340LA-80

### Section 4.5 Maintenance Schedule

INSPECTION / REPLACEMENT	BREAK IN 50 HRS.	BREAK IN 100 HRS.	EVERY 100 HRS.	3 MONTHS OR 150 HRS.	3 MONTHS OR 500 HRS.	6 MONTHS OR 1000 HRS.	ANNUALLY
WINCH OIL	-----	CHANGE	-----	-----	-----	-----	CHANGE
GEARBOX OIL	-----	CHANGE	-----	-----	-----	CHANGE	-----
*BALLRING & PEDESTAL BOLTS	RE-TORQUE	-----	INSPECT	-----	-----	-----	RE-TORQUE
HOSES	-----	-----	CHECK	-----	-----	-----	-----
HOIST BOLTS	-----	-----	INSPECT	-----	-----	-----	RE-TORQUE
PIN KEEPERS	-----	-----	INSPECT	-----	-----	-----	-----
WELDS	-----	-----	INSPECT	-----	-----	-----	-----
HYDRAULIC OIL	-----	-----	-----	-----	-----	-----	DRAIN & CLEAN
SUCTION STRAINERS	-----	-----	-----	-----	-----	-----	REPLACE
HYD. OIL RETURN FILTER ELEMENT	CHANGE	-----	-----	-----	-----	-----	-----
FUEL FILTERS	CHANGE	-----	-----	-----	CHANGE	-----	-----
RADIATOR	CHANGE	-----	-----	-----	-----	-----	-----
COOLANT	CHANGE	-----	-----	-----	-----	-----	-----
NORMAL USE	-----	-----	-----	-----	-----	-----	CHANGE
HEAVY USE	-----	-----	-----	-----	-----	CHANGE	-----
EXHAUST SYSTEM	-----	-----	-----	-----	DRAIN	-----	-----
OIL FILTER	-----	-----	-----	CHANGE	-----	-----	-----
FUEL TANK	-----	-----	-----	-----	DRAIN	-----	-----
EMERGENCY ENGINE KILL CABLE	TEST/INSPECT	-----	-----	-----	-----	-----	-----
ENGINE FOOT THROTTLE	TEST/INSPECT	-----	-----	-----	-----	-----	-----
ACTUATOR	TEST/INSPECT	-----	-----	-----	-----	-----	-----
DYNAMIC SWING BRAKE ACTUATOR	TEST/INSPECT	-----	-----	-----	-----	-----	-----
AIR FILTER	-----	-----	-----	-----	CHANGE	-----	-----

WIRE ROPE

API RECOMMENDED PRACTICE 2D (RP 2D)



\*Ballring and Pedestal bolts must be retorqued at the intervals shown to prevent premature bearing wear and / or failure.



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LUBRICATION	1 MONTH OR 50 HRS.	3 MONTHS OR 100 HRS.	6 MONTHS OR 1000 HRS.
OVERRIDE VALVE SPOOLS	LUBRICATE	-----	-----
BOOM FOOT PINS	LUBRICATE	-----	-----
SHEAVE PINS (MAIN / AUX / IDLER)	LUBRICATE	-----	-----
SHEAVE PINS (GANTRY / BRIDLE)	LUBRICATE	-----	-----
GANTRY / UPPERSTRUCTURE PINS	LUBRICATE	-----	-----
LOAD BLOCK / OVERHAUL BALL	LUBRICATE	-----	-----
PARKING BRAKE SPOOLS	LUBRICATE	-----	-----
GEARBOXES	LUBRICATE	SOME ITEMS DO NOT HAVE GREASE ZERK FITTINGS, BUT SHOULD BE LUBRICATED BY HAND ON EXPOSED SHAFTS FOR ENVIRONMENTAL PROTECTION	-----
HOISTS (MAIN / AUX / BOOM)	LUBRICATE		-----
CONTROL VALVE SPOOLS	LUBRICATE		-----
ENGINE FOOT THROTTLE ACTUATOR	LUBRICATE		-----
DYNAMIC SWING BRAKE ACTUATOR	LUBRICATE		-----
BOOM STOPS	LUBRICATE		-----
ANTI-TWO BLOCKING SPOOLS	LUBRICATE		-----
SWING LOCK BEARCLAW	LUBRICATE		-----
WIRE ROPES (MAIN / AUX / BOOM)	-----	-----	LUBRICATE
PENDANT LINES (BOOM)	-----	-----	LUBRICATE
*BALLRING	-----	LUBRICATE	-----
PINION GEARS	-----	LUBRICATE	-----



\*Ballring and Pedestal bolts must be retorqued at the intervals shown to prevent premature bearing wear and / or failure.



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## Nautilus Crane Model 340LA-80

### Section 4.6 Lubrication Diagrams



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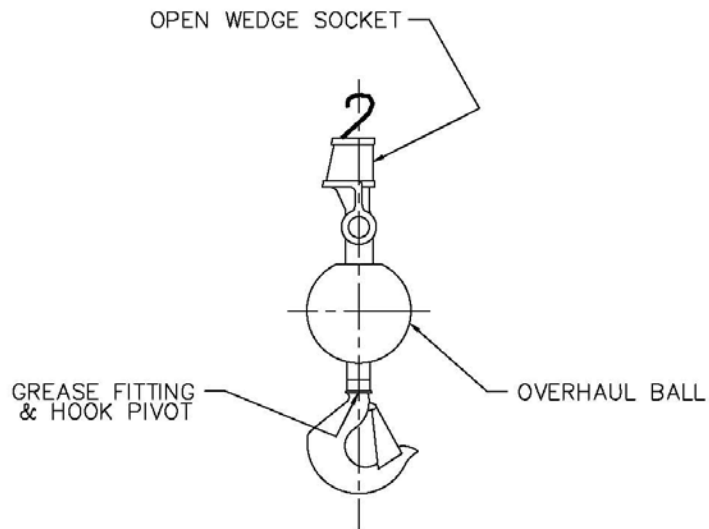
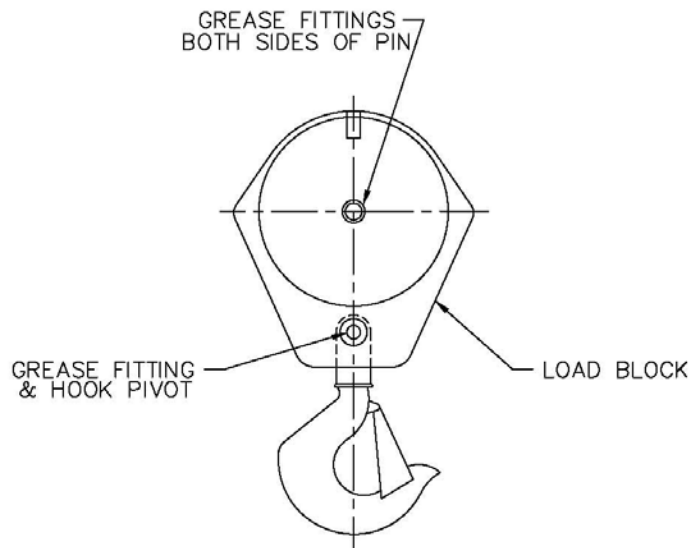
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## Nautilus Crane Model 340LA-80

### Section 4.6.1 Load Block & Overhaul Ball









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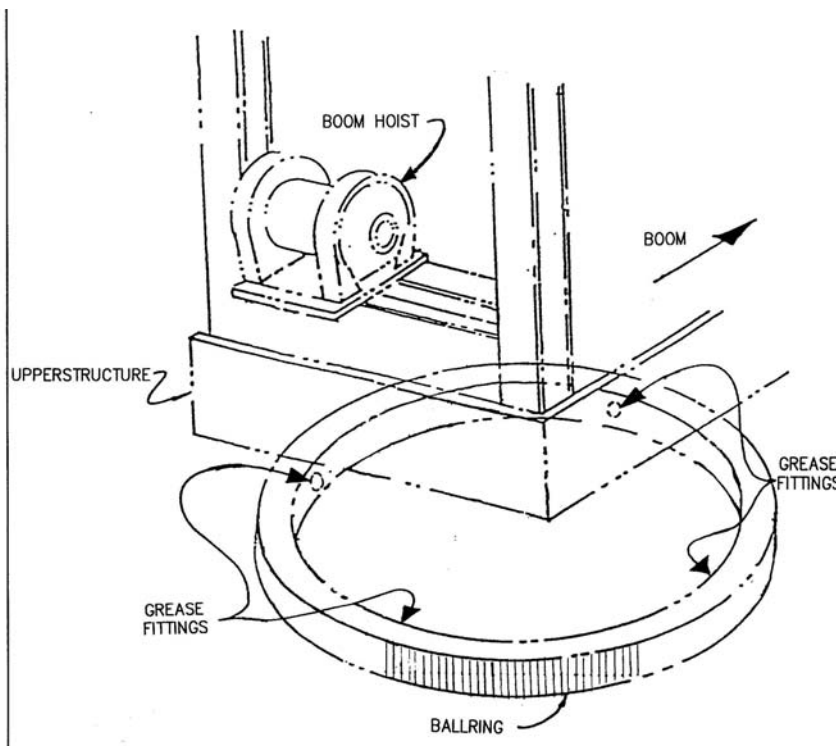
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## Nautilus Crane Model 340LA-80

### Section 4.6.2 Ballring



Each bearing is equipped with one or more grease fittings. Models equipped with two or three rows of fittings should be greased on each row. To insure uniform distribution of grease throughout the bearing, the machine should be rotated at least two complete revolutions while greasing. When complete rotation is impractical, grease may be pumped into each fitting, rotating the device back and forth as possible as each fitting is greased. For bearings with integral gears, lubricate gear as necessary to prevent metal-to-metal contact.



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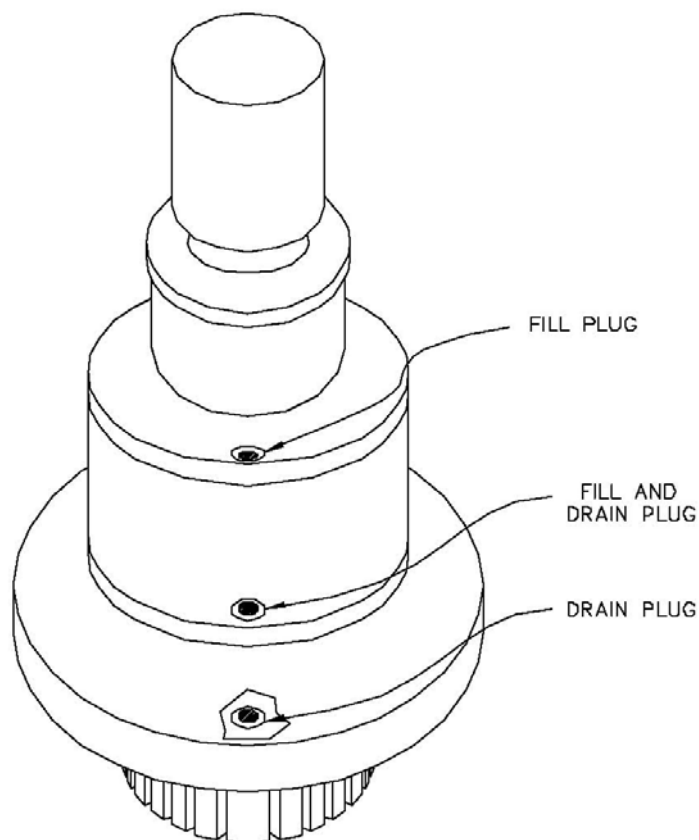
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## Nautilus Crane Model 340LA-80

### Section 4.6.3 Gearbox







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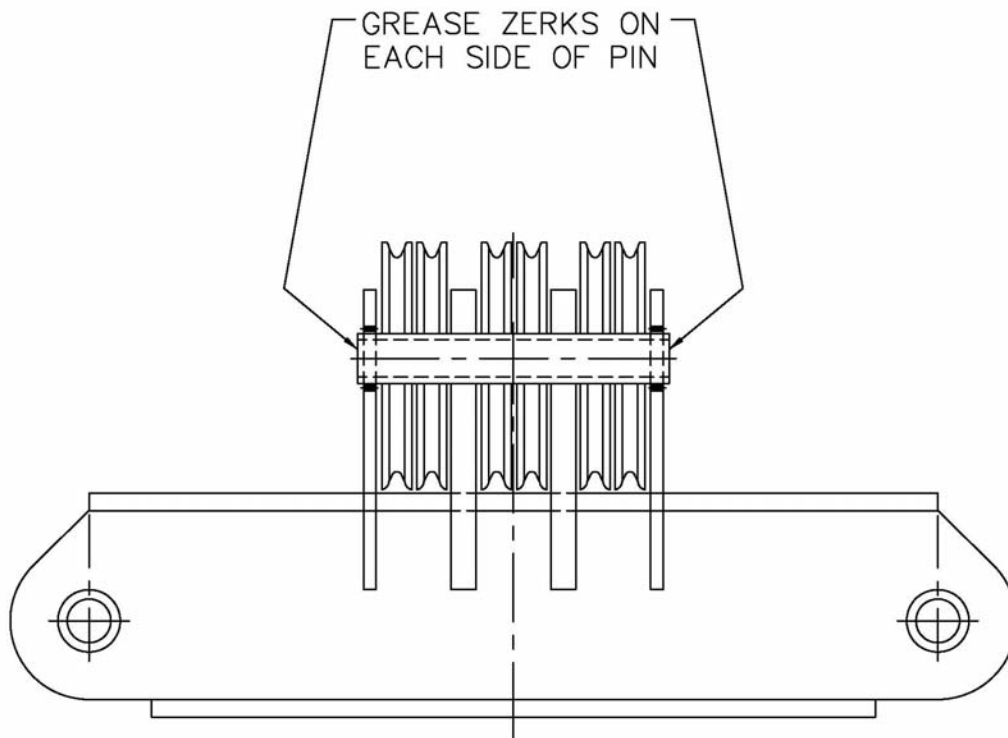
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## Nautilus Crane Model 340LA-80

### Section 4.6.4 Bridle Sheaves



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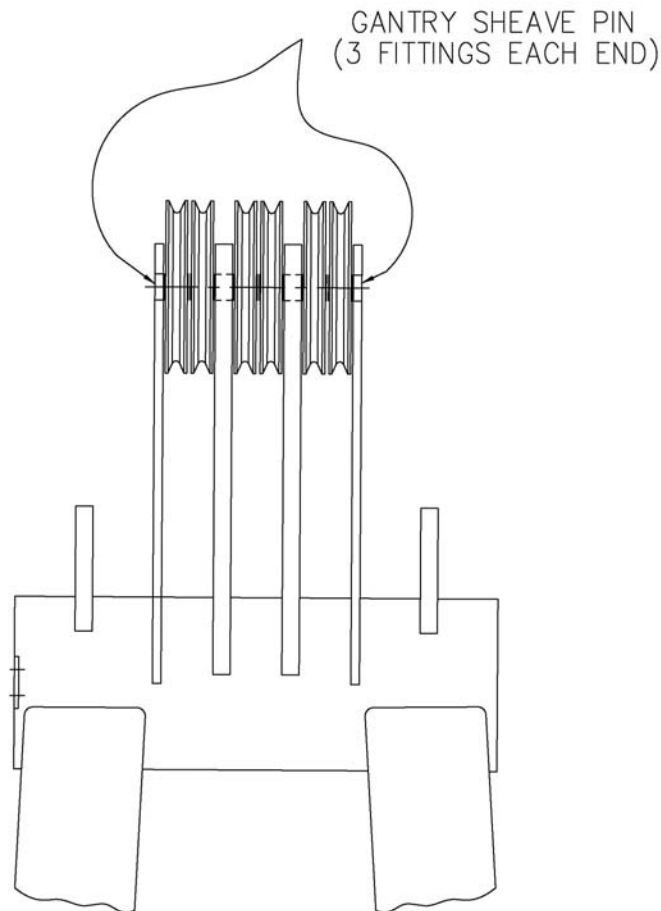
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## Nautilus Crane Model 340LA-80

### Section 4.6.5 Gantry Sheaves









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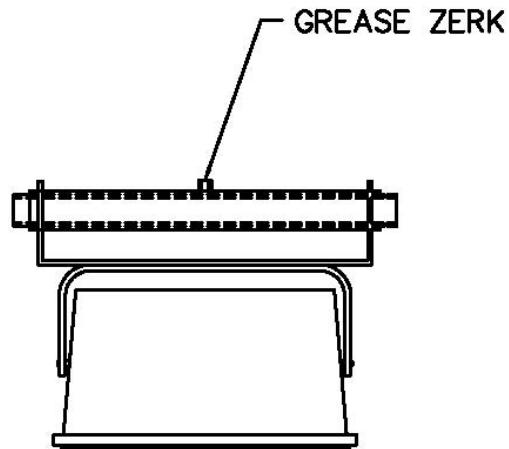
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## Nautilus Crane Model 340LA-80

### Section 4.6.6 Floodlights



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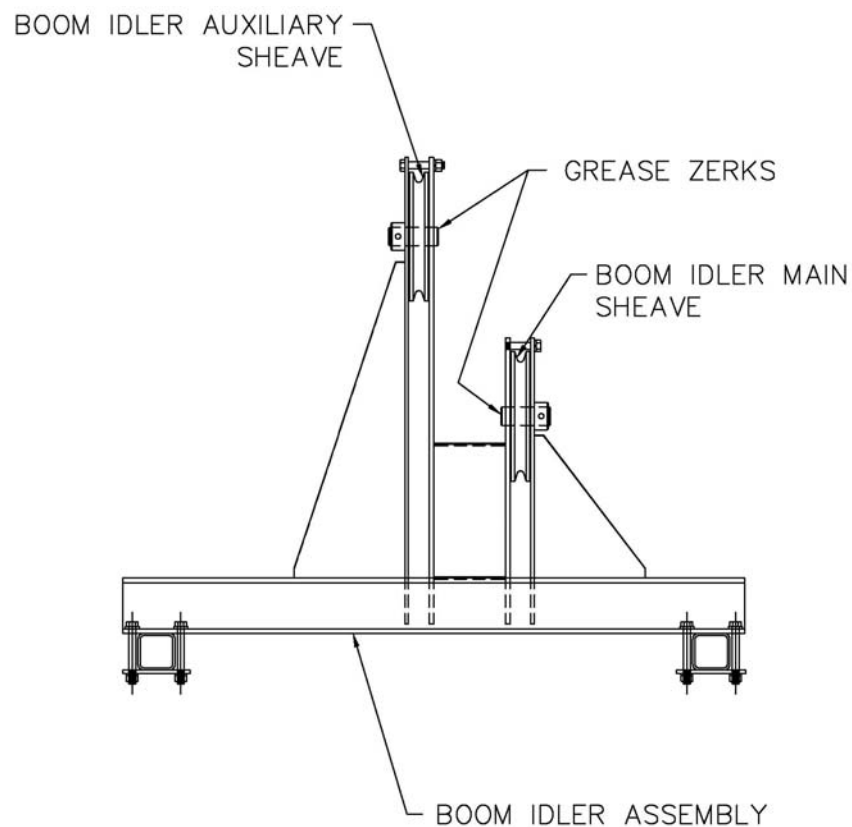
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## Nautilus Crane Model 340LA-80

### Section 4.6.7 Boom Idler



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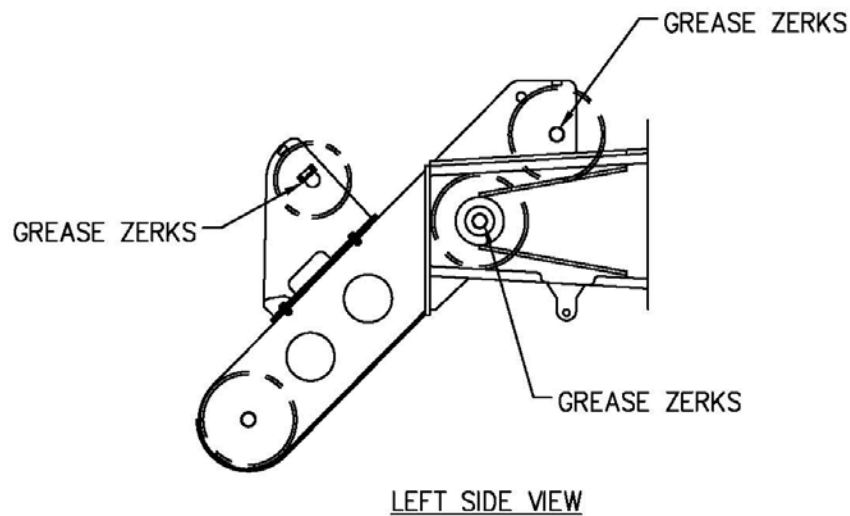
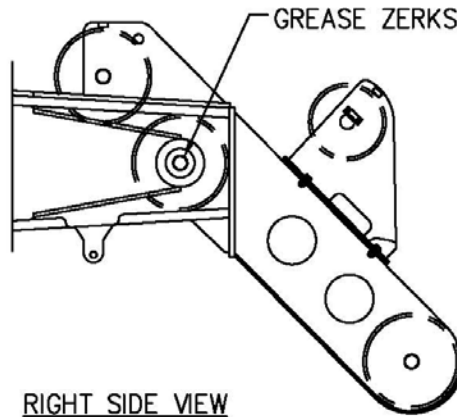
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## Nautilus Crane Model 340LA-80

### Section 4.6.8 Boom Point







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ImXport Services Corp.

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## Nautilus Crane Model 340LA-80

### Section 4.7 Recommended Fluids & Lubricants



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1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA









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## Nautilus Crane Model 340LA-80

### Section 4.7.1 Hydraulic Oil

Viscosity	150-225 SSU @ 100°F
Viscosity Index	90 Minimum
Pour Point	No Higher than 20°F
Neutralization Point	0-05 Maximum
Compounds For	Wear
Compounds For	Anti-Foam
Compounds For	Anti-Rust

#### SUPPLIER

Arco  
Conoco  
CITGO  
Exxon  
Gulf  
Mobil  
Pennzoil  
Phillips  
Shell  
Sun  
Tenneco  
Chevron Texaco  
Union

#### DESIGNATION

Duro AW 46 Hydraulic Oil  
Super Hydraulic Oil 32  
AW Hydraulic 32  
NUTO 32  
Harmony 32 AW  
DTE 24  
Pennzoil AW 32  
Magnus A 32  
Tellus 32 (Winter) / 46 (Summer)  
Sunvis 816 WR  
EP 300  
Rando HD 46  
UNAS AW32



Do not use Phosphate Esters.  
Do not use Synthetic Fluids.

Seals are compatible with mineral base fluids only.



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### Section 4.7.2 Gear Oil

Recommended Hoist Lubricants

<u>SUPPLIER</u>	<u>DESIGNATOR</u>	<u>AMBIENT TEMPERATURE</u>
Texaco	Meropa 220 / Equivalent API GL-2/3	+ 50 to + 130°F
Texaco	Meropa 150 / Equivalent API GL-2/3	- 10 to + 50°F
Mobil	SCH630 Synthetic	- 40 to - 10°F

<u>SUPPLIER</u>	<u>DESIGNATION</u>
Conoco	Universal Gear 140w
CITGO	Premium Gear Oil 140w
Exxon	Gear Oil GX 140
Gulf	Multi-Purpose G.L. 140
Mobil	Mobilube HD 140w
Pennzoil	Pennzoil – 140w
Phillips	Philube SMP 140
Shell	Spirex HD 140w
Sun	Sunfleet GL 5 140w
Tenneco	
Texaco	Multigear EP 140w
Union	MP Gear Lube LS 140w



**WARNING**

Failure to use the proper type and viscosity of planetary gear oil could result in property damage, severe personal injury or death.



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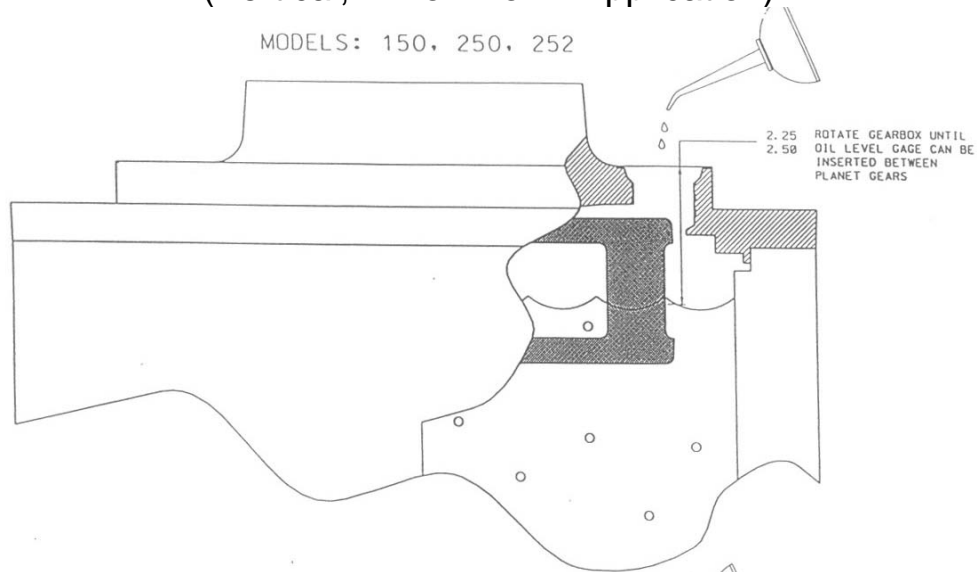
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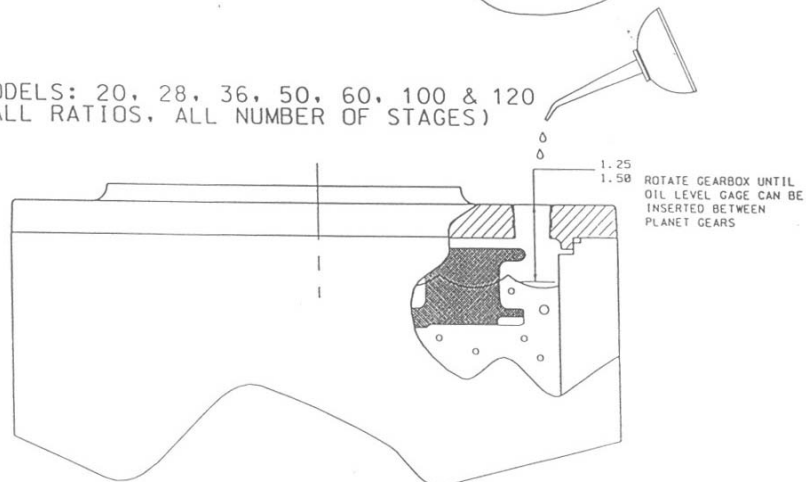
## Nautilus Crane Model 340LA-80

### Section 4.7.3 Oil Fill & Level Check for Eskridge Geardrives (Vertical, Pinion Down Application)

MODELS: 150, 250, 252



MODELS: 20, 28, 36, 50, 60, 100 & 120  
(ALL RATIOS, ALL NUMBER OF STAGES)



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## Nautilus Crane Model 340LA-80

### Section 4.8 Miscellaneous Fluids

#### **Ballring, Pins, Bushings, Swivel:**

Grease

General Purpose: Lithium based grease with “EP” additives and rust inhibitors  
(use Grade #2 for temperatures about 32°F and Grade #1 for temperatures  
under 32°F.)

#### **Engine:**

Fuel

See Engine Operators Guide

Lube Oil

See Engine Operators Guide

#### **Coolant:**

Depends on environmental requirements. Complete analysis provided in engine  
service manual (50% anti-freeze, 50% water normal mix). See also engine  
manual

#### **For Personnel Handling:**

Check oil level in winches every 2 weeks and brake test every quarter.  
Disassemble and inspect all wear parts annually.

#### **Wire Rope:**

Esgard

#### **Hydraulic Actuators:**

Use a quality oil as prescribed for the hydraulic system.



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## Nautilus Crane Model 340LA-80

### Section 4.9 Maintenance Malfunction Diagnosis

The following chart list malfunctions which may occur during equipment operation, followed immediately by the possible cause and solution. These are not all inclusive but are designed to help isolate the problem.

CONDITION	POSSIBLE CAUSE	POSSIBLE SOLUTION
<i>No response to control</i>	Load too heavy	Check Capacity Chart
	Low hydraulic fluid supply pressure	Check and fill as required
	Broken hydraulic pressure line	Replace as required
	Incorrect relief valve setting	Call OSI* Service
	Relief valve sticking	Call OSI* Service
<i>Poor hydraulic system performance</i>	Low hydraulic supply flow	Call OSI* Service
	Relief valve sticking	Call OSI* Service
	Relief setting too low	Call OSI* Service
	Boom holding valves out of adjustment	Warm oil or use less viscous oil
	Lines restricted	Check lines; clean and repair as necessary
	Internal valve crack	Replace valve
	Load too heavy	Check Capacity Chart and reduce load
<i>Swing moves erratic or loosely</i>	Loose turntable bearing	Torque bearing mounting and call OSI* Service
	Loose swing gearbox mounting bolts	Tighten bolts
	Worn gears or bearing	Replace worn parts or adjust gearbox spacing
	Operator control of lever too erratic	Operate controls smoothly
	Brake not releasing	Check pressure in brake release line



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## Nautilus Crane Model 340LA-80

The following chart list malfunctions which may occur during equipment operation, followed immediately by the possible cause and solution. These are not all inclusive but are designed to help isolate the problem.

CONDITION	POSSIBLE CAUSE	POSSIBLE SOLUTION
<i>Swing will not turn</i>	Attempting to swing up too much on incline	Level machine
	Turn circuit relief valves sticking	Clean and check circuit pressure
	Turntable bearing drag	Lubricate thoroughly as rotating boom
	Brake not releasing	Use bleed screw on brake to remove air
<i>Excessive noise during operation</i>	Low oil temperature	Allow unit to warm up
	Low hydraulic oil supply	Check and fill
	Suction line kinked, collapsed or blocked	Clear blockage
	Hydraulic oil too thick	Warm oil use oil more applicable to environment
	Plugged suction strainers	Remove from tank and clean
	Relief valve chatting	Dirt in relief valve or damaged relief
	Swing brake dragging	Use bleed screw on brake to remove air
	Hydraulic tubing vibration	Check for loose tubing
	Tank breather plugged	Clean breather
<i>Cylinders drift loosely</i>	Not getting oil to cylinders	Clean and replace as required
	Worn or damaged piston seals	Replace as required
	Air in hydraulic oil	Cylinder operate crane cylinder to remove air
	Loose holding valve	Tighten valve
	Dirt in holding or check valve	Clean valve



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The following chart list malfunctions which may occur during equipment operation, followed immediately by the possible cause and solution. These are not all inclusive but are designed to help isolate the problem.

CONDITION	POSSIBLE CAUSE	POSSIBLE SOLUTION
<i>Winch will not lift or hold load</i>	Load too heavy.	Check load and change to applicable multipart reeving
	Relief valve setting too low	Check and adjust if required
	Motor worn excessive.	Replace motor
	Counterbalance valve defective or leaking	Clean and replace as necessary
	Brake worn out	Repair or replace brake
** Boom chatters during extension or retraction or does not sequence	Boom section needs lubrication.	Grease boom
	Worn wear pads	Replace pads
	Locks inoperative	Clean and grease dirty locks or replace worn/broken parts
	Worn locks	Remove burrs or slightly worn areas with a file. Replace if major wear is evident
*** Boom winch chatters	Ratchet and pawl not releasing	Adjust

\* OSI Service (985)851-5600

\*\* If Telescopic Crane Only

\*\*\* If Lattice Boom Crane Only



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## Nautilus Crane Model 340LA-80

### Section 4.10 Hoist Descriptive Literature, Catalogues



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## Nautilus Crane Model 340LA-80

### Section 4.10.1

#### Braden Gearmatic

Inspection, Testing, Preventive Maintenance and Special Operating Instructions



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA







# BRADEN Gearmatic

## Inspection, Testing, Preventive Maintenance and Special Operating Instructions For Planetary Hoists

### ⚠ WARNING ⚠

Read and understand these entire instructions BEFORE operating or servicing your BRADEN/Gearmatic hoist. Retain these instructions for future reference. Failure to properly operate, maintain and service a hoist may lead to loss of load control and result in property damage, serious injury or death.

➔ **NOTE:** This publication replaces PB-308 Rev. 3, Bulletin PA125A and Braden Part No. 25672. ➔

Inspection Records & Retention	1	Brake Test Procedure	6-7
Periodic Inspections	2-4	Emergency Lowering Procedure	8
Oil Sampling & Analysis	5	Personnel Handling	9

These instructions apply to the following planetary hoists:

PD5/GH5/BG6 (any design series)	CH150A, CH165A, CH175A, CH185A, CH210A
PD7/BG8 (any design series, Equal Speed only)	CH230A, CH230B, CH240A, CH330A, CH400A
PD12 (any design series)	CH400B, CH500A, CH600A, CH640
PD15B ("B" design series only)	CH22B ("B" design series only)
PD17A	GH30, GH50 (with external motor & brake valve)

The user of Braden products is responsible for hoist inspection, testing and maintenance with frequency dependent upon the severity of the hoist duty cycle and thoroughness of the preventive maintenance program in effect.

### ⚠ WARNING ⚠

Any time a hoist exhibits erratic operation and/or unusual noise, the hoist must be taken out of service until it is inspected and serviced by a qualified technician. Continued operation of a hoist with a defect in a critical component may lead to loss of load control, property damage, serious injury or death.

### Record Retention:

A log of written, dated and signed records of ALL inspections, load tests, maintenance, repairs or modifications must be kept readily available in an appropriate location for a minimum of four (4) years.

To provide customers with qualified outlets for hoist service and repairs, BRADEN has established authorized Service Centers. These Service Centers have factory trained service technicians, up-to-date

service information, extensive parts inventories, complete testing facilities and are audited by BRADEN on a regular basis for compliance. BRADEN strongly recommends the use of BRADEN authorized Service for maintenance, repair and inspection of BRADEN/Gearmatic products. Contact the Braden Technical Support Department at 918-251-8511 for the names of current authorized Service Centers.

## Usage and Inspection:

Inspection procedures for hoists are divided into five general categories based upon their usage or duty cycle, which in turn determines appropriate intervals for inspections. The usage categories must be assigned by the crane user on a consistent crane-by-crane basis. The five crane/hoist usage categories are as follows:

**Idled** - The crane/hoist has not been used for three months.

**Infrequent Usage** - The crane/hoist is used less than ten hours per month based on a three month average.

**Moderate Usage** - Crane/hoist used 10 - 50 hours per month based on a three month average.

**Heavy Usage** - Crane/hoist used 50 - 200 hours per month.

**Severe Duty** - Crane/hoist is operated more than 200 hours per month OR where 50% of the lifts exceed 75% of the Braden rated capacity for the hoist.

The following chart lists the inspections that are required for each type of usage category.

INSPECTION USAGE CATEGORY	PRE-USE DAILY INSPECTION	QUARTERLY INSPECTION	SEMI-ANNUAL INSPECTION	ANNUAL INSPECTION	TEAR-DOWN INSPECTION
<b>IDLED</b> Not used for 3 months or longer	REQUIRED BEFORE PLACED IN SERVICE QO / QI	REQUIRED BEFORE PLACED IN SERVICE QO / QI	REQUIRED BEFORE PLACED IN SERVICE QO / QI	----	REFER TO NOTE 1
<b>INFREQUENT USAGE</b> less than ten hours per month	REQUIRED QO / QI	REQUIRED QO / QI	REQUIRED QO / QI	REQUIRED QI	5 YEARS 3 YEARS IF NOT SUBJECT TO FULL INSPECTION PROGRAM
<b>MODERATE USAGE</b> 10-50 hours per month	REQUIRED QO / QI	REQUIRED QI	REQUIRED QI	REQUIRED QI	4 YEARS 2 YEARS IF NOT SUBJECT TO FULL INSPECTION PROGRAM
<b>HEAVY USAGE</b> 50-200 hours per month	REQUIRED QO / QI	REQUIRED MONTHLY QO / QI	REQUIRED QUARTERLY (3 months) QI	REQUIRED SEMI-ANNUALLY (6 months) QI	3 YEARS 1.5 YEARS IF NOT SUBJECT TO FULL INSPECTION PROGRAM
<b>SEVERE USAGE</b> 200+ hours per month or 50% of lifts exceed 75% rated capacity	REQUIRED QO / QI	REQUIRED QI	REQUIRED QUARTERLY (3 months) QI	REQUIRED SEMI-ANNUALLY (6 months) QI	1 YEAR

QO = Qualified Operator

QI = Qualified Inspector

**NOTE 1:** For idled units with unknown maintenance and repair history, it is highly recommended that the hoist undergo a tear down inspection prior to being placed into service. If personnel lifting is expected with such a hoist, a tear down inspection is required before use.

### Pre-Use or Daily Inspection:

Must include but is not limited to the following inspections that will be performed prior to placing the crane into service and then as necessary during extended operation. This inspection must be performed by a qualified crane operator or qualified crane inspector.

1. Check for external oil leaks and repair as necessary. **This is extremely important due to the accelerated wear that will result from insufficient lubricating oil in the hoist.** Hoists with a sight glass; check oil level daily. Hoists without a sight glass; check oil level monthly if no external oil leaks are detected. Lubricant level must be maintained between the minimum and maximum levels; midway up sight glass or at bottom of level plug port as equipped. Use only the recommended type of lubricant. Refer to the specific hoist service manual and/or the latest revision Braden Service Bulletin 503.
2. Check the ratchet and pawl mechanism (if equipped) for proper operation and full, spring-force engagement of the pawl with the ratchet wheel. Adjust or repair as necessary.
3. Check hydraulic fittings and hoses for chaffing, deterioration or corrosion and repair as necessary.
4. Visually inspect for corroded, loose or missing bolts, pins or other fasteners and replace or tighten as necessary.
5. Visually inspect rotation indicator transmitters, anti-two-blocking switches and other safety equipment and repair as necessary.

### Quarterly Inspection (every three months):

Must include but is not limited to the following inspections that must be performed by a qualified crane operator or qualified crane inspector. A qualified crane inspector shall perform inspections on cranes assigned a moderate, heavy or severe usage category.

1. Perform the pre-use inspection.
2. On hoists used for personnel handling, the internal spring-applied brake shall be tested in accordance with the procedure on page 6 of these instructions.
3. Inspect for corrosion of fasteners, hoist base, drum, etc. and repair/replace as required to maintain the structural integrity of the hoist.

### Semi-Annual Inspection (every six months):

Must include but is not limited to the following inspections that must be performed by a qualified crane operator or qualified crane inspector. A qualified crane inspector shall perform inspections on cranes assigned a moderate, heavy or severe usage category

1. Perform the Pre-Use and Quarterly inspections.
2. Take a sample of the lubricant from the hoist gear cavity as described on page 5 and analyze it for wear metals content, correct viscosity, lubricant deterioration, moisture and other contaminants. If the oil sample contains an high amount of metallic particles, the hoist must be taken out of service to undergo a tear down inspection.

**NOTE: Oil analysis cannot detect nor warn against a fatigue failure.**

### Annual Inspection:

This inspection must be carried out by a qualified crane inspector. The annual inspection **MUST** include, but not be limited, to the following:

1. Perform the Pre-Use/Daily Inspection, Quarterly inspection and Semi-Annual Inspection.
2. Change the lubricating oil in the hoist gear cavity after an oil sample has been taken as described on page 5. Refill the hoist to the proper level with recommended lubricant. Refer to Braden Service Bulletin 503 Rev. 3.

### WARNING

Failure to use the proper type and viscosity of planetary gear oil may contribute to intermittent brake clutch slippage which could result in property damage, severe personal injury or death. Some gear lubricants contain large amounts of EP (extreme pressure) and anti-friction additives which may contribute to brake clutch slippage or damage to brake friction discs or seals. Oil viscosity with regard to ambient temperature is also critical to reliable brake clutch operation. Our tests indicate that excessively heavy or thick gear oil may contribute to intermittent brake clutch slippage. Make certain that the gear oil viscosity used in your hoist is correct for your prevailing ambient temperature.

## Tear-down Inspection:

Tear down inspections of BRADEN hoists should be completed per the usage schedule defined below. Magnetic Particle Inspection (MPI) of the internal ring gear and reduction gears must be performed during tear down inspections to aid in the detection of cracks in the ring gears due to fatigue. The preferred inspection method is the Fluorescent Wet Magnetic Particle Inspection using ultraviolet light consistent with ASTM E709. For further information related to this inspection, and for testing of the older CH150 ring gears, P/N 24446, refer to BRADEN Service Bulletin LIT2162.

**Severe Duty** - Perform tear down inspection / MPI annually

**Heavy Usage** - Perform tear down inspection / MPI at least every (3) years

**Moderate Usage** - Perform tear down inspection / MPI at least every (4) years

**Infrequent Usage** - Perform tear down inspection / MPI at least every (5) years

It is strongly recommended that any moderate or infrequent usage hoist that is also used for personnel lifting undergo tear down inspections on a maximum basis of once every (3) years.

**Any hoist that has NOT been subject to regular oil sample analysis must undergo a tear down inspection on an annual (12 month) basis.** Also, if a hoist has an unknown history of repair and/or maintenance, it is highly recommended that the hoist undergo a tear down inspection prior to being placed into service.

**NOTE: Oil analysis alone cannot detect nor warn against component fatigue failure.**

A tear down inspection includes the hoist being completely disassembled, cleaned, inspected and repaired as required. Replacement of all worn, cracked, corroded or distorted parts, such as pins, bearings, shafts, gears, brake rotors, brake plates, drum and base should occur as required. All seals and O-rings should be replaced at this time.

**Any deficiencies, including but not limited to those above, shall be corrected immediately.**

All of the following operations **MUST** be performed **BEFORE** the hoist is placed back into service.

1. The rebuilt hoist **MUST** be line pull tested to the rated load of the hoist (hoist rating will vary with motor, gear ratio and drum options) with a dynamometer or equivalent load measuring device. This test load shall be the maximum rating of the hoist for the specific application (at the normal relief valve setting for the hoist) - **NOT** the reduced rating used for personnel lifts.
2. The hoist must be dynamically tested by rotating the drum several times, in both the hoisting and lowering directions, while under a load of at least 30% of the hoist lifting capacity. Check for smooth operation during this procedure.
3. The hoist internal friction brake shall be tested per the procedures on page 6 of this manual.
4. After inspection or rebuild and testing, a new certificate for personnel handling shall be issued by the inspector / service technician, effective on the date the hoist is placed back in service. A sample certificate is shown below, and shall include, at a minimum, all of the information depicted here.

### Name of Service Company

Approved by BRADEN for handling personnel  
if used and maintained in accordance with BRADEN  
Recommendations For Personnel Handling Hoists

Hoist Model No.: \_\_\_\_\_

Hoist Serial No.: \_\_\_\_\_

Date of Inspection: \_\_\_\_\_

Work Order/Job No.: \_\_\_\_\_

Inspector's Name: \_\_\_\_\_

For a copy of recommendations call or write: BRADEN  
PO Box 547, Broken Arrow, OK, 74012, USA (918) 251-8511

## PREVENTIVE MAINTENANCE AND OIL SAMPLING

### Oil Change

The hoist gear oil must be changed after the first 100 operating hours then on an annual basis, at a minimum thereafter. In severe duty applications, the gear oil should be changed every six months. Use the recommended lubricants. Refer to the applicable hoist service manual or Braden Service Bulletin 503 Rev. 3 or later for the recommended lubricants.

### Gear Oil Sampling and Analysis

Proper gear oil sampling and analysis is a vital part of a comprehensive preventive maintenance program. Information obtained from the oil analysis allows the maintenance technician to substitute preventive maintenance for more costly unscheduled down time or a far more dangerous failure. Early detection of accelerated component wear allows the scheduling of corrective maintenance.

Prepare the hoist by cleaning the drain plug area and drain extension tube in order to obtain an uncontaminated sample. Operate the hoist in both directions for one or two minutes to thoroughly mix the gear oil then take the sample from the "mid-stream" flow of the oil to obtain an accurate representation of the oil condition. After taking the oil sample continue with the oil change or refill the hoist gear cavity to the proper level with recommended lubricant.

#### **WARNING**

Hot oil may cause personal injury and/or burns to unprotected skin. Make certain the oil has cooled to a safe temperature (typically less than 110°F or 43°C) before taking an oil sample, changing oil or servicing the hoist.

General guidelines for iron contaminant level:

100-500 ppm	Normal
500-800 ppm	Caution - Abnormal Sample. Change oil and retake sample after 50 hours of operation. If second sample is above 500 ppm, remove hoist from service and perform tear-down inspection to determine source of contamination.
800+ ppm	Unacceptable. Remove hoist from service and perform tear-down inspection to determine source of contamination.

Iron contaminant levels will be on the high side of "Normal" during break-in.

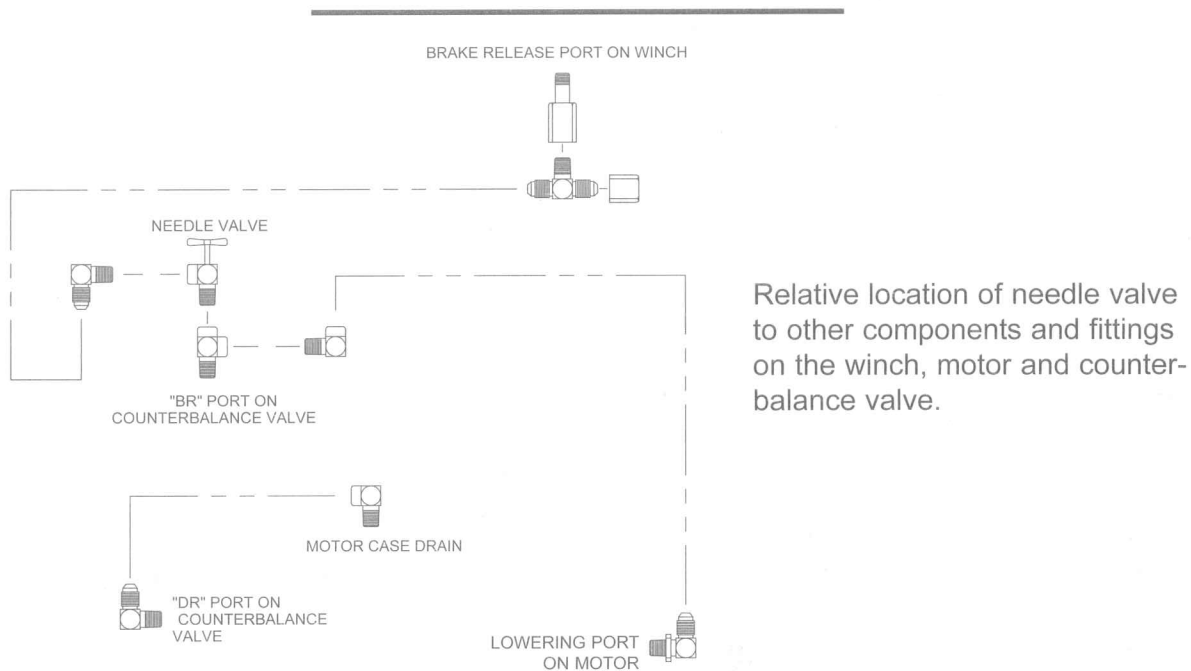
Equally important as the level of contamination is the change in level of contamination. An effective oil analysis program should provide the technician with a view of the progression of wear or a trend. If a sample shows a sudden rise in contaminant level action should be taken to determine "what has changed".

**NOTE: Oil analysis cannot detect nor warn against a fatigue failure.**

## BRAKE TEST PROCEDURE FOR BRADEN/Gearmatic HOISTS

All BRADEN planetary hoists have a spring applied, hydraulically released, multiple disc brake inside the hoist housing (Gearmatic hoists have a large single brake disc). This brake holds a suspended load when the directional control valve is in neutral, or when hydraulic power is lost. A brake clutch assembly permits the power train and drum to rotate in the direction to lift a load, while the brake remains fully applied. A load cannot be lowered, however, without applying hydraulic pressure to the release port and releasing the brake.

Hoists ordered for personnel handling cranes will have a needle valve in the brake release line. They will also have a tee in the brake release line between the needle valve and the brake release port on the hoist. One opening in the tee is capped. With the valve closed and the cap removed from the tee, the brake is isolated from system pressure and vented to atmosphere. The brake cannot be released under these conditions by actuating the directional control valve.



One purpose of the valve/tee combination is to provide a means to test the brake; the other is to provide a means to lower a load when hydraulic power is lost.

### **Brake Test Procedure (Hoists Equipped With Brake Valves)**

(Test to be performed with no load on the hoist.)

Remove the lockwire on the needle valve handle and close the valve tightly.

Remove the plug or cap in the tee (in the brake release circuit).

With the hydraulic power unit running, move the directional control valve handle slowly to the full open, lowering position.

Increase the engine speed, if necessary, to bring

system pressure up to the relief valve setting. The hoist drum should remain stationary.

If the drum rotates, the hoist should be disassembled and the brake components should be examined for wear. In addition, the brake springs should be measured for correct free length in those hoists using helical compression springs.

Replace any parts showing excessive wear and any spring whose length is shorter than the minimum shown in the applicable hoist Service Manual.

Reassemble the brake and hoist and repeat the above steps.

When testing is complete, be sure to reinstall the plug or cap in the tee, fully open the needle valve and install lockwire to secure the valve in position.



The above procedure utilizes the hoist hydraulic motor to test the brake's ability to resist approximately 115% of the rated hoist load.

**Brake Test Procedure (For Standard Hoists Not Equipped With The Needle Valve)**

(Test to be performed with no load on the hoist)

Remove and cap or plug the brake release line from fitting in the hoist brake release port.

With the hydraulic power unit running, move the directional control valve handle slowly to the full open, lowering position.

Increase the engine speed, if necessary, to bring system pressure up to the relief valve setting. The hoist drum should remain stationary.

If the hoist drum rotates, the hoist should be disassembled and the brake components should be

examined for wear. In addition, the brake springs should be measured for the correct free length in those hoists using helical compression springs.

Replace any parts showing excessive wear, and any spring whose free length is shorter than the minimum shown in the applicable hoist Service Manual.

Reassemble the brake and hoist and repeat the above steps.

When testing is complete, reattach the brake release line to the brake release port fitting.

The above procedure utilizes the hoist hydraulic motor to test the brake's ability to resist approximately 115% of the rated hoist load.

## EMERGENCY LOWERING PROCEDURES FOR HOISTS WITH GEAR MOTORS

The following procedure releases the multiple disc brake while leaving the brake valve closed. Since gear type motors are not zero leakage devices, internal motor leakage permits the load to slowly rotate the motor although its outlet is blocked by the closed brake valve. This procedure will **NOT** work if there is little or no oil in the motor. Using properly rated pipe and fittings, the standpipe described below may be permanently installed in the hydraulic system to avoid installing one in an emergency.

1. Remove the lockwire on the needle valve handle and close the valve tightly.

### **WARNING**

The standpipe referred to in step (3) below **MUST** be used. Attempting this procedure with no oil in the motor or with the brake valve stuck in the open position will cause the load to free fall, which could result in property damage, personal injury or death.

2. Remove the plug in the tee.
3. Remove both main hoses from the motor. Attach a standpipe to the lowering motor port (opposite side of the motor from the brake valve). Install a plug into the hoisting port in the brake valve.

The standpipe is simply a length of pipe (approximately 12 inches (305 mm) long) attached to a 90° elbow. The other end of the elbow is attached to the lowering motor port or manifold. The standpipe is installed with the long, open end pointing up in a vertical position to serve as a small reservoir. While the load is being lowered, hydraulic oil **MUST** be added to the standpipe as necessary to prevent the motor from running dry.

4. Fill the standpipe with hydraulic oil, making certain that oil is not running out of the brake valve. If oil is running out of the brake valve, stop the emergency lowering procedure. Remove the spring retainer and tap the main spool of the brake valve to the closed position. Replace the spring retainer. After completing the emergency lowering procedure, the brake valve **MUST** be serviced and repaired if the spool was stuck.
5. Connect a hand pump to the open port in the tee.

### **WARNING**

Do not touch the motor, brake valve, or standpipe while lowering a load. They may become hot enough to cause burns.

6. Slowly operate the hand pump up to no more than 1,000 psi (6,900 kPa). A suspended load will slowly come down when the static brake is released. Releasing the pressure on the hand pump will cause the load to stop. If a chattering noise is heard while the load is coming down, pump the hand pump to a slightly higher pressure until the noise stops. Do not exceed 1,500 psi (10,350kPa) to the brake release port.
7. **Always** remove the hoist from service to inspect the brake components for signs of overheating and replace if necessary following this procedure. Refer to the applicable Braden or Gearmatic service manual for details.
8. If this procedure was performed due to a malfunction of the hoist, remove the hoist from service and perform a complete teardown and inspection to correct the cause of the malfunction before returning the hoist to service.



## PERSONNEL HANDLING

BRADEN recognizes that most hoists and cranes are designed and intended for handling materials and not personnel. **The crane or hoist is only to be used to handle personnel if it can be shown there is no less hazardous way of carrying out the job.** In these situations, all safety precautions must be strictly adhered to. BRADEN recommends adherence to the latest revision of API 2C (RP 2D) and/or ANSI/ASME standard B30.5 and/or OSHA and/or other applicable standards for your application. It is important that you obtain a copy of all applicable safety standards, and that you read and understand them prior to using the hoist. **In addition to**, or in conjunction with, the applicable standards, BRADEN requires \*:

- The hoist must be maintained in accordance with the recommendations in this document and the service procedures in the Installation, Maintenance and Service Manual for your specific hoist.
- When handling personnel, the allowable line pull will be limited to 30% of the hoist rated line pull for the respective layer of wire rope on the drum. This reduction increases the hoist design factor from 3:1 to 10:1, approximately. Example: a hoist rated at 15,000 lbs. on the first layer will be rated at  $15,000 \times 0.3 = 4,500$  lbs. on the first layer when handling personnel.
- Personnel are only permitted to ride in an approved personnel platform as described in API, OSHA or ANSI/ASME standards.
- The crane must be in good working order and equipped with all required safety equipment, including an anti two-blocking device or warning signal and a boom angle and length indicator. Two-blocking occurs when the load block or hook assembly comes in contact with the upper block or point sheave assembly and often results in damage to the wire rope, rigging, crane and/or hoist.
- Personnel being lifted or supported shall wear safety belts with lanyards attached to designated points unless lifting over water. If lifting over water, provide approved personal flotation devices (PFD's).

- The lift shall be made under controlled conditions and under the direction of an appointed qualified signal person.
- The operator and signal person shall conduct test lift, without personnel in the personnel platform, to verify adequacy of the crane footing and support. The crane outriggers, if so equipped must be fully extended and properly set.
- Cranes shall not travel (move locations) while personnel are on the personnel platform.
- The platform must be landed or tied off, and a brakes set before personnel enter or exit.

\* If there are any questions, concerns, or conflict with other safety standards, contact the BRADEN Product Support Department, PO Box 547, Broken Arrow, OK, 74013, USA, Telephone 1-(918) 251-8511, or via email at [winch.service@paccar.com](mailto:winch.service@paccar.com).

Additional information can be obtained from the following organizations:

- Booklet on "Hoisting Personnel", Crane Institute of America Inc., 1063 Maitland Center Commons, Suite 100, Maitland, Florida, 3275 USA (800) 832-2726
- OSHA Standard 29 CFR 1926.550 - Cranes, Derricks, Hoists, Elevators, and Conveyors Occupational Safety and Health Administration (OSHA), 200 Constitution Ave. N.W. Washington D.C. 20210 USA (202) 219-4667
- ANSI/ASME Standard B30.5, American National Standards Institute (ANSI), 11 W. 42nd Street New York, New York 10036 USA (212) 642-490
- API Specification 2C and RP 2D, American Petroleum Institute (API) 1220 L Street, N.W. Washington, DC 20005 USA (202) 682-8375





PEMEX – PP LUM A  
Project

ImXport Services Corp.

# Vendor Data Book

P.O. # 0018987

Serial # 23407C

Volume: 1

## Nautilus Crane Model 340LA-80

### Section 4.10.2 Hoist Installation, Maintenance & Service Manual



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA







PEMEX – PP LUM A  
Project

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Serial # 23407C

Volume: 1

## Nautilus Crane Model 340LA-80

### Section 4.10.2 (a) CH240A Series Hoist Main Hoist



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA



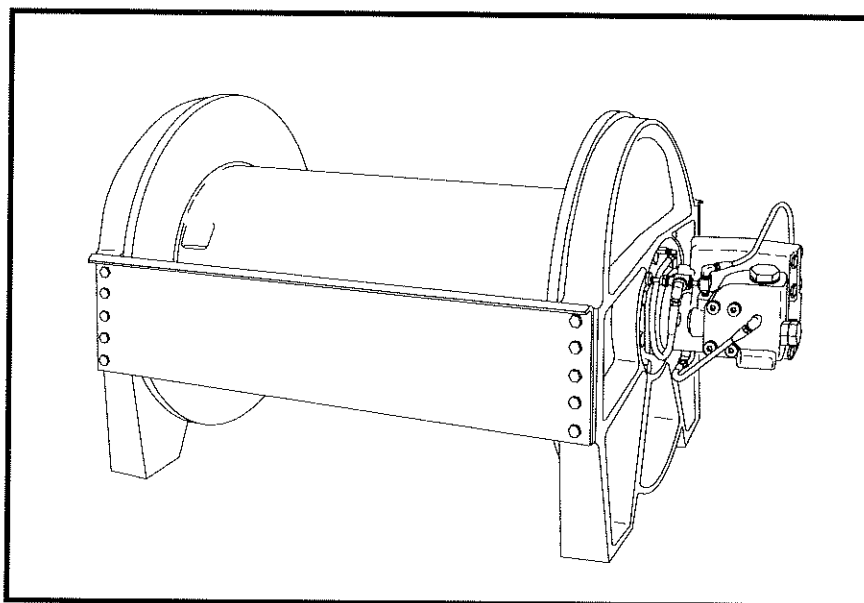


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# BRADEN

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## CH240 PLANETARY HOIST



### INSTALLATION, MAINTENANCE AND SERVICE MANUAL

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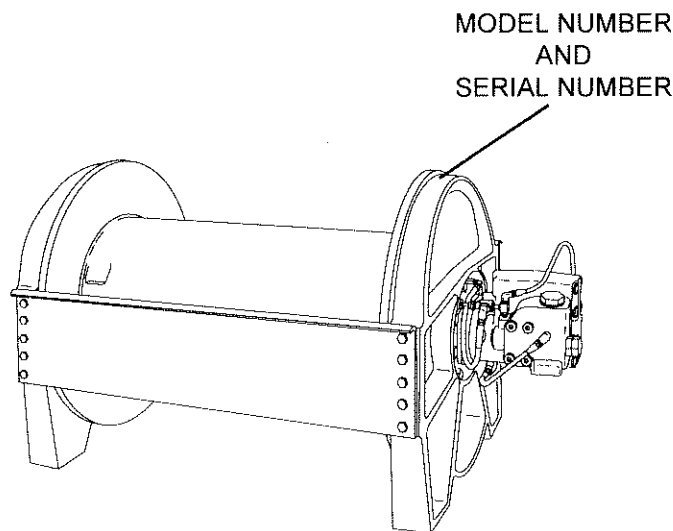


# FOREWORD

The following service instructions have been prepared to provide assembly, disassembly and maintenance information for the BRADEN Model CH series winch. It is suggested that before doing any work on these units, all assembly and disassembly instructions should be read and understood.

Some pictures in this manual may show details or attachments that are different from your winch. Also, some components have been removed for illustrative purposes.

Continuing product improvement may cause changes in your winch, which are not included in this manual. Whenever a question arises regarding your BRADEN Winch or this manual, please contact BRADEN Service Department for the latest available information.



## MODEL NUMBER AND SERIAL NUMBER

When information on a hoist is needed, always refer to the model number and serial number. Both are located on the top of the motor side end plate as indicated above.

## EXPLANATION OF MODEL NUMBER

<b>CH</b>	<b>240</b>	<b>A</b>	<b>-</b>	<b>23</b>	<b>090</b>	<b>01</b>
CONSTRUCTION HOIST	MAX RATING	DESIGN MODEL		GEAR RATIO	MOTOR SIZE	DRUM SIZE

<b>CH</b>	DESIGNATES CONSTRUCTION HOIST (C2H DESIGNATES TWO SPEED)
<b>150</b>	DESIGNATES 15,000 LB FIRST LAYER LINE PULL
<b>A</b>	DESIGNATES THE MODEL SERIES RELATING TO DESIGN CHANGES
<b>23</b>	DESIGNATES TOTAL GEAR REDUCTION
<b>090</b>	DESIGNATES HYDRAULIC MOTOR DISPLACEMENT IN CU IN/REV (DECIMAL POINT ELIMINATED EXAMPLE 090 – 9.0 CU IN/REV)
<b>01</b>	DESIGNATES THE DRUM OPTION

# GENERAL SAFETY RECOMMENDATIONS

1. Be certain equipment (boom, sheave blocks, pendants, etc.) is either lowered to the ground or blocked securely before servicing, adjusting, or repairing winch.
2. Be sure personnel are clear of work area BEFORE operating winch.
3. Read all warning and caution tag information provided for safe operation and service of winch.
4. Inspect rigging and winch at the beginning of each work shift. Defects should be corrected immediately.
5. Keep equipment in good operating condition. Perform scheduled servicing and adjustments listed in the "Preventive Maintenance" section of this manual.
6. An equipment warm-up procedure is recommended for all start-ups and essential at ambient temperatures below +40°F. Refer to "Warm-up Procedure" listed in the "Preventive Maintenance" section of this manual.
7. Do not exceed the maximum pressure (PSI) or flow (GPM) stated in the winch specifications.
8. Operate winch line speeds to match job conditions.
9. Leather gloves should be used when handling wire rope.
10. Never attempt to handle wire rope when the hook end is not free.
11. When winding wire rope on the winch drum, never attempt to maintain tension by allowing wire rope to slip through hands. Always use "Hand-Over-Hand" technique.
12. Never use wire rope with broken strands. Replace wire rope.
13. Do not weld on any part of the winch.
14. Use recommended hydraulic oil and gear lubricant.
15. Keep hydraulic system clean and free from contamination at all times.
16. Use correct anchor for wire rope and pocket in drum.
17. Do not use knots to secure or attach wire rope.
18. The BRADEN designed wire rope anchors are capable of supporting the rated load when installed properly. For additional safety, ALWAYS maintain a minimum of five (5) wraps of wire rope on the drum.

Safety and informational callouts used in this manual include:



This emblem is used to warn against potential or unsafe practices which COULD result in personal injury, and product or property damage if proper procedures are not followed.



This emblem is used to warn against unsafe practices which COULD result in severe personal injury or death if proper procedures are not followed.

# BASIC OPERATION

## DESCRIPTION OF HOIST

The hoist is made up of the following sub-assemblies:

1. Hydraulic motor and brake valve
2. Drum, drum closure, ball bearings and oil seals
3. Support end plate and bearing support
4. Motor end plate and motor adapter
5. Tie plates
6. Brake clutch assembly
7. Brake cylinder assembly and multiple-disc brake parts
8. Primary, second stage and output planetary reducer assemblies
9. Ring gear

## THEORY OF OPERATION

The primary sun gear is directly coupled to the hydraulic motor by the inner race of the brake clutch assembly. As the motor turns in the hoisting direction (normally clockwise), the three planetary assemblies reduce the input speed of the motor and rotate the ring gear and winch drum. Since the output reducer planet carrier is held from turning by the bearing support, the drum rotates in the opposite direction of the motor input shaft. In the hoisting direction, the static brake remains fully applied and the input shaft rotates freely through the sprag clutch. When the motor is stopped, the load tries to rotate the winch gear train in the opposite direction. The sprag clutch on the input shaft immediately locks up, allowing the fully applied static brake to hold the load from dropping. See Dual Brake System - Operation for a detailed description of the lowering sequence of operation.

### Dual Brake System – Description

The dual brake system consists of a dynamic brake system and a static brake system.

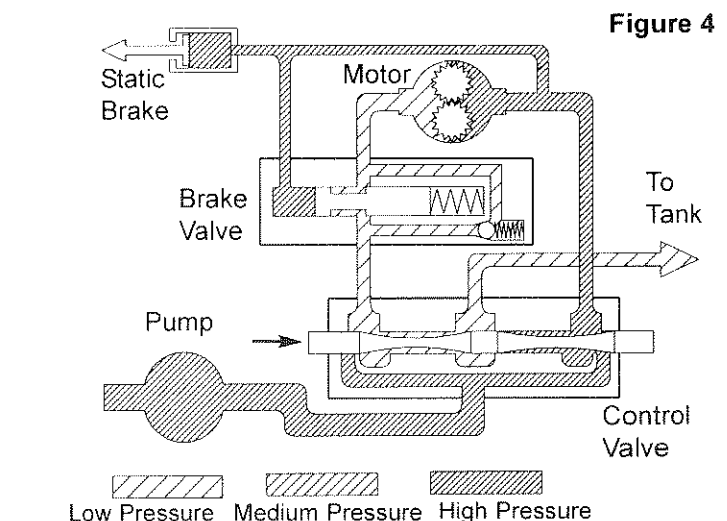
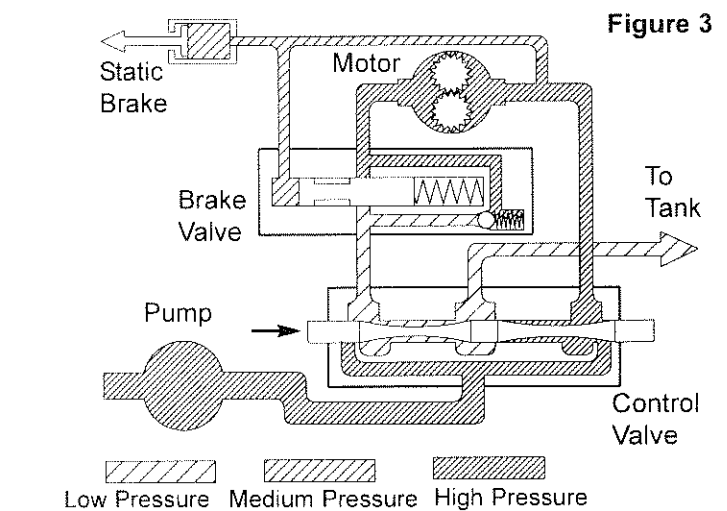
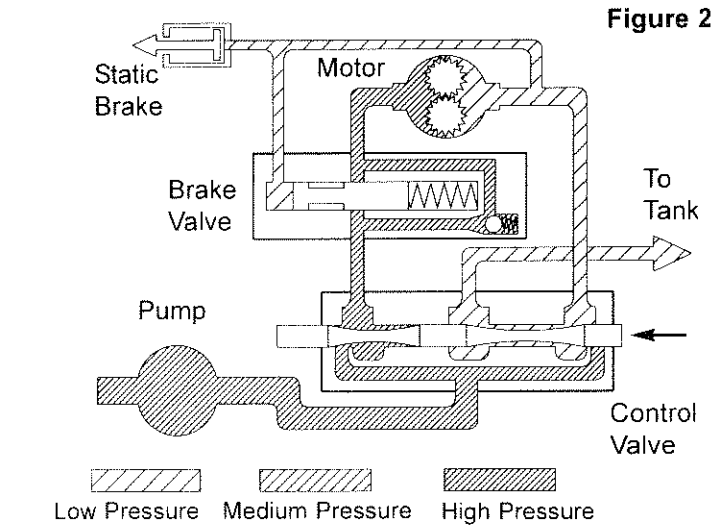
The dynamic brake system has two operating components:

1. Brake valve assembly
2. Hydraulic motor

The brake valve is basically a counterbalance valve. It contains a check valve to allow free flow of oil to the motor in the hoisting direction and a pilot operated, spring-loaded spool valve that blocks the flow of oil out of the motor when the control valve is placed in neutral. When the control valve is placed in the lowering position, the spool valve remains closed until sufficient pilot pressure is applied to the end of the spool to shift it against spring pressure and open a passage. After the spool valve cracks open, the pilot pressure becomes flow-dependent and modulates the spool valve opening which controls the lowering speed. See figures 2, 3 and 4

The static brake system has three operating components:

1. Spring Applied, Multiple Friction Disc Static Brake
2. Brake Clutch Assembly
3. Hydraulic Piston and Cylinder



The static brake is released by the brake valve pilot pressure at a pressure lower than that required to open the pilot operated spool valve. This sequence assures that dynamic braking takes place in the brake valve and that little, if any, heat is absorbed by the friction brake.

The friction brake is a load holding brake only and has nothing to do with dynamic braking or rate of descent of a load.

The brake clutch is splined to the primary sun gear shaft between the motor and the primary sun gear. It will allow this shaft to turn freely in the direction to raise a load and lock up to force the brake discs to turn with the shaft in the direction to lower a load. Figures 5 and 6.

The hydraulic cylinder, when pressurized, will release the spring pressure on the brake discs, allowing the brake discs to turn freely.

#### DUAL BRAKE SYSTEM – OPERATION

When hoisting a load, the brake clutch which connects the motor shaft to the primary sun gear, allows free rotation. The sprag cams lay over and permit the inner race to turn free of the outer race. Figure 5. The friction brake remains fully engaged. The winch, in raising a load, is not affected by any braking action. Figure 2.

When the lifting operation is stopped, the load attempts to turn the primary sun gear in the opposite direction. This reversed input causes the sprag cams to instantly roll upward and firmly lock the shaft to the fully engaged friction brake. Figure 6.

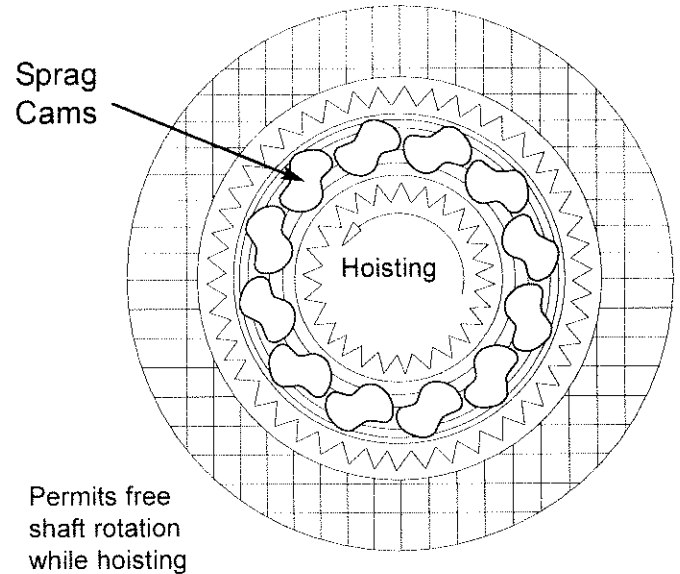
When the winch is powered in reverse, to lower the load, the motor cannot rotate until sufficient pilot pressure is present to open the brake valve. Figures 3 & 4. The friction brake within the winch will completely release at a pressure lower than that required to open the brake valve. The extent to which the brake valve opens will determine the amount of oil that can flow through it and the speed at which the load will be lowered. Increasing the flow of oil to the winch motor will cause the pressure to rise and the opening in the brake valve to enlarge, speeding up the descent of the load. Decreasing this flow causes the pressure to lower and the opening in the brake valve to decrease thus slowing the descent of the load.

When the control valve is shifted to neutral, the pressure will drop and the brake valve will close, stopping the load. The friction brake will engage and hold the load after the brake valve has closed.

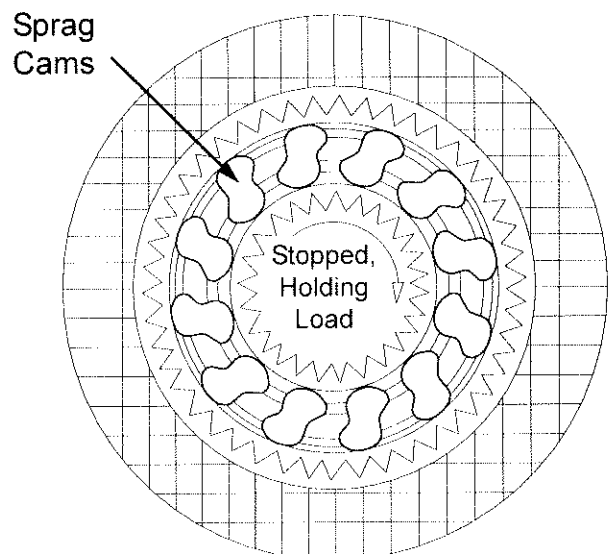
When lowering a load very slowly for precise positioning, no oil flow actually occurs through the winch motor. The pressure will build up to a point where the brake will release sufficiently to allow the load to rotate the motor through its own internal leakage. This feature results in a very slow speed and extremely accurate positioning.

The friction brake receives very little wear in the lowering operation. All of the heat generated by the lowering and stopping of a load is absorbed by the hydraulic oil where it can be readily dissipated.

**Figure 5** Static Friction Brake Applied



**Figure 6** Static Friction Brake Applied



# INSTALLATION

## GENERAL REQUIREMENTS

1. The hoist should be mounted with the centerline of the drum in a horizontal position. The mounting plane can be rotated to any position around this centerline.
  2. When mounting the hoist, use at least grade five bolts and nuts, and use both mounting holes in each end plate.
  3. It is important that the hoist be mounted on a surface that will not flex when the hoist is in use, since this could bind the working parts of the hoist. Also, be sure the hoist is mounted on a flat surface. If necessary, use shim stock to insure proper mounting. The mounting surface should be flat within + or -.020 inches.
  4. Hydraulic lines and components that operate the hoist should be of sufficient size to assure minimum back pressure at the hoist. The motor manufacturer recommends that the back pressure not exceed 100 psi for maximum motor seal life. 150 psi is the maximum allowable back pressure. The standard CH240A hoist is supplied with the motor internally drained. If high back pressures are encountered, the motor can be drained directly to tank to improve motor seal life. To insure adequate static brake load holding ability, back pressure on the hoist should not exceed 200 psi. For pressures exceeding 200 psi, consult Braden Engineering.
  5. Make certain that the hoist drum is centered behind the first sheave and the fleet angle does not exceed 1 1/2 degrees. The hoist should also be mounted perpendicular to an imaginary line from the center of the drum to the first sheave to insure even spooling.
  6. The hoist directional control valve must be a three-position, four-way valve with a motor spool such that when the valve is in the center position both work ports are opened directly to tank.
  7. The hydraulic oil filter should have a 10 micron nominal rating and be a full-flow type.
  8. High quality hydraulic oil is essential for satisfactory performance and long hydraulic system component life.
- Oil having 150 to 330 SUS viscosity at 100°F (38°C) and viscosity index of 100 or greater will give good results under normal temperature conditions. The use of an oil having a high viscosity index will minimize cold-start trouble and reduce the length of warm-up periods. A high viscosity index will minimize changes in viscosity with corresponding changes in temperature.
- Maximum cold weather start-up viscosity should not exceed 5000 SUS with a pour point at least 20°F lower than the minimum temperature.
- Under continuous operating conditions the temperature of the oil at any point in the system must not exceed 180°. 120-140°F is generally considered optimum.
- In general terms; for continuous operation at ambient temperatures between 50 and 110°F, use SAE 20W; for continuous operation between 10 and 90°F, use SAE 10W; for applications colder than 10°F, contact the BRADEN Service Department. The use of multi-viscosity oils is generally not recommended.

## WIRE ROPE INSTALLATION

### **WARNING**

**THE CABLE ANCHORS ALONE ON HOISTS ARE NOT DESIGNED TO HOLD RATED LOADS.** Winch loads applied directly to the wire rope anchor may cause the wire rope to pull free and result in the sudden loss of load control and cause property damage, personal injury or death. A minimum of 3 wraps of wire rope must be left on the drum barrel to achieve rated load.

The wedge and anchor pocket must be clean and dry. The end of the wire rope being anchored to the drum must be clean and dry and not frayed. Anything on the end of the wire rope to keep it from fraying (i.e. tape or wire) must not be in contact with the wedge when the installation is complete. Consult the wire rope manufacturer on the proper treatment of the dead end of the wire rope. Some rope manufacturers recommend when using rotation resistant wire rope, that the rope end be seized, welded or brazed before inserting the wire rope into the wedge socket to pre-

vent core slippage or loss of rope lay.

Take the free end of the wire rope and insert it through the small opening on the cable drum. Loop the wire rope and push the free end about 3/4 of the way back through the pocket. Install the wedge as shown in figure 7, then pull the slack out of the wire rope. The "dead" end of the rope needs to extend slightly beyond the end of the wedge as shown in figure 8.

Using a hammer and brass drift, drive the wedge as deep into the pocket as possible to ensure it is fully seated and no further movement is detected. Applying a load on the wire rope will also help seat the wedge in the pocket.

Check to ensure the wedge does not protrude from either end of the pocket, causing it to interfere with proper spooling of wire rope onto the drum (see figures 9 & 10). If there is interference or the wedge does not seat firmly, contact the Braden Product Support Department at 918-251-8511 to determine the proper wedge size.

It is important that the wire rope have the proper tensioning when it is installed on the drum. When the wire rope is first installed, you should operate the hoist, with light to moder-

ate loads, with reeving that let's you place these loads on the block and the drum with all the rope off the drum except for the last three wraps.

### Correct Installation

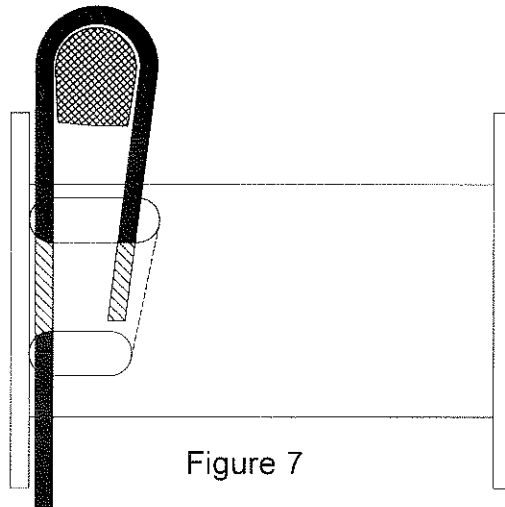


Figure 7

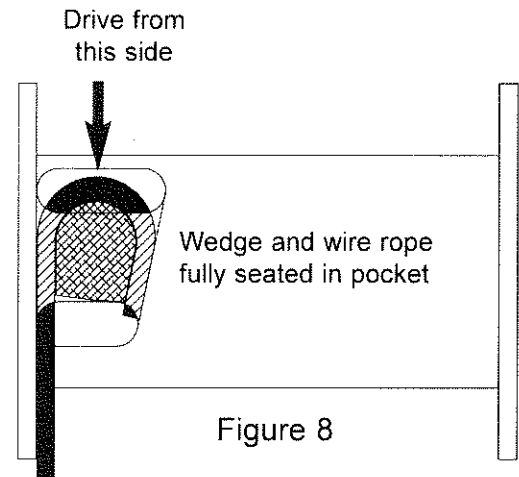
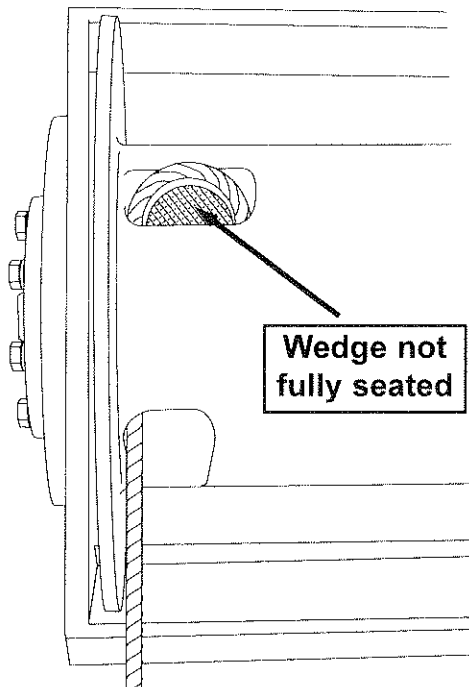


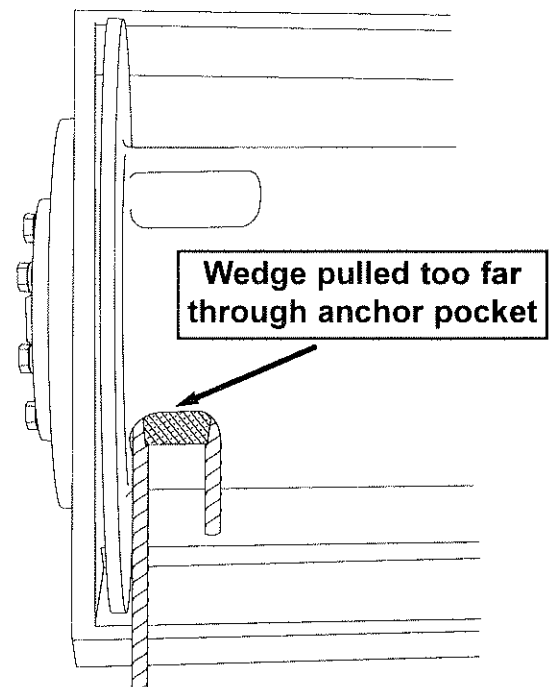
Figure 8

### Incorrect Installations



- Wire rope not tight against wedge
- Wedge may be too large

Figure 9



- "Dead" end of wire rope and/or wedge may interfere with proper spooling
- Wedge may be too small

Figure 10

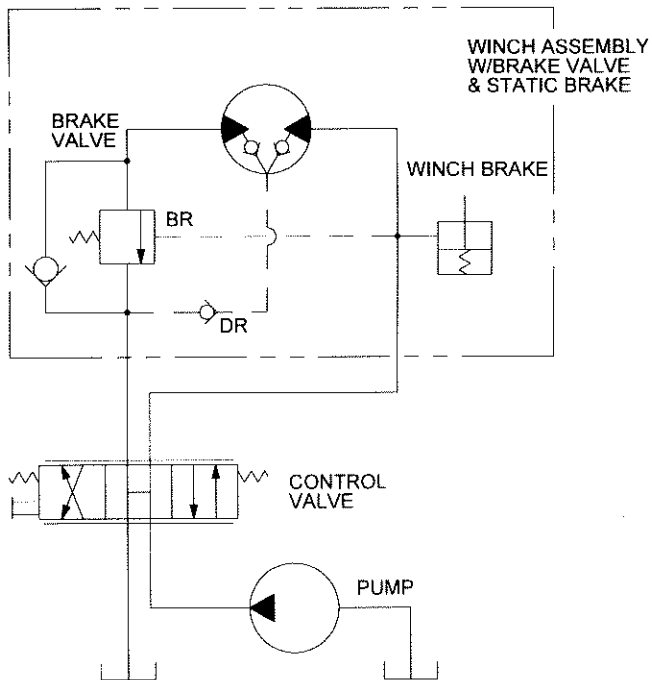
### WIRE ROPE WEDGE PART NUMBERS

<u>WINCH MODEL</u>	<u>WEDGE PART NO.</u>
CH240A .....	24494* for 7/8 thru 1 in. (22 - 25 mm); 24493 for 3/4 in. (19 mm)

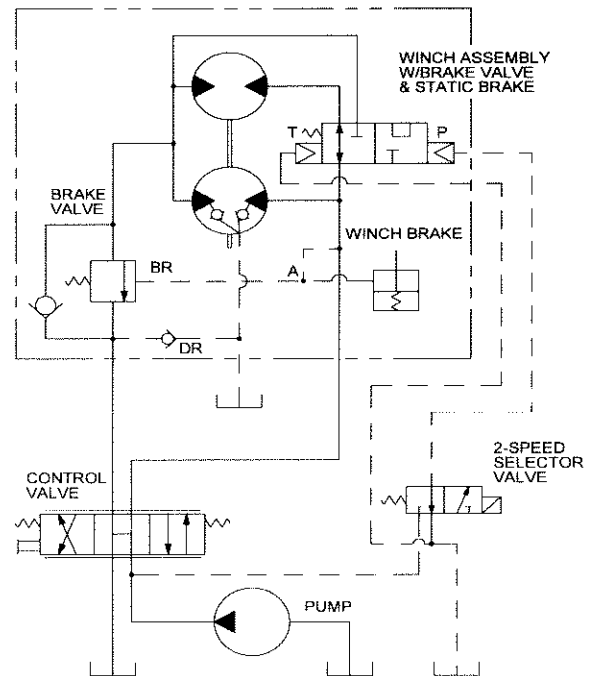
\* Standard Anchor

# HYDRAULIC CIRCUITS

## SINGLE SPEED CIRCUIT



## 2 SPEED CIRCUIT



## RECOMMENDED BOLT TORQUE

The general purpose torque shown in the chart applies to SAE Grade 5 bolts, studs and standard steel full, thick and high nuts.

Higher or lower torques for special applications will be specified such as the use of spanner nuts, nuts on shaft ends, jam nuts and where distortion of parts or gaskets is critical.

Lubricated torque values based on use of SAE 30wt engine oil applied to threads and face of bolt or nut.

Bolt Dia. Inches	Thds Per Inch	Torque LB-FT	
		Dry	Lubed
1/4	20 28	9	6
5/16	18 24	18	13
3/8	16 24	31	23
7/16	14 20	50	27
1/2	13 20	75	55
9/16	12 18	110	80
5/8	11 18	150	115

Bolt Dia. Inches	Thds Per Inch	Torque LB-FT	
		Dry	Lubed
3/4	10 16	265	200
7/8	9 14	420	325
1	8 14	640	485
1 1/8	7 12	790	590
1 1/4	7 12	1110	835
1 3/8	6 12	1460	1095
1 1/2	6 12	1940	1455

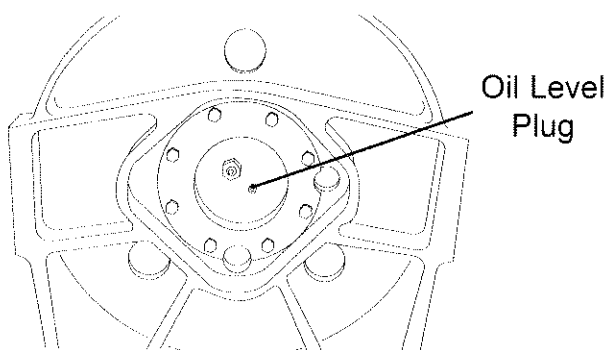
# PREVENTIVE MAINTENANCE

A regular program of preventive maintenance for your planetary winch is strongly recommended to minimize the need for emergency servicing and promote safe, reliable winch operation.

Field experience, supported by engineering tests, indicate the three (3) service procedures listed below are the **MOST** critical to safe, reliable winch operation and must be observed.

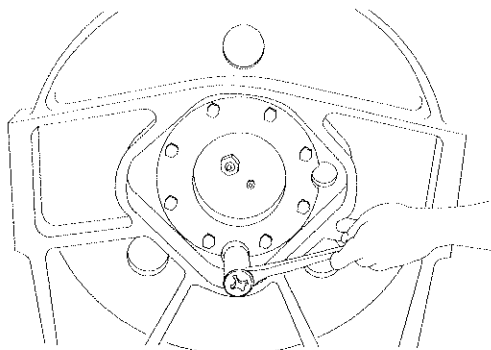
- **Regular Gear Oil Changes** – every 1000 hours or six (6) months
- **Use of Proper Gear Oil** – recommended type for prevailing ambient temperature
- **Annual Disassembly and Inspection of All Wear Items** – in compliance with American National Standards Institute (ANSI) specification B30.5c 1987 and American Petroleum Institute (API) recommended practice RP 2D section 3.

The following minimum service intervals are specified for operating hours of the prime mover.



## 1. Oil Level

The gear oil level should be checked every 500 operating hours or three (3) months, whichever occurs first. To check the oil level, remove the plug located in the drum support. The oil should be level with the bottom of this opening. If additional oil is needed, refer to "Recommended Planetary Gear Oil".



## 2. Oil Change

The gear oil should be changed after the first one hundred (100) hours of operation, then every 1,000 oper-

ating hours or six (6) months, whichever occurs first. The gear oil must be changed to remove wear particles that impede the reliable and safe operation of the brake clutch and erode bearings, gears and seals. Failure to change gear oil at these suggested minimum intervals may contribute to intermittent brake slippage which could result in property damage, severe personal injury or death.

The gear oil should also be changed whenever the ambient temperature changes significantly and an oil from a different temperature range would be more appropriate. Oil viscosity with regard to ambient temperature is critical to reliable brake clutch operation. Our tests indicate that excessively heavy or thick gear oil may contribute to intermittent brake clutch slippage. Make certain that the gear oil viscosity used in your winch is correct for your prevailing ambient temperature. Failure to use the proper type and viscosity of planetary gear oil may contribute to brake clutch slippage which could result in property damage, severe personal injury or death. Refer to "Recommended Planetary Gear Oil" for additional information.

## 3. Vent Plug

The vent plug is located in the drum support as shown. It is very important to keep this vent clean and unobstructed. Whenever gear oil is changed, remove vent plug, clean in solvent and reinstall.

Do not paint over the vent or replace with a solid plug.

## 4. Hydraulic System

The original filter element should be replaced after the first fifty (50) hours of operation, then every 500 operating hours or three (3) months, or in accordance with the equipment manufacturer's recommendations.

## 5. Wire Rope

Inspect entire length of wire rope according to wire rope manufacturers recommendations.



## 6. Mounting Bolts

Tighten all winch base mounting bolts to recommended torque after the first one hundred (100) hours of operation, then every 1000 operating hours or six (6) months, whichever occurs first.

## 7. Warm-up Procedures

A warm-up procedure is recommended at each start-up and is essential at ambient temperatures below +40°F (4°C).

The prime mover should be run at its lowest recommended RPM with the hydraulic winch control valve in neutral allowing sufficient time to warm up the system. The winch should then be operated at low speeds, forward and reverse, several times to prime all lines with warm hydraulic oil, and to circulate gear lubricant through the planetary gear sets.

### ⚠ WARNING ⚠

Failure to properly warm up the winch, particularly under low ambient temperature conditions, may result in temporary brake slippage due to high back pressures attempting to release the brake, which could result in property damage, severe personal injury or death.

## 8. Recommended Planetary Gear Oil

Field experience, supported by extensive engineering tests, indicates the use of the proper planetary gear oil is essential to reliable and safe operation of the brake clutch and obtaining long gear train life.

### ⚠ WARNING ⚠

Failure to use the proper type and viscosity of planetary gear oil may contribute to intermittent brake clutch slippage which could result in property damage, severe personal injury or death. Some gear lubricants contain large amounts of EP (extreme pressure) and anti-friction additives which may contribute to brake

clutch slippage and damage to brake friction discs or seals. Oil viscosity with regard to ambient temperature is also critical to reliable brake clutch operation. Our tests indicate that excessively heavy or thick gear oil may contribute to intermittent brake clutch slippage. Make certain that the gear oil viscosity used in your winch is correct for your prevailing ambient temperature.

For simplicity, BRADEN has listed one (1) readily available product in each temperature range which has been tested and found to meet our specifications. This is not to say that other lubricant brands would not perform equally as well.

If the following lubricant brands are not available in your area, make certain your lubricant vendor supplies you with oil that is equivalent to those products listed below.

BRADEN planetary winches are factory filled with Texaco Meropa 150 or equivalent API GL-2/3 gear oil.

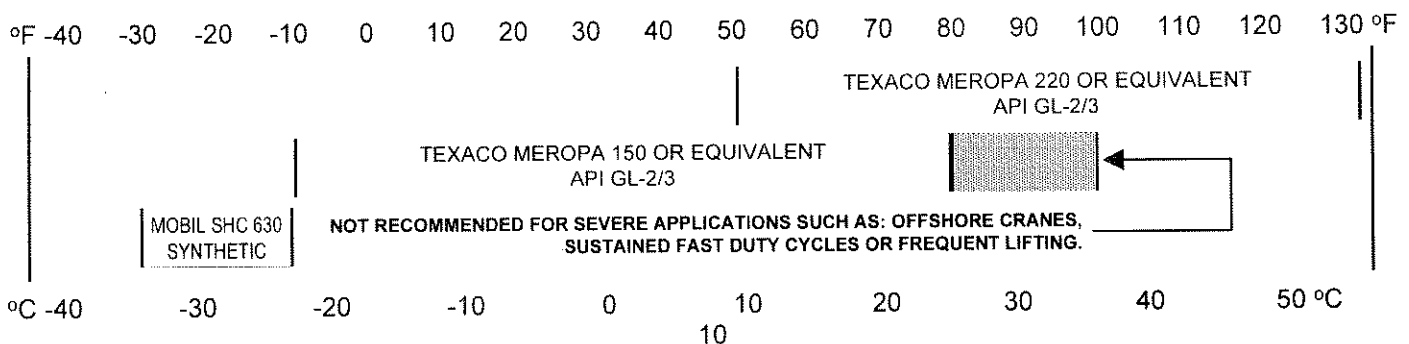
## 9. Inspection

In compliance with ANSI specification number B30.5c1987 and API Recommended Practice RP 2D section 3, we recommend that the winch be disassembled for a thorough inspection of all wear items every 2,000 hours of operation or twelve (12) months, whichever occurs first.

- A. **Bearings and Gears** – Refer to DISASSEMBLY OF WINCH, item 17 on page 19; and PLANET CARRIER SERVICE, item 3 on page 20.
- B. **Brake Cylinder** – Refer to MOTOR SUPPORT – BRAKE CYLINDER SERVICE, Clean and Inspect, pages 22 and 23.
- C. **Brake Clutch** – Refer to BRAKE CLUTCH SERVICE, item 4 on page 26.

## RECOMMENDED GEAR OIL

### PREVAILING AMBIENT TEMPERATURE



# TROUBLE SHOOTING

## ⚠ WARNING ⚠

If a winch ever exhibits any sign of erratic operation, or load control difficulties (i.e. load creeping or chattering) appropriate troubleshooting tests and repairs should be performed immediately. Continued operation in this manner may result in property damage, serious personal injury or death.

TROUBLE	PROBABLE CAUSE	REMEDY
<p style="text-align: center;"><b>A</b></p> <p>The winch will not lower the load or not lower the load smoothly.</p>	<p>1. The problem could be a plugged or loose pilot orifice. The pilot orifice is a small pipe plug with a hole drilled through it, located behind the pilot port fitting on the brake valve. If it becomes plugged, it will prevent the pilot pressure, from the manifold, from opening the brake valve. If it becomes loose, it will allow an unregulated amount of oil in to operate the brake valve which cause erratic brake valve operation.</p>	<p>Remove the pilot hose and fitting from the brake valve, then use a 5/32 inch Allen wrench to remove the pilot orifice. The diameter of the orifice is approximately .020 inches. Clean and install the pilot orifice tightly in the brake valve.</p>
	<p>2. The friction brake may not be releasing as a result of a defective brake cylinder seal.</p> <p>NOTE: If the brake cylinder seal is defective you will usually find oil leaking from the winch vent plug.</p>	<p>Check brake cylinder seal as follows:</p> <p>A. Disconnect the swivel tee from the brake release port. Connect a hand pump with accurate 0-2000 psi gauge and shut-off valve to the -4 J.I.C. fitting in the brake release port.</p> <p>B. Apply 1000 psi to the brake. Close shut-off valve and let stand for five (5) minutes.</p> <p>C. If there is any loss of pressure in five (5) minutes, the brake cylinder should be disassembled for inspection of the sealing surfaces and replacement of the seals. Refer to "Motor Support-Brake Cylinder Service".</p>
	<p>3. Friction brake will not release as a result of damaged brake discs.</p>	<p>Disassemble brake to inspect brake discs. Check stack-up height as described in "Motor Support-Brake Cylinder Service".</p>

TROUBLE	PROBABLE CAUSE	REMEDY
<p style="text-align: center;"><b>B</b></p> <p>Oil leaks from vent plug.</p>	<ol style="list-style-type: none"> <li>1. Same as A2.</li> <li>2. Motor seal may be defective as a result of high system back pressure or contaminated oil.</li> </ol>	<p>Same as A2.</p> <p>System back pressure must not exceed 150 psi. Inspect hydraulic system for a restriction in the return line from the control valve to the reservoir. Be sure control valve and plumbing is properly sized to winch motor.</p> <p>Oil analysis may indicate contamination has worn motor shaft and seal. Thoroughly flush entire hydraulic system and install new filters and oil. Install new motor seal.</p>
<p style="text-align: center;"><b>C</b></p> <p>The brake will not hold a load with the control lever in neutral.</p>	<ol style="list-style-type: none"> <li>1. Excessive system back pressure acting on the brake release port.</li> <li>2. Friction brake will not hold due to worn or damaged brake discs.</li> <li>3. Brake clutch is slipping.</li> </ol>	<p>The same as Remedy 2 of Trouble B2.</p> <p>Same as Remedy 3 of Trouble A3.</p> <p>Improper planetary gear oil may cause the brake clutch to slip. Drain old gear oil and flush winch with solvent. Thoroughly drain solvent and refill winch with recommended planetary gear oil listed in "Preventive Maintenance".</p> <p>Brake clutch may be damaged or worn. Disassemble and inspect brake clutch as described in "Brake Clutch Service".</p>
<p style="text-align: center;"><b>D</b></p> <p>The winch will not hoist the rated load</p>	<ol style="list-style-type: none"> <li>1. The winch may be mounted on an uneven or flexible surface which causes distortion of the winch base and binding of the gear train. Binding in the gear train will absorb horsepower needed to hoist the rated load and cause heat.</li> <li>2. System relief valve may be set too low. Relief valve needs adjustment or repair.</li> </ol>	<p>Reinforce mounting surface.</p> <p>If necessary, use shim stock to level winch. Refer to "Winch Installation".</p> <p>First loosen, then evenly retighten all winch mounting bolts to recommended torque.</p> <p>Check relief pressure as follows:</p> <p>A. Install an accurate 0-4000 psi gauge into the inlet port of the brake valve.</p>

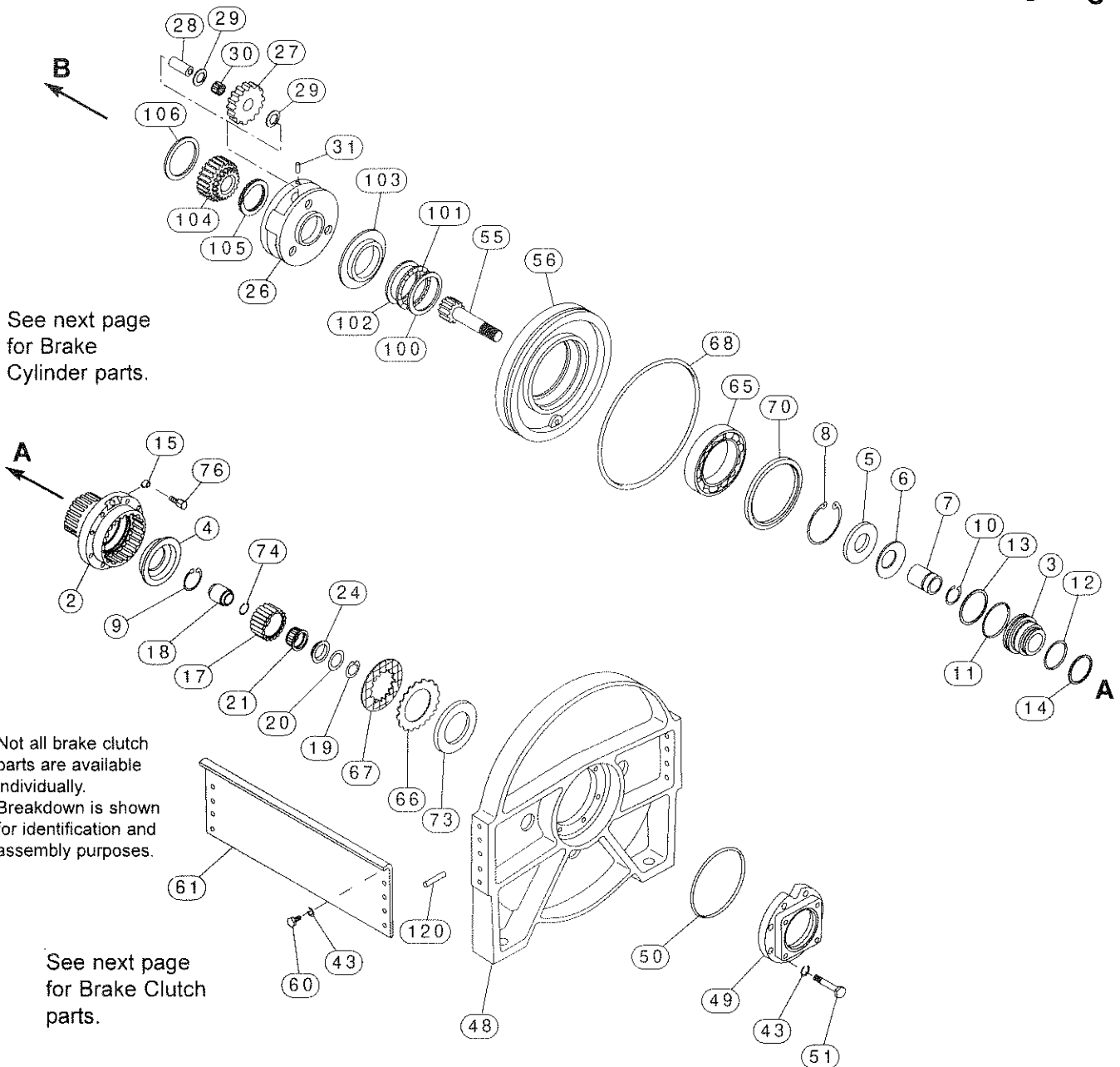
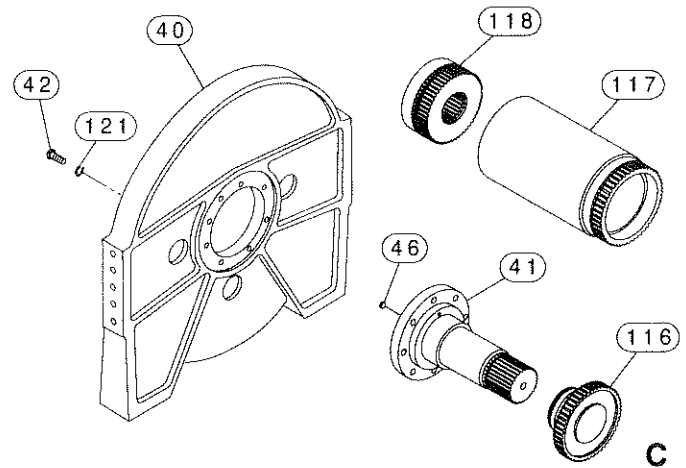
TROUBLE	PROBABLE CAUSE	REMEDY
TROUBLE "D" CONTINUED FROM PREVIOUS PAGE	<p>3. Be certain hydraulic system temperature is not more than 180 degrees F. Excessive hydraulic oil temperatures increase motor internal leakage and reduce motor performance.</p> <p>4. Winch line pull rating is based on 1<sup>st</sup> layer of wire rope.</p> <p>5. Rigging and sheaves not operating efficiently.</p>	<p>B. Apply a stall pull load on the winch while monitoring pressure.</p> <p>C. Compare gauge reading to winch specifications. Adjust relief valve as required.</p> <p>NOTE: If pressure does not increase in proportion to adjustment, relief valve may be contaminated or worn out. In either case, the relief valve may require disassembly or replacement.</p> <p>Same as remedies for Trouble D1 &amp; D2.</p> <p>Same as remedies for Trouble E2.</p> <p>Refer to winch performance charts for additional information.</p> <p>Perform rigging service as recommended by crane manufacturer.</p>
<p><b>E</b></p> <p>The winch runs hot.</p>	<p>1. Same as D1.</p> <p>2. Be certain that the hydraulic system temperature is not more than 180 degrees F. Excessive hydraulic oil temperatures may be caused by:</p> <p>A. Plugged heat exchanger.</p> <p>B. Too low or too high oil level in hydraulic reservoir.</p> <p>C. Same as D2.</p> <p>D. Hydraulic pump not operating efficiently.</p> <p>3. Excessively worn or damaged internal winch parts.</p>	<p>Same as remedies for Trouble D1.</p> <p>Thoroughly clean exterior and flush interior.</p> <p>Fill/drain to proper level.</p> <p>Same as remedies for Trouble D2.</p> <p>Prime mover low on horsepower or R.P.M. Tune/adjust prime mover.</p> <p>Check suction line for damage.</p> <p>If pump is belt driven, belts are slipping. Replace/tighten belts.</p> <p>Pump worn. Replace pump.</p> <p>Disassemble winch to inspect/replace worn parts.</p>

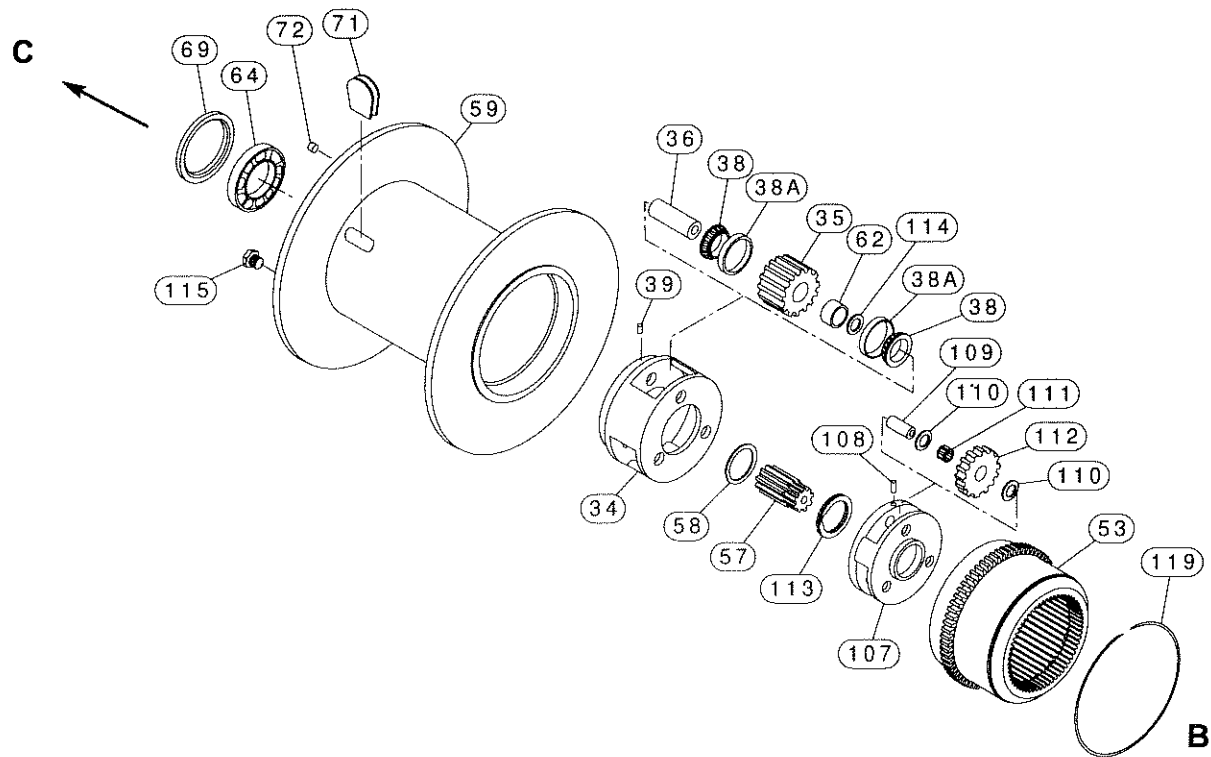
TROUBLE	PROBABLE CAUSE	REMEDY
<p style="text-align: center;"><b>F</b></p> <p>Winch "chatters" while raising rated load.</p>	<ol style="list-style-type: none"> <li>1. Same as D2.</li> <li>2. Hydraulic oil flow to motor may be too low.</li> <li>3. Controls being operated too quickly.</li> </ol>	<p>Same as remedies for Trouble D2.</p> <p>Same as remedies for Trouble E2.</p> <p>Conduct operator training as required.</p>
<p style="text-align: center;"><b>G</b></p> <p>The wire rope does not spool smoothly on the drum.</p>	<ol style="list-style-type: none"> <li>1. The winch may be mounted too close to the main sheave, causing the fleet angle to be more than 1½ degrees.</li> <li>2. The winch may not be mounted perpendicular to an imaginary line between the center of the cable drum and the first sheave.</li> <li>3. Could possibly be using the wrong lay rope. There is a distinct advantage in applying rope of the proper direction of lay. When the load is slacked off, the several coils on the drum will stay closer together and maintain an even layer. If rope of improper lay is used, the coils will spread apart each time the load is removed. Then, when winding is resumed, the rope has a tendency to criss-cross and overlap on the drum. The result is apt to be a flattened and crushed rope.</li> <li>4. The winch may have been overloaded, causing permanent set in the wire rope.</li> </ol>	<p>Check mounting distance and fleet angle. Reposition winch as required.</p> <p>Refer to "Winch Installation".</p> <p>Consult wire rope manufacturer for recommendation of wire rope that best suits your application.</p> <p>Replace wire rope and conduct operator/rigger training as required.</p>

# BRADEN CH240 COMPONENTS

PARTS KEY		
ITEM	DESCRIPTION	QTY.
115	Sight Gauge	1
116	Output Adapter	1
117	Bearing Support Extension	1
118	Coupling	1
119	Internal Retaining Ring	1
120	Dowel Pin	8
121	Lockwasher (5/8)	8

NOTE: item 116 used with 01 drum only  
items 117 & 118 used with 02 drum only





PARTS KEY		
ITEM	DESCRIPTION	QTY.
26	Primary Planet Carrier	1
27	Primary Planet Gear	3
28	Primary Planet Gear Shaft	3
29	Thrust Washer	6
30	Loose Rollers	51
31	Rollpin	3
34	Output Planet Carrier	1
35	Output Planet Gear	3
36	Output Planet Gear Shaft	3
38	Bearing Cone	6
38A	Bearing Cup	6
39	Rollpin	3
40	Support End Plate	1
41	Bearing Support	1
42	Capscrew (5/8 - 18 X 2 1/4 Gr 8)	8
43	Lockwasher (1/2)	32
46	Vent Plug	1
48	Motor End Plate	1
49	Motor Adapter	1
50	O-Ring	1
51	Capscrew (3 in. Special)	8
53	Ring Gear	1
55	Primary Sun Gear	1
56	Cable Drum Closure	1
57	Output Sun Gear	1
58	Thrust Washer	1
59	Cable Drum	1
60	Capscrew (1/2 - 13 X 1 1/2 Gr 5)	24

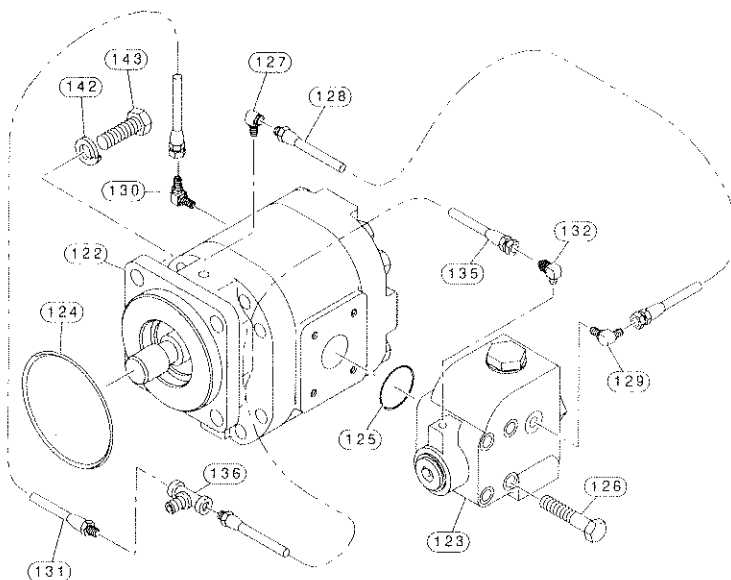
PARTS KEY		
ITEM	DESCRIPTION	QTY.
61	Tie Plate	2
62	Bearing Spacer	3
64	Bearing	1
65	Bearing	1
66	Brake Disc	10
67	Friction Disc	9
68	O-Ring	1
69	Oil Seal	1
70	Oil Seal	1
71	Cable Wedge (3/4 - 1)	1
72	Plug	1
73	Brake Plate Spacer	1
76	Nipple	1
100	Thrust Bearing Race (.09 thick)	1
101	Thrust Bearing	1
102	Thrust Bearing Race (.06 thick)	1
103	Spacer	1
104	Second Stage Sun Gear	1
105	External Retaining Ring	1
106	Thrust Washer	1
107	Second Stage Planet Carrier	1
108	Rollpin	3
109	Second Stage Planet Gear Shaft	3
110	Thrust Washer	6
111	Loose Roller	42
112	Second Stage Planet Gear	3
113	External Retaining Ring	1
114	Internal Retaining Ring	1

BRAKE CYLINDER ASSEMBLY	
ITEM	DESCRIPTION
2	Brake Cylinder
3	Brake Piston
4	Brake Piston Plate
5	Backup Plate
6	Belleville Spring
7	Spring Guide
8	Retaining Ring
9	Snap Ring
10	Snap Ring
11	O-Ring
12	O-Ring
13	Backup Ring
14	Backup Ring
15	Street Elbow - 45°

O-RING AND SEAL KIT	
ITEM	DESCRIPTION
11	Brake Piston O-Ring
12	Brake Piston O-Ring
13	Backup Ring
14	Backup Ring
50	O-Ring
68	Drum Closure O-Ring
69/70	Drum Seals
124	Motor O-Ring

OVER-RUNNING BRAKE CLUTCH ASSY.	
ITEM	DESCRIPTION
17	Outer Brake Race*
18	Inner Brake Race*
19	Snap Ring
20	Sprag Bearing Retainer
21	Sprag Clutch*
24	Sprag Bearing
74	Retaining Ring

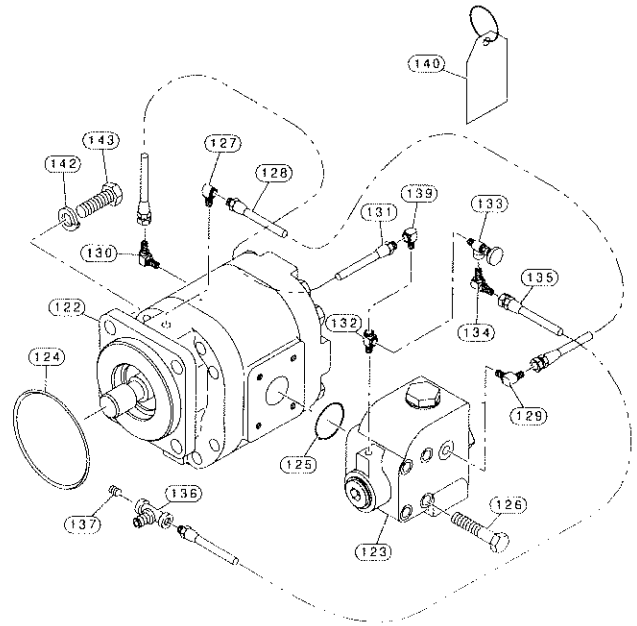
\* NSS - Not Serviced Separately. Order complete brake clutch assembly no. 81644.



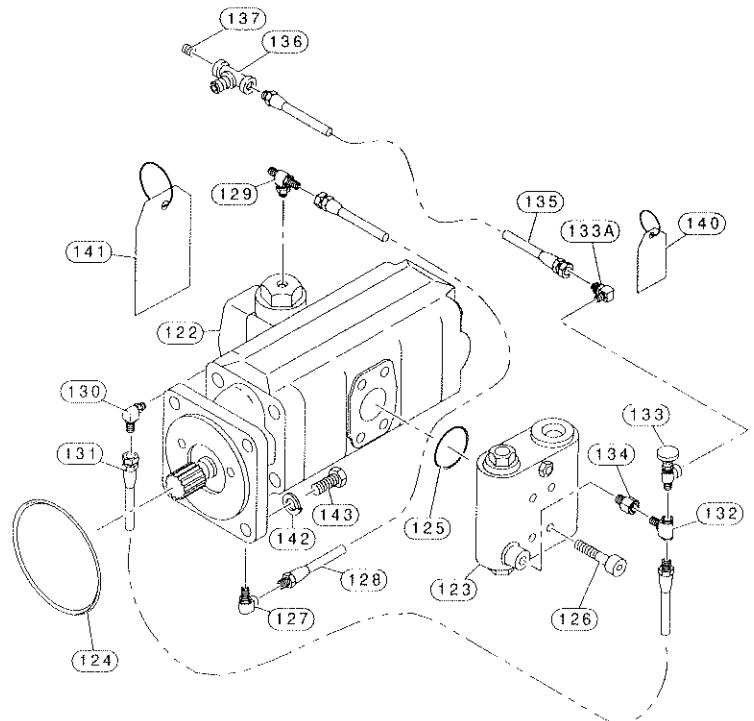
SINGLE SPEED MOTOR SUB-ASSEMBLY	
ITEM	DESCRIPTION
122	Hydraulic Motor 090
	Hydraulic Motor 110
	Hydraulic Motor 120
123	Brake Valve
124	O-Ring
125	O-Ring
126	Capscrew (1/2-13 X 4 1/2)
127	Reducer Elbow Fitting
128	Hose Assembly
129	Elbow Fitting
130	Elbow Fitting
131	Hose Assembly
132	Elbow Fitting
135	Hose Assembly
136	Tee Fitting
142	Lockwasher (1/2)
143	Capscrew (1/2-13 X 1 1/2)



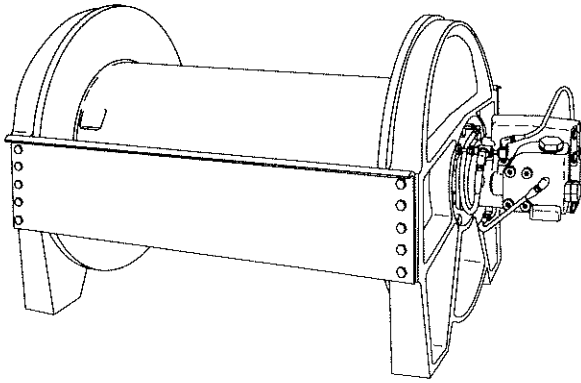
SINGLE SPEED MOTOR	
SUB-ASSEMBLY (-1)	
ITEM	DESCRIPTION
122	Hydraulic Motor 090
	Hydraulic Motor 110
	Hydraulic Motor 120
123	Brake Valve
124	O-Ring
125	O-Ring
126	Capscrew (1/2-13 X 4 1/2)
127	Reducer Elbow Fitting
128	Hose Assembly
129	Elbow Fitting
130	Elbow Fitting
131	Hose Assembly
132	Tee Fitting
133	Needle Valve
134	Tee Fitting
135	Hose Assembly
136	Tee Fitting
137	Plug
139	Elbow Fitting
140	Warning Tag (needle valve)
142	Lockwasher (1/2)
143	Capscrew (1/2-13 X 1 1/2)



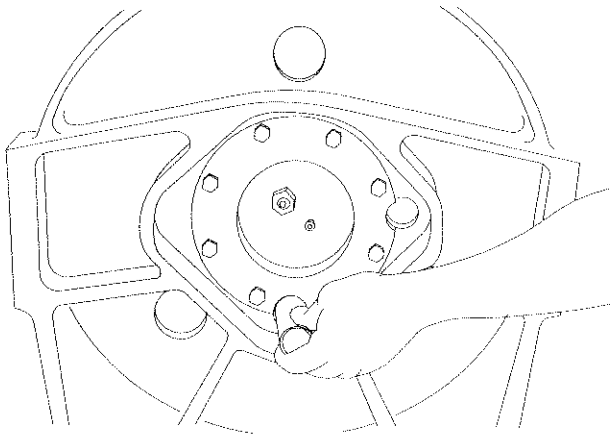
TWO SPEED MOTOR	
SUB-ASSEMBLY (-1)	
ITEM	DESCRIPTION
122	Hydraulic Motor 128/064
123	Brake Valve
124	O-Ring
125	O-Ring
126	Capscrew (7/16 - 14 X 3)
127	Reducer Elbow Fitting
128	Hose Assembly
129	Tee Fitting
130	Elbow Fitting
131	Hose Assembly
132	Tee Fitting
133	Needle Valve
133A	Elbow Fitting
134	Adapter Fitting
135	Hose Assembly
136	Tee Fitting
137	Plug
140	Warning Tag (needle valve)
141	Warning Tag (case drain)
142	Lockwasher (1/2)
143	Capscrew (1/2-13 X 1 1/2)



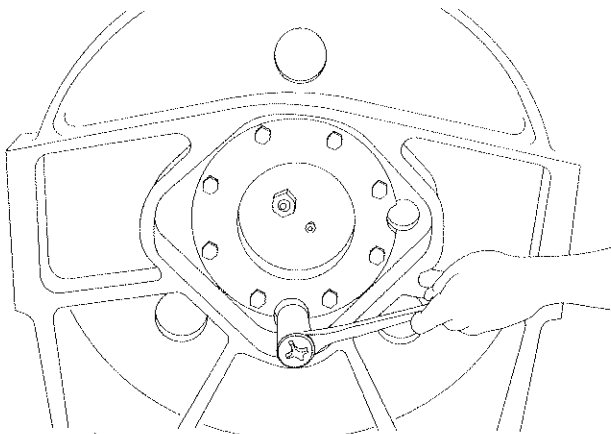
## DISASSEMBLY PROCEDURE FOR HOIST



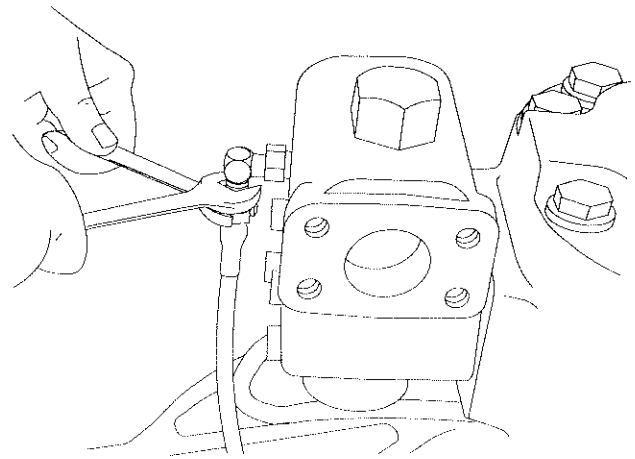
1. Remove the wire rope from the hoist drum and align the drain plug in the drum with the hole in the support end plate before removing the hoses and mounting bolts. After the hoist is removed from its mounting, clean the outside surfaces.



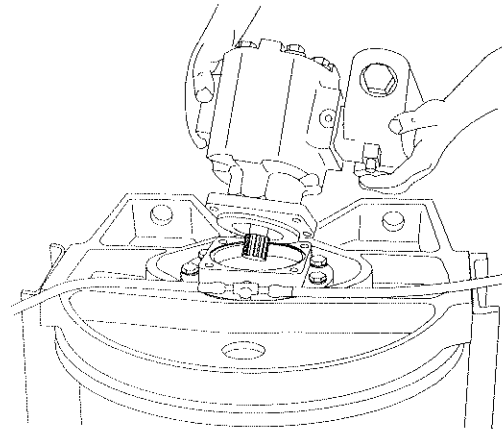
2. To drain the oil, screw a short piece of 1" pipe into the larger threads of the drain hole.



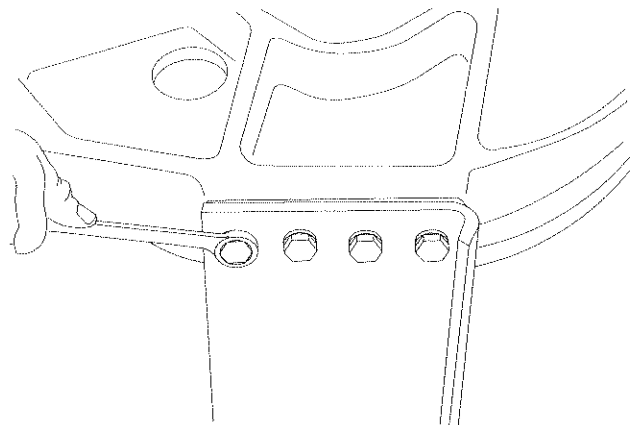
3. Use a 3/8" drive extension to remove the drain plug through the pipe. If the drain holes were not aligned before the hoist was removed from its mounting, the oil can be drained through the fill/vent plug in the bearing support by turning the hoist up on the bearing support end.



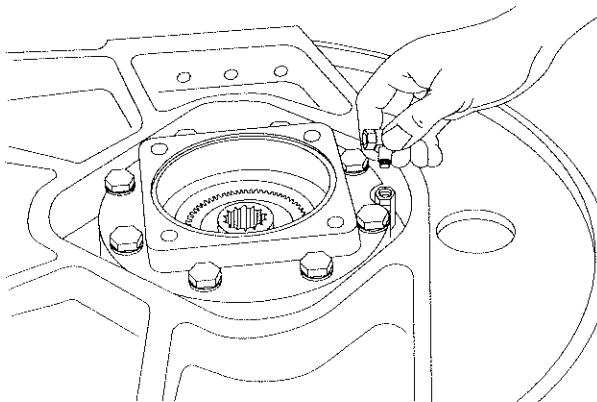
4. Begin the disassembly by standing the hoist on the end opposite the motor. Tag and remove the hydraulic hoses that connect the brake valve and the motor (manifold in the case of a two-speed motor) to the brake release port.



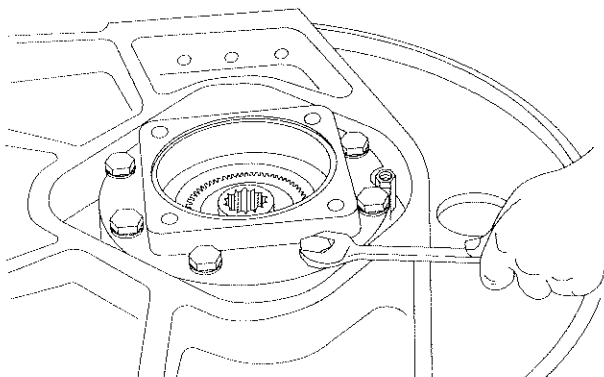
5. Remove the four (4) capscrews and lockwashers securing the motor and lift the motor off the hoist. Remove and discard the O-ring installed on the outside of the motor pilot.



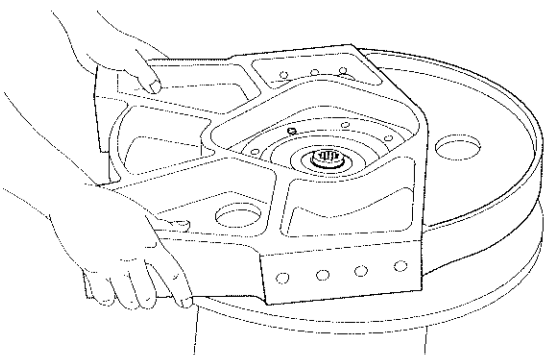
6. Remove the sixteen (16) capscrews and lockwashers from the two (2) tie plates, and remove the plates.



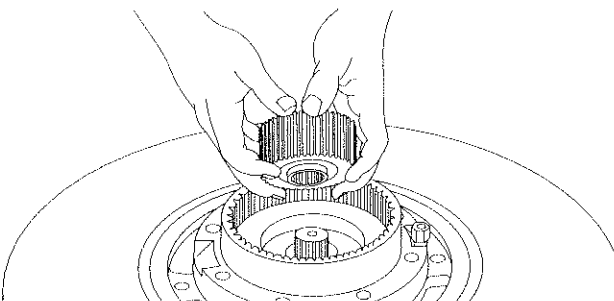
7. Remove the tee fitting from the brake cylinder nipple.



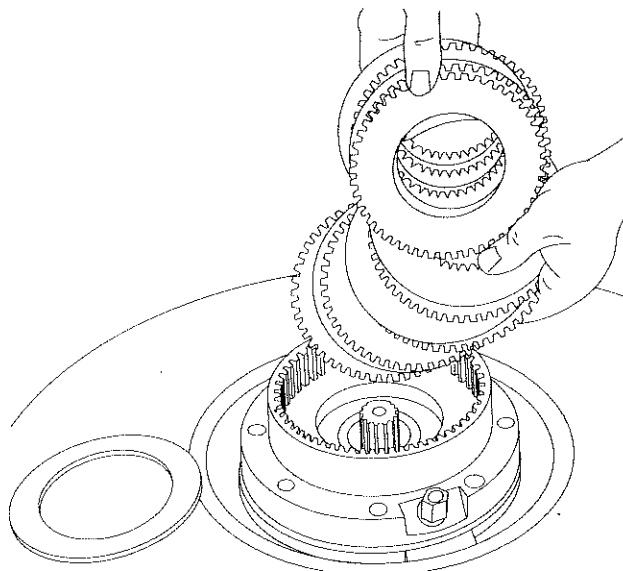
8. Remove the eight (8) capscrews and lockwashers from the motor adapter, and remove the motor adapter. Remove and discard the O-ring that was under the motor adapter.



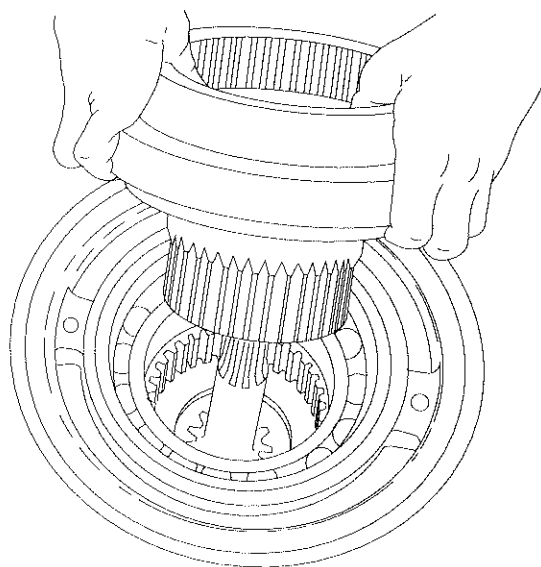
9. Remove the brake cylinder nipple, then remove the motor end plate. Be careful not to damage the hydraulic fitting located in the brake housing.



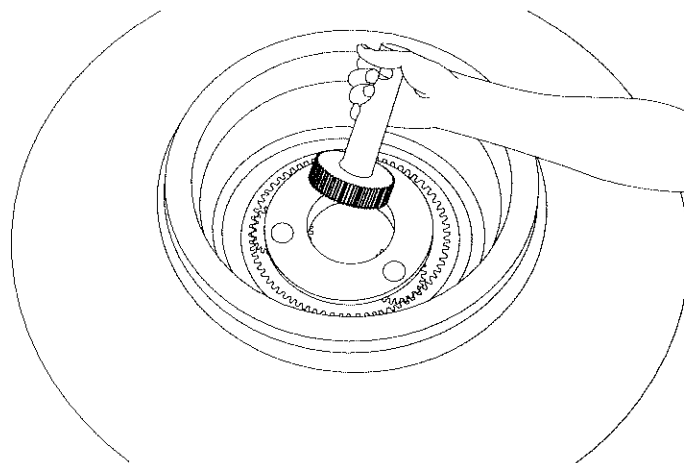
10. Remove the brake clutch assembly from the brake cylinder. Refer to the section on disassembly of the brake clutch assembly.



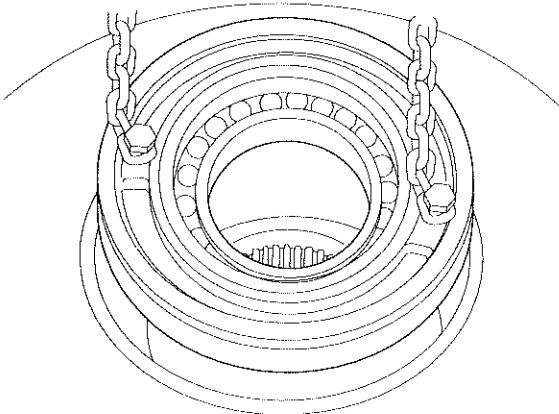
11. Remove the brake plate spacer and brake and friction discs.



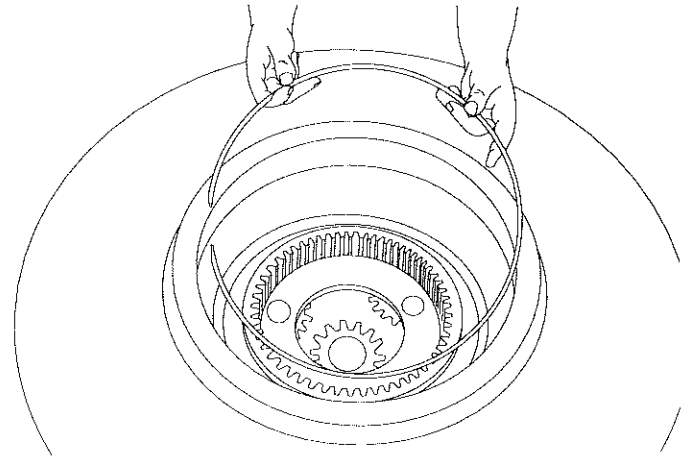
12. Remove the brake cylinder assembly, and place it on a clean, dry surface so as not to damage the splines. Refer to the section on disassembly of the brake cylinder assembly.



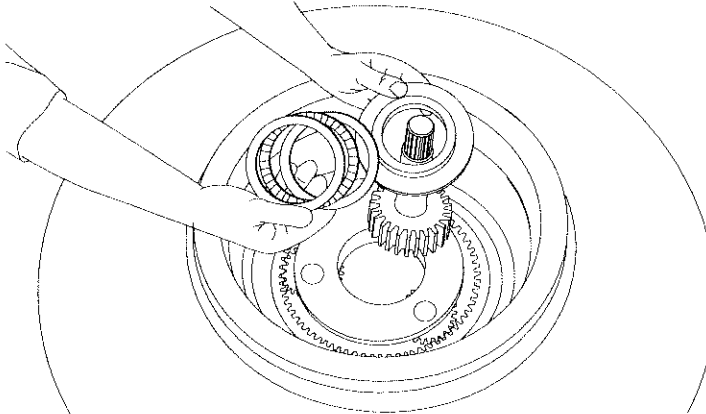
13. Next, remove the primary sun gear.



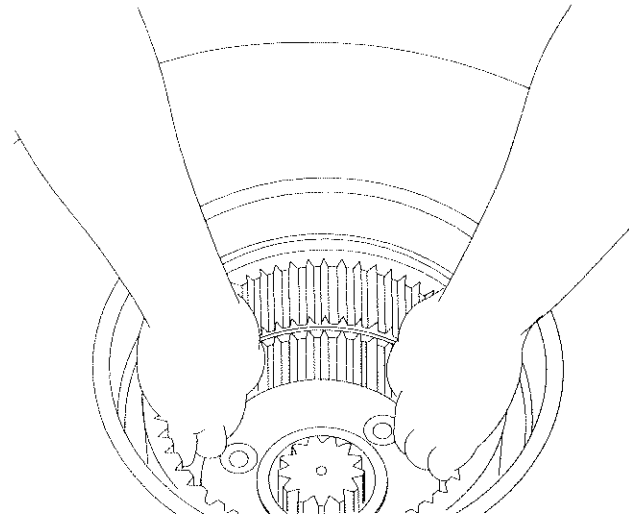
14. Remove the cable drum closure by using two (2) cap screws from the motor adapter and a short piece of chain. Lift the closure out of the drum. Remove and discard the O-ring and the seal. Inspect the bearing for wear. If replacement is necessary, use a bearing driver to remove the bearing.



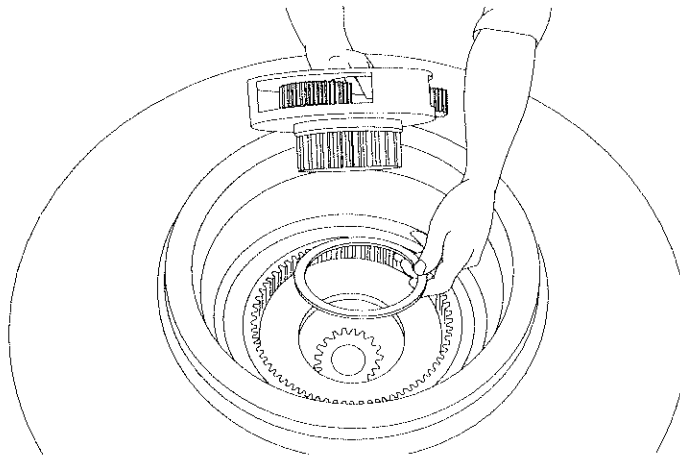
17. Remove the snap ring from the cable drum.



15. Remove the thrust bearing and two (2) races. Remove the spacer that locates the thrust bearing assembly.



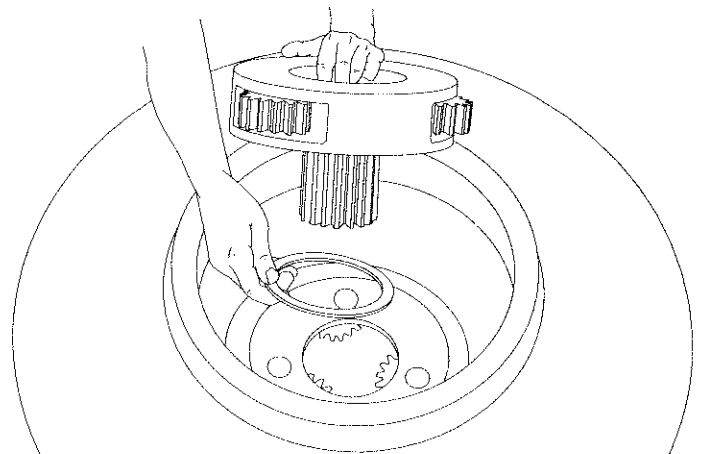
18. Lift out the ring gear. Inspect the gear for abnormal wear or pitting.



16. Lift the primary planet assembly out of the ring gear.

*NOTE: The second stage sun gear is held in the primary planet carrier with a retaining ring and will lift out with the primary planet assembly.*

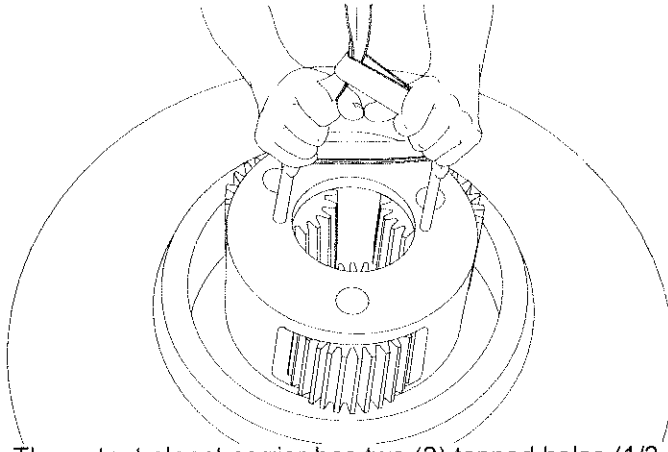
If the thrust washer between the primary and second stage planet assemblies stayed in the winch, remove it and set it aside with the primary planet carrier. Refer to the section of Disassembly of Planet Carrier.



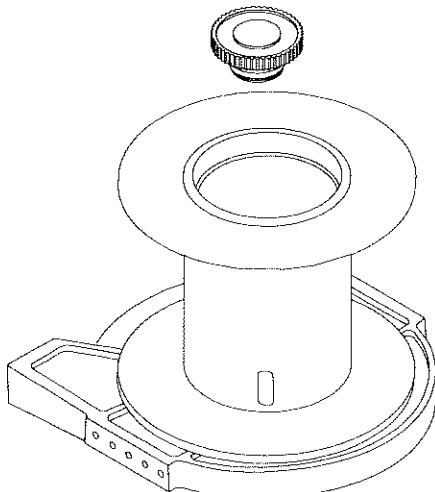
19. Lift the second stage planet assembly out of the drum. The output sun gear is held in the second stage planet carrier with a retaining ring and will lift out with the carrier assembly. If the thrust washer which is between the secondary and output planet carrier assemblies stayed in the winch, remove and set it aside with the second stage planet assembly.

## ⚠ CAUTION ⚠

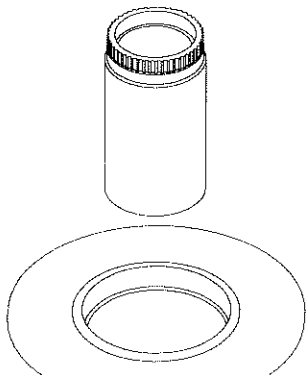
In the following step, the output adapter on long drum CH240 units may lift out with the output planet assembly and drop unexpectedly.



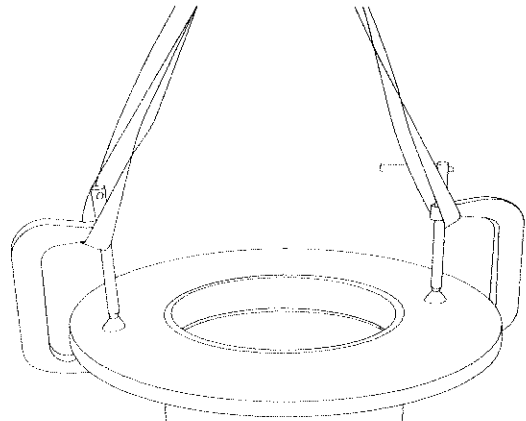
20. The output planet carrier has two (2) tapped holes (1/2-13) which can be used to lift the assembly out of the ring gear. Thread two (2) eye bolts into these holes and use them to lift the output planet assembly out of the drum. Due to the weight of the assembly, install a piece of chain of a lifting strap between the eyebolts and use a small hoist if one is available.



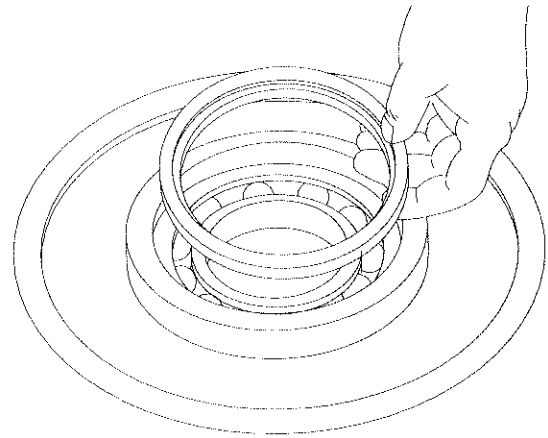
21. Remove the output adapter from the bearing support splines. (units with 01 drum only)



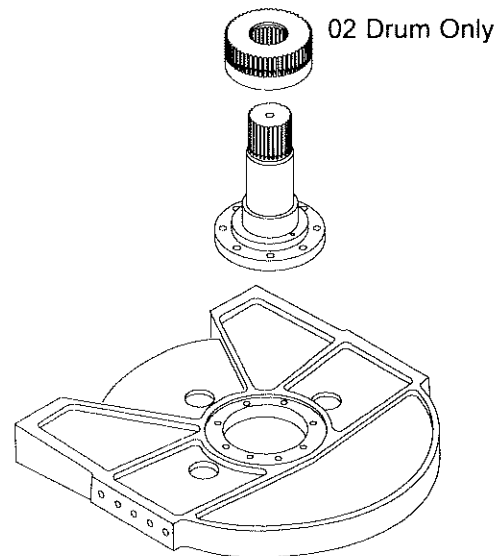
23. On CH240 Models with the 02 drum remove the bearing support extension.



23. Lift the drum off the support end plate.

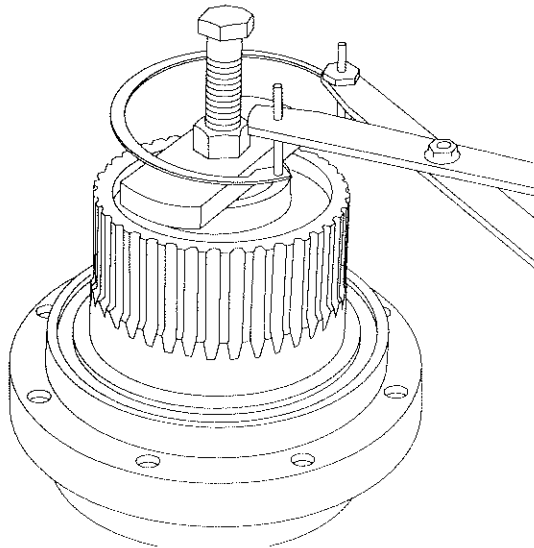


24. Turn the drum over and remove and discard the seal. Inspect the bearing in the end of drum. If replacement is necessary, use a bearing driver to remove the bearing.



25. On models with the 02 drum, there is a coupling between the bearing support and bearing support extension, as shown above. Check the bearing support sealing surface for nicks and burrs. It is not necessary to remove the bearing support from the support end plate unless it has been damaged.

## BRAKE CYLINDER SERVICE

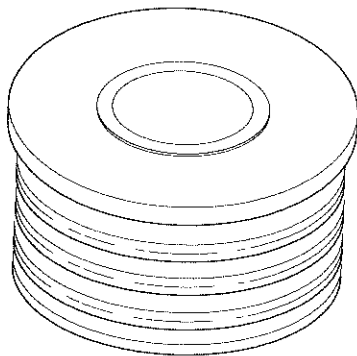


1. Turn the brake cylinder on end with the large end down. Use the special compression tool or a shop press to compress the backup plate in order to remove the retaining ring.

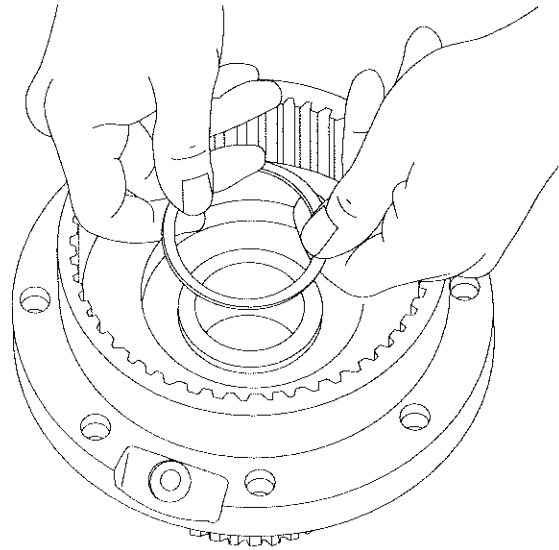
### **CAUTION**

Make certain that the threaded rod of the compression tool fully engages the lower plate. If a press is used, be careful not to damage any parts by applying too much pressure.

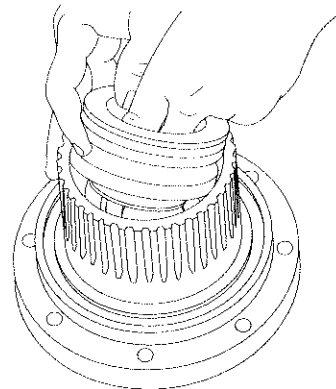
Remove the retaining ring with snap ring pliers. Be careful to not let the pliers slip out of the retaining ring. Release the compression tool by holding the threaded rod stationary while backing off the nut.



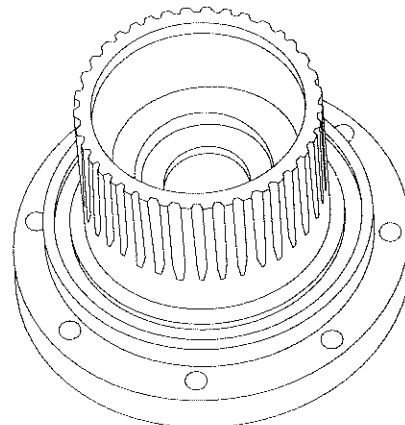
2. Remove the spring guide. The backup plate, belleville springs and spring guide will come out together. Closely inspect the spring guide for damage that might prevent the springs from moving freely in an axial direction. Also inspect the springs for cracks and material displacement. Replace any defective parts.



3. Turn the brake cylinder over. Remove the spiral retaining ring and lift out the brake piston plate.

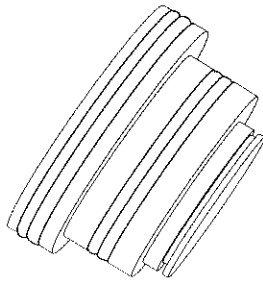


4. Turn the brake cylinder over again and pull the piston out. Remove and discard the O-rings. Inspect the backup rings for nicks or cuts, and replace if necessary. Be careful not to damage the O-ring groove surfaces.

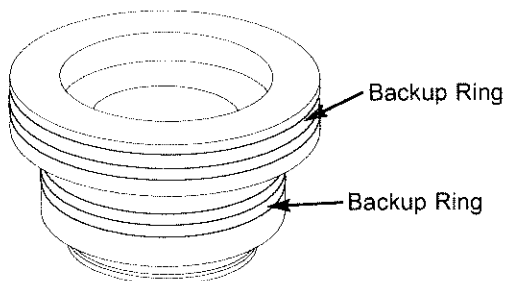


5. Inspect the brake cylinder for nicks and scratches on the O-ring sealing area. Check the internal splines for notches that might prevent the brake discs from sliding freely. Be careful not to damage the O-ring sealing surfaces.

## BRAKE CYLINDER ASSEMBLY

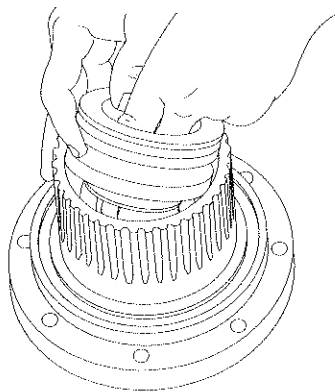


1. Lubricate O-rings and backup rings with oil and install them on the brake piston. The concave surface of the backup ring must be next to the O-ring. Let the assembly set for 10 minutes in order for the O-rings and backup rings to return to their original shape.

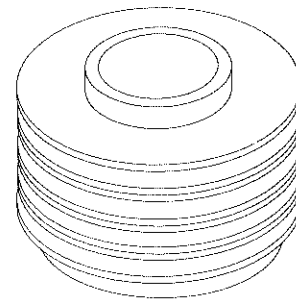


2. Here are the backup rings and O-rings installed correctly. The backup rings must be to the outside of the O-rings.

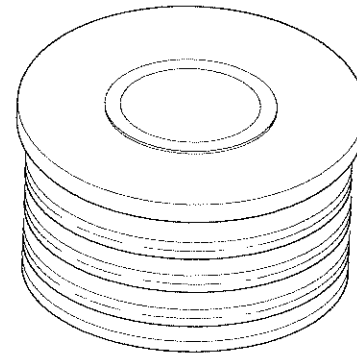
3. Lubricate the outside of the piston with oil or grease.



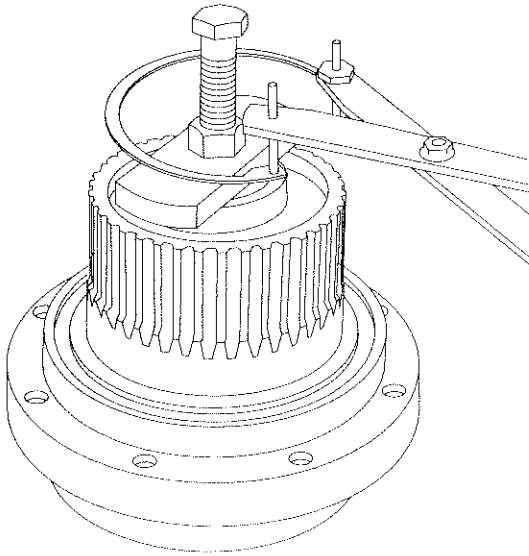
4. With the brake cylinder resting on its large end, insert the piston into the brake cylinder. Be careful not to cut the O-rings or backup rings.



5. Install the eight (8) belleville springs over the spring guide. The first one should rest against the snap ring on the spring guide, with the concave side facing the snap ring. The second spring should be installed with its convex side facing the snap ring. Alternate the remaining six (6) springs until all eight (8) are in place.

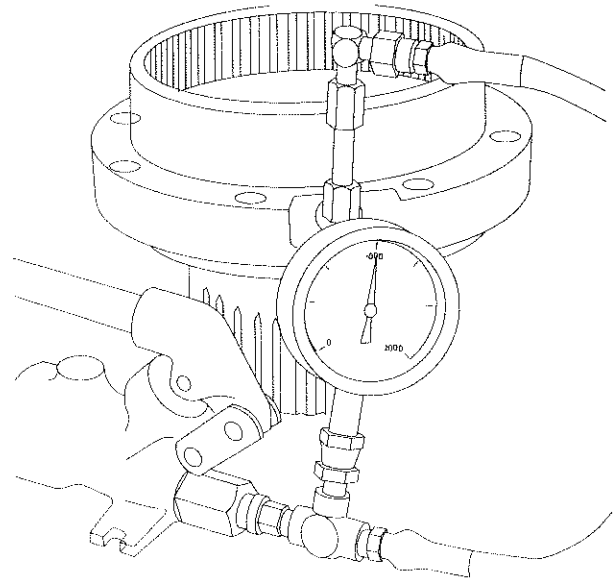


6. Next, place the backup plate over the spring guide so that it rests on the top spring. Then, insert the spring guide, springs and backup plate into the brake cylinder.



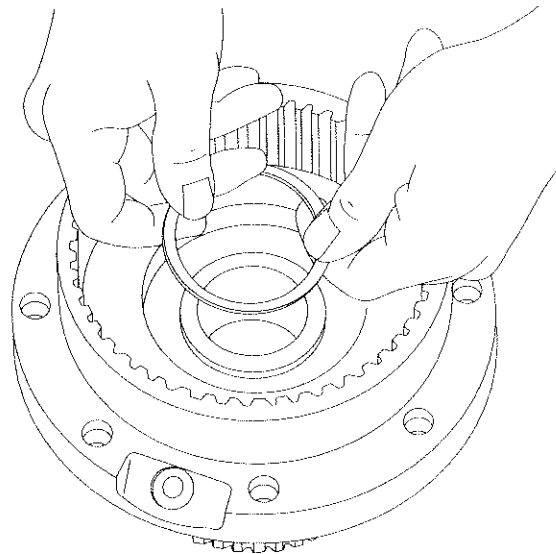
7. Use a press or the special compression tool to compress the springs. Make certain the threaded portion of the compression tool fully engages the lower plate. Install the retaining ring using snap ring pliers. Be careful to not let the pliers slip out of the retaining ring.

After making certain the retaining ring is fully seated, release the compression tool slowly, holding the threaded portion of the tool stationary, while backing off the nut.



9. Now pressure check the brake cylinder assembly with the hand pump connected to the 1/8" NPTF elbow in the top of the assembly.

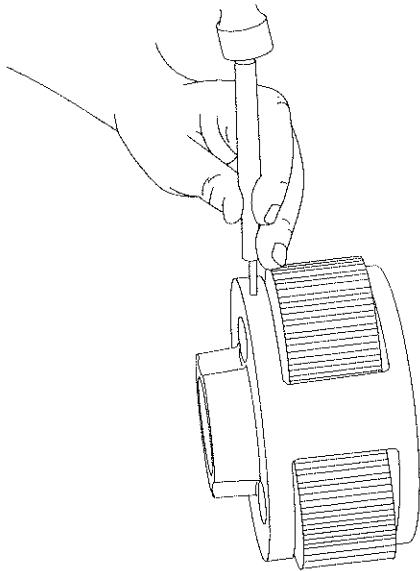
Apply 1,000 psi (6,900 kPa) and let the unit set for 5 minutes. If there is any loss of pressure, the brake piston must be removed to locate and correct the source of the leak.



8. Turn the assembly over and place the brake piston plate over the brake piston. Install the spiral retaining ring in the groove in the brake piston.



## PRIMARY AND SECOND STAGE PLANET CARRIER SERVICE



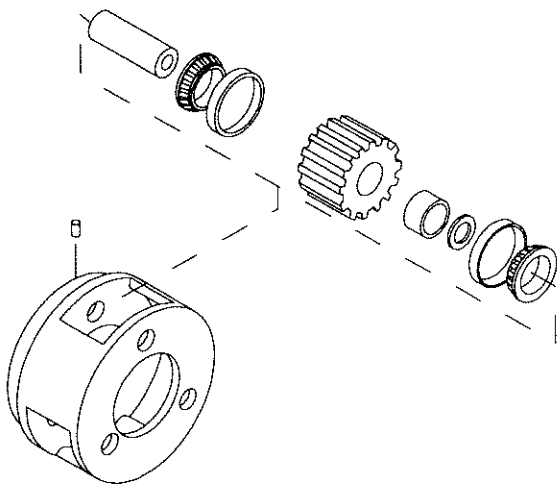
1. Drive the three (3) spiral pins into the center of the planet gear shafts on the primary assembly. On the second stage assembly, use a punch or small pry bar to drive or push the roll pin out of the planet carrier. If this is not successful, the roll pin must be sheared by driving or pressing the planet gear shaft out of the carrier. A piece of pipe or tubing long enough to hold the planet pin may be used to support the carrier while each pin is removed. Adequately support the assembly and drive or press out the planet pin, shearing the roll pin.
2. Remove the planet gear shaft. Remove the planet gear, bearings and thrust washers from the carrier. Repeat steps 1 and 2 for each of the planet gears. The primary planet gears have 17 loose rollers in each gear. The second stage gears have 14 loose rollers in each gear.
3. Both planet carriers have the next stage sun gear held in place by a retaining ring. Remove the retaining ring and sun gear from the carrier.
4. Remove roll pins from all planet gear shafts.

Thoroughly clean all parts and inspect for damage and wear. The bearing rollers should be examined for any signs of spalling, corrosion, discoloration, material displacement or abnormal wear. If any of these conditions are found, all the rollers should be replaced. Gears should be carefully inspected for abnormal wear or pitting and replaced as necessary. Inspect all machined surfaces and bearing bores for signs of damage or excessive wear. The thrust washers and their contact areas should be free from any surface irregularities that might cause excessive abrasion or friction.

## ASSEMBLY

1. Engage the sun gear with the splines on the planet carrier and install the retaining ring onto the sun gear.
2. Liberally coat the bore of a planet gear with a good grade of oil soluble grease.
3. Set a thrust washer on a clean flat work surface. Set the planet gear on the thrust washer with the bore in the gear centered over the washer. Install a row of loose rollers around the bore of the gear, using additional grease as required to hold them in place.
4. Set another thrust washer on top of the rollers and slide the gear and bearing assembly into place in the planet carrier. Align the gear with a bore in the carrier and install a planet pin. Align the hole in the pin with the hole in the carrier and install a new roll pin.  
**NOTE:** Always use **NEW** roll pins.
5. The roll pin should be slightly recessed in the carrier when properly installed. Use a punch to stake the carrier next to the pin hole so the pin will not back out when the unit is in operation.
6. Repeat steps 1 through 5 for the remaining planet gears.

## OUTPUT STAGE PLANET CARRIER SERVICE

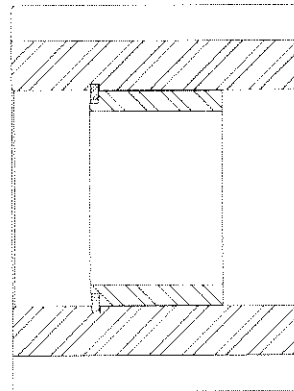


1. The planet gears in the output carrier assembly are each mounted on two tapered roller bearings. The preferred method of removing each planet gear shaft is to first remove the rollpin. This can usually be done by driving or prying the rollpin out of the carrier until it can be pulled from the outside. If this method is unsuccessful, the rollpin must be sheared by driving or pressing the shaft through the carrier. A piece of pipe or tubing large enough to hold the shaft should be used to support the carrier while it is pressed out.
2. Slide the planet gear assembly out of the carrier. Remove the bearings and bearing spacer. Remove the internal retaining ring from the bore of the gear.
3. Repeat steps 1 and 2 for each planet gear.

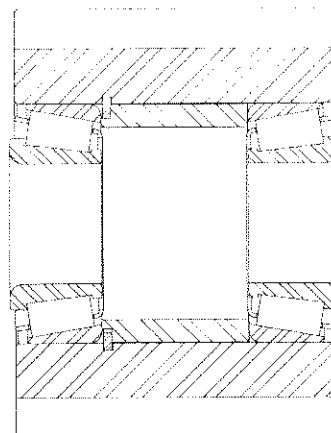
Thoroughly clean and inspect all parts for damage and wear. The bearings should be examined for any signs of spalling, corrosion, discoloration, material displacement or abnormal wear. The bearing cages should be inspected for wear or deformation. If any of these conditions are found, the bearing should be replaced. Gears should be inspected for abnormal wear or pitting and replaced as necessary. Inspect all machined surfaces and bearing bores for signs of damage or excessive wear.

## ASSEMBLY

1. Install a retaining ring in the bore of a planet gear, being sure it is completely seated in the groove.
2. Install a bearing spacer into the bore of the planet gear. The stepped end of the spacer **MUST** be toward the retaining ring and fit over the retaining ring as shown.



3. Press a bearing cup into each side of the planet gear. Install a bearing cone into each cup. A completed planet gear with bearings is shown below.

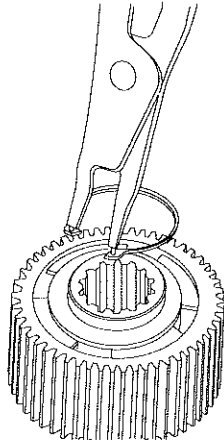


4. Slide the planet gear assembly into the planet carrier, aligning the bearing bores with one of the planet gear shaft holes. Install a planet gear shaft through the carrier and bearings, aligning the hole in the shaft with the hole in the carrier.
5. Drive a new rollpin into place in the carrier.

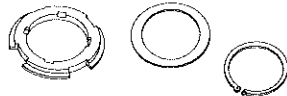
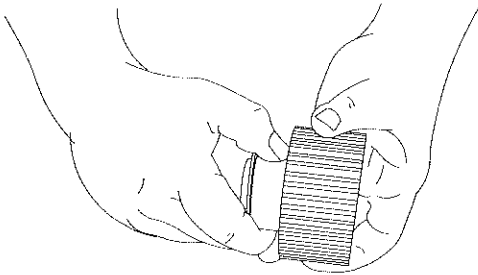
**NOTE:** Always use **NEW** rollpins. The rollpin should be slightly recessed in the carrier when properly installed. With a center punch, stake the carrier next to the pin hole to distort the hole so the pin will not back out in service.

6. Repeat steps 1 through 5 for each planet gear.

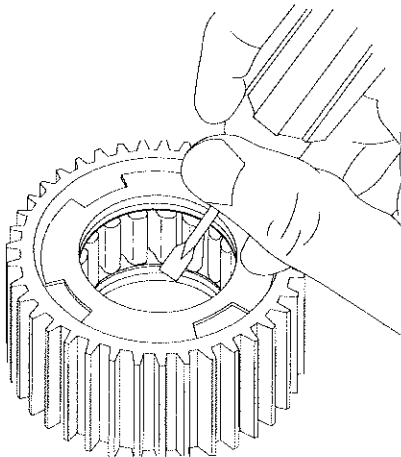
## BRAKE CLUTCH SERVICE



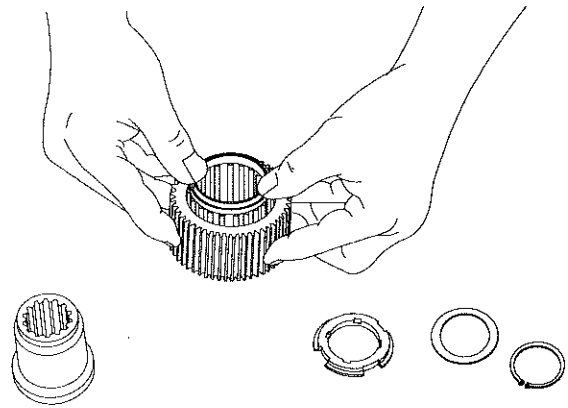
1. Remove the snap ring and sprag bushing retainer from one end only.



2. Pull the inner race out. Examine the race for scoring, wear or indentations caused by the sprag cams.



3. Use a screwdriver and mallet to remove the sprag bushing from one end of the outer race. There are four special cut-outs in the bushing for this purpose. Be careful not to damage the bushing inside surface. If a bushing's inside surface is damaged or shows wear, replace it.

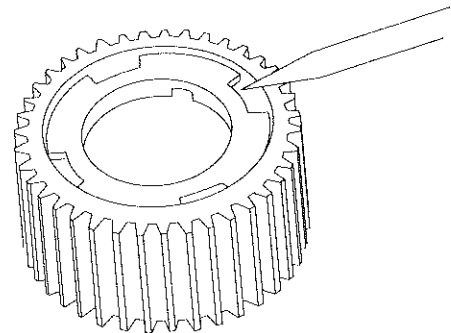


4. Next, slide the sprag clutch out, inspect the sprag clutch closely for abnormal wear, cracks, pitting or corrosion. Check small clips for breakage or bright spots; the signs of excessive wear. Unless the outer race or remaining sprag bushing is damaged or shows excessive wear, there is no need for further disassembly. If disassembly is necessary, remove the bushing according to the procedure covered in Step No. three (3). All brake clutch assembly parts should be thoroughly cleaned and inspected before assembly.

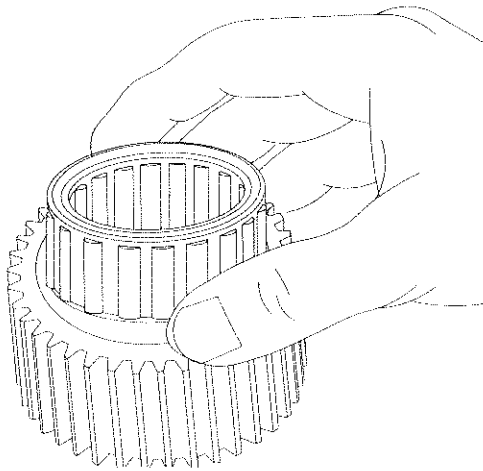
### ⚠ WARNING ⚠

The polished surfaces of the races and sprag cams must be perfectly smooth to insure positive engagement of the clutch. The slightest defect may reduce brake clutch effectiveness, which could result in property damage, severe personal injury or death. It is generally recommended to replace the entire brake clutch assembly if any component is defective.

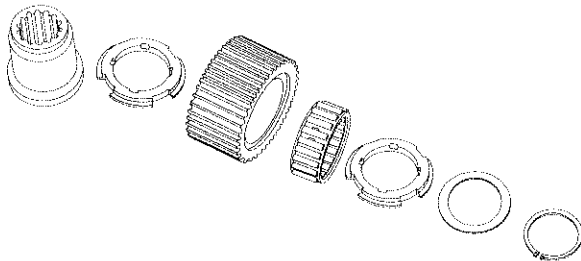
### ASSEMBLY



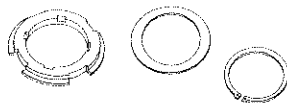
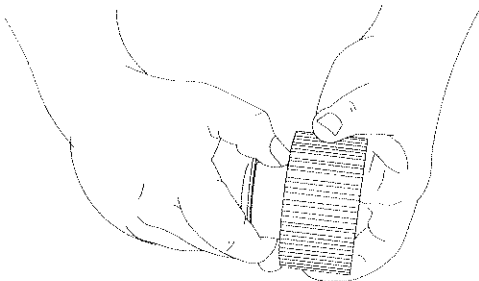
1. Press a sprag bushing into the outer race, using a mechanical or hydraulic press. A flat plate of approximately the same diameter as the bushing flange outside diameter should be placed between the press and bushing during assembly to protect the bushing. Be certain the bushing flange is against the shoulder in the outer race.



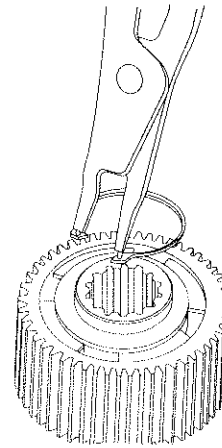
2. Turn the assembly over and install the sprag clutch in the bore of the outer race.
3. Press the remaining bushing into the race. Again, make sure the bushing is against the shoulder.



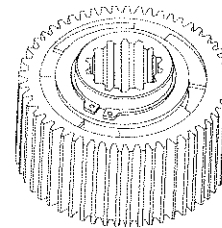
4. Next, install a sprag bushing retainer, then a snap ring on the inner race. Be sure the snap ring is seated in the snap ring groove.



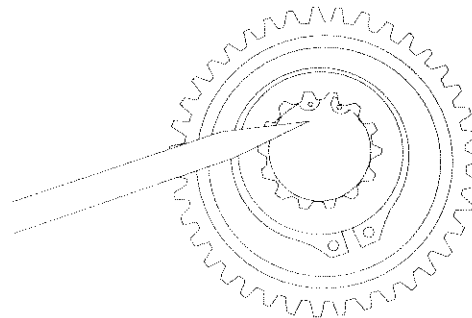
5. Slide the inner race through the bushings and sprag clutch (the race will have to be rotated in the free-wheeling direction to start it through the sprag clutch). If the inner race will not go through the bushings, the bushings have probably been damaged and should be replaced.



6. Turn the assembly over with the snap ring down. Install the second retainer and snap ring. Make certain the snap ring is seated in the groove properly.



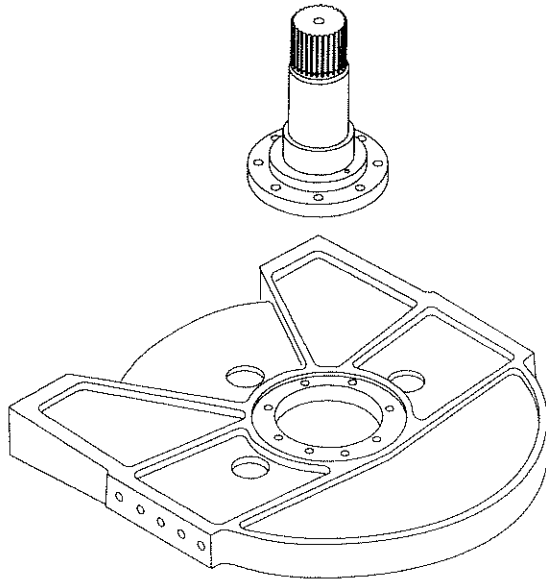
7. This is a completed brake clutch assembly.



## ⚠ WARNING ⚠

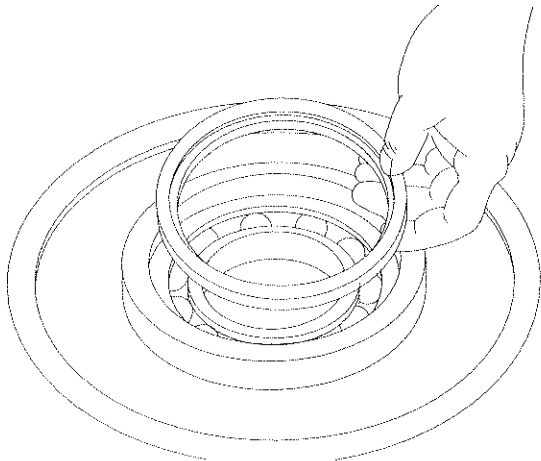
Be certain the snap ring is seated in the groove in the splined bore of the inner race. This snap ring will keep the brake clutch assembly correctly positioned in the center of the friction brake pack. Binding of the brake or brake failure may occur if this snap ring is omitted.

## HOIST ASSEMBLY

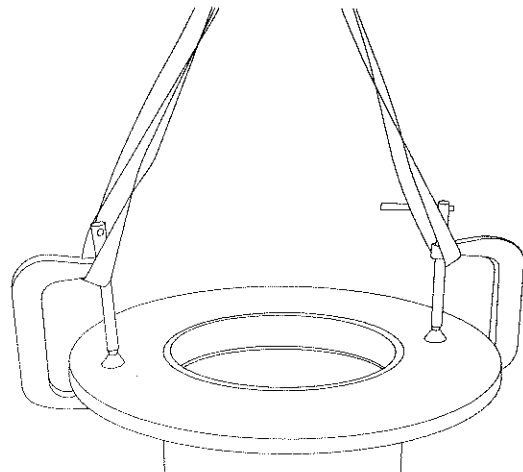


1. Clean all parts before reassembling. The first step is to lay the support end plate down with the bearing support up. Lubricate the sealing and bearing lands on the bearing support.

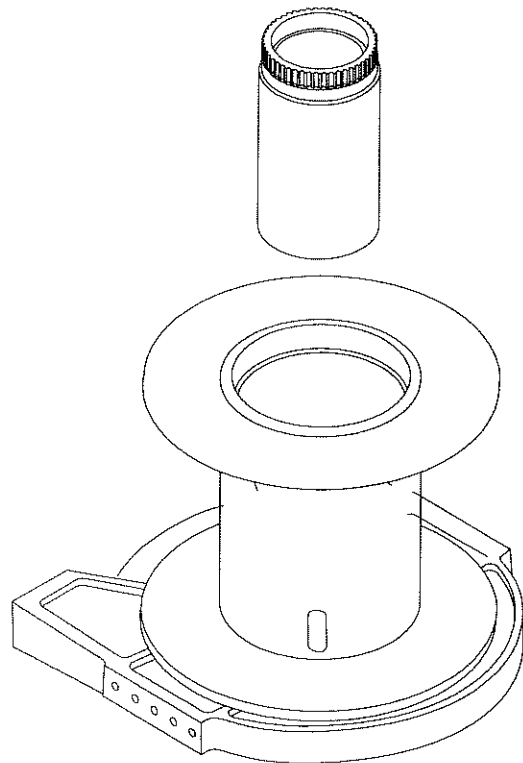
*NOTE: If the bearing support was removed from the end plate, reinstall it with eight (8) capscrews and lockwashers, making certain two (2) large holes in the end plate line up with the cutouts in the bearing support.*



2. Install a new bearing in the drum if replacement is necessary, making certain to press it against the shoulder in the bottom of the bearing bore. Coat the outside diameter of the new seal with a good grade of sealant. Turn the spring side of the seal next to the bearing, and press the seal into the seal bore, leaving it flush with the surface of the drum bore.



3. Turn the drum over, and set it down on the bearing support. Be careful not to damage the seal when lowering the drum onto the bearing support.

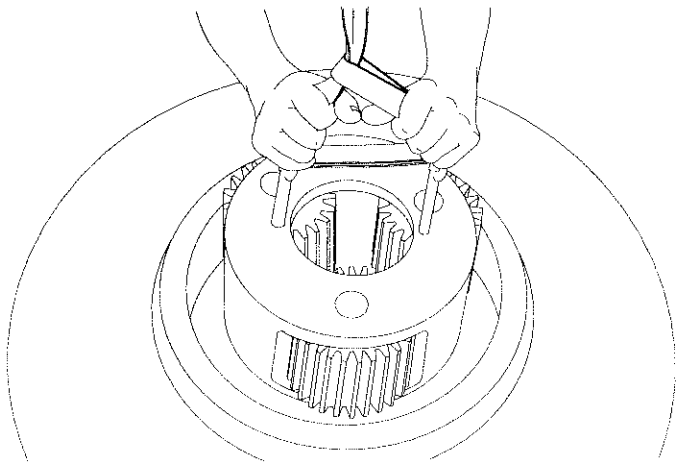


### 4. UNITS WITH 01 DRUM

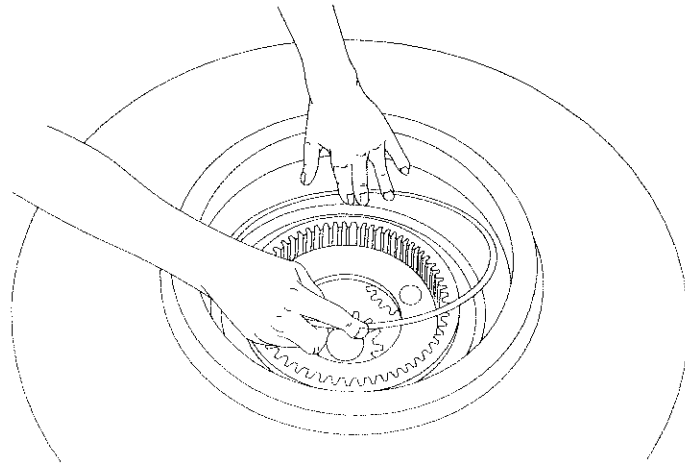
Install the output adapter on the bearing support.

### UNITS WITH 02 DRUM

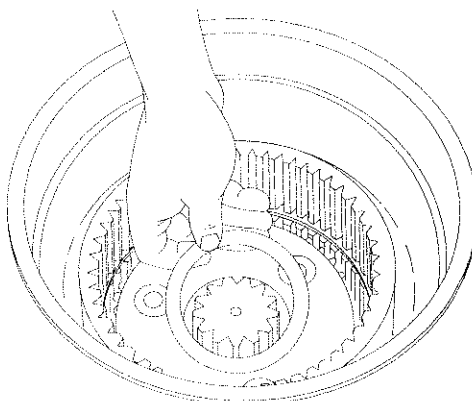
Install the coupling and bearing support extension onto the bearing support.



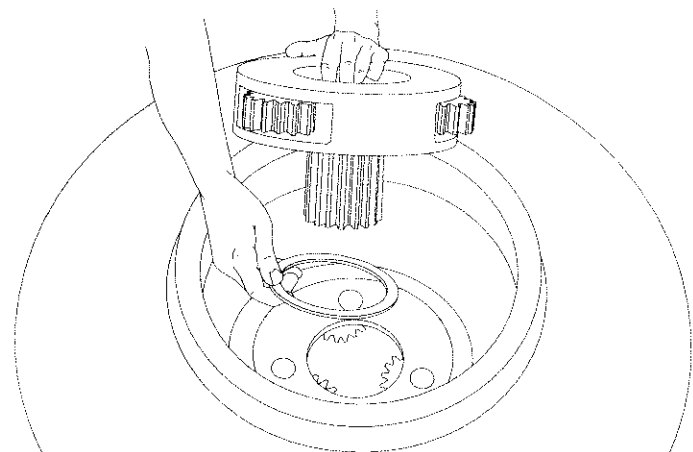
5. Lower the output planet carrier assembly into the drum, making certain that the teeth on the carrier mesh with the teeth in the on the output adapter or bearing support extension.
6. Install the thrust washer aligning the center of the washer on the output planet carrier so the secondary planet carrier can be installed in it.



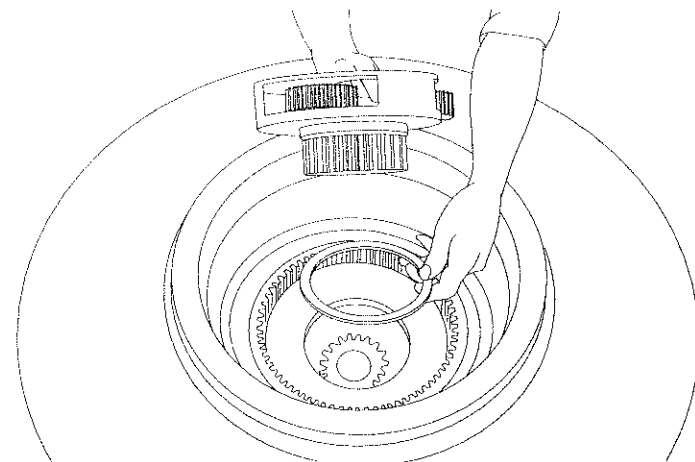
9. Install the snap ring into the drum. This holds the ring gear in position.



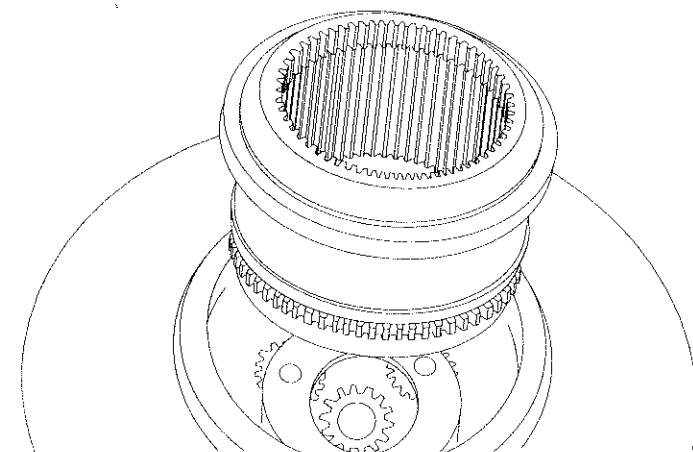
10. Install the thrust washer over the secondary planet carrier insuring it is centered and will allow the pilot of the primary planet carrier to be inserted through it. Apply a small amount of grease to hold the thrust washer in place.



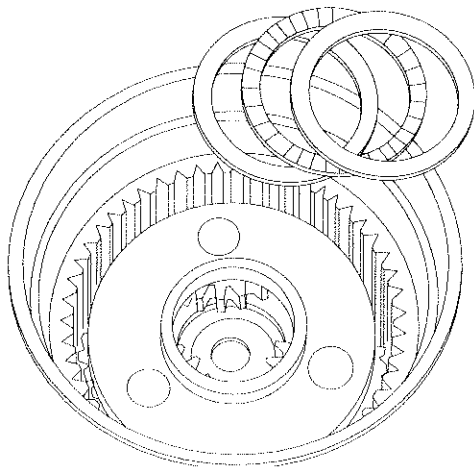
7. Install the secondary planet carrier and final sun gear assembly into the winch. Make certain the thrust washer is seated on the pilot of the carrier.



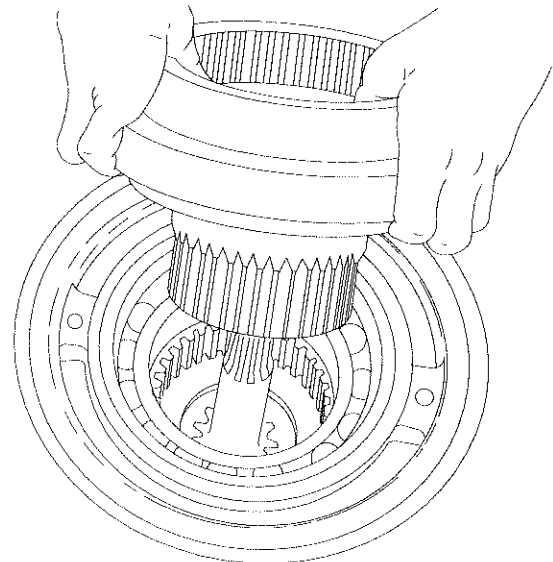
11. Install the primary planet carrier assembly in the ring gear, meshing the planet gears with the ring gear. The hub goes down, engaging the secondary sun gear. Be sure the pilot enters the thrust washer.



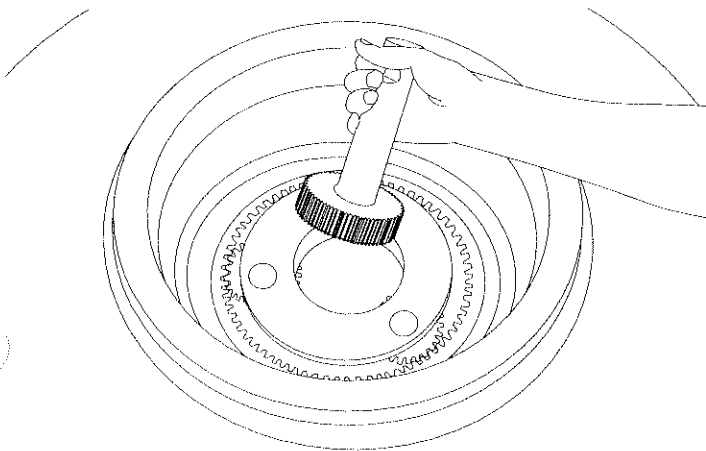
8. Install the ring gear into the winch. Make certain that the secondary and output planet gear teeth are aligned with the ring gear teeth.



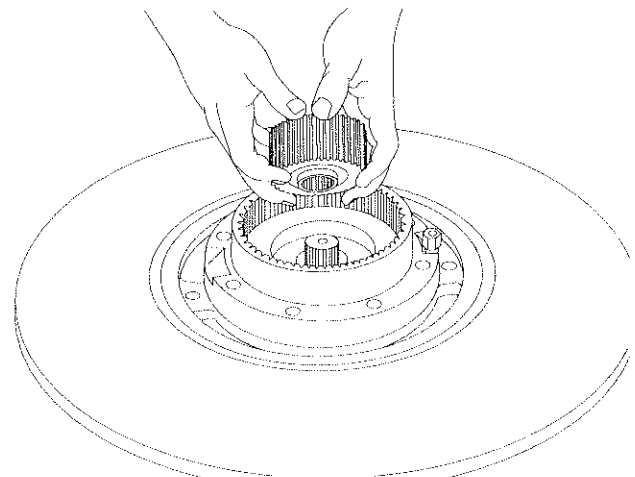
12. Install the spacer, thrust bearing and two (2) races as shown. The thinner race goes against the spacer. Then install the thrust bearing and the thicker race on top of it.



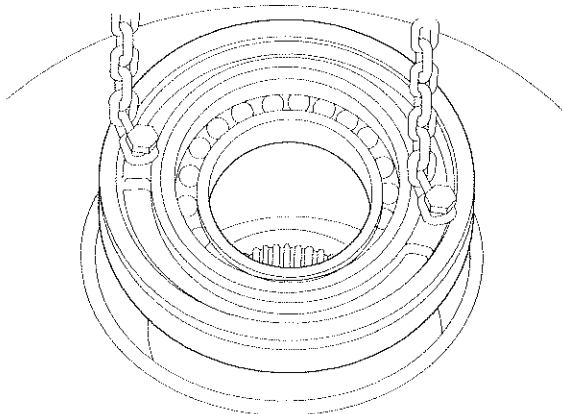
15. Install the brake cylinder assembly over the primary sun gear.



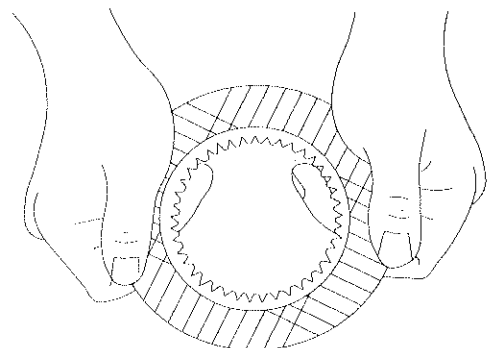
13. Install the primary sun gear, meshing its teeth with the primary planet gears.



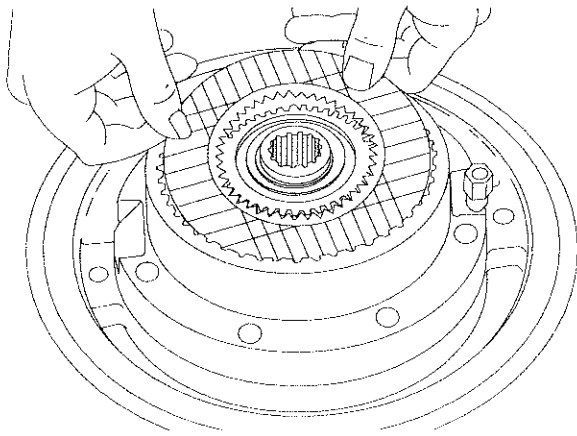
16. Install the brake clutch assembly over the primary sun gear. When installed correctly, the outer race should turn freely in the same direction as the drum turns to spool wire rope in. For the CH240, this will be counter clockwise when viewed from the motor end.



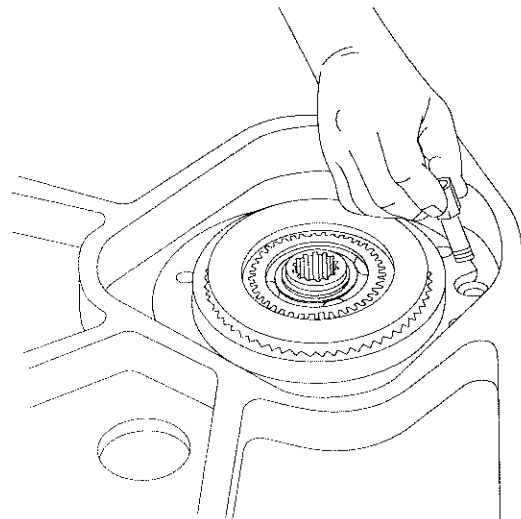
14. Install a new bearing in the drum closure if replacement is necessary, making certain to press it against the shoulder in the bottom of the bearing bore. Coat the outside diameter of the new seal with a good grade of sealant. Turn the spring side of the seal toward the bearing, and press the seal into the seal bore, leaving it flush with the surface shown. Lubricate the new O-ring and install it on the drum closure. Lubricate the large diameter on the closure and install the closure in the drum.



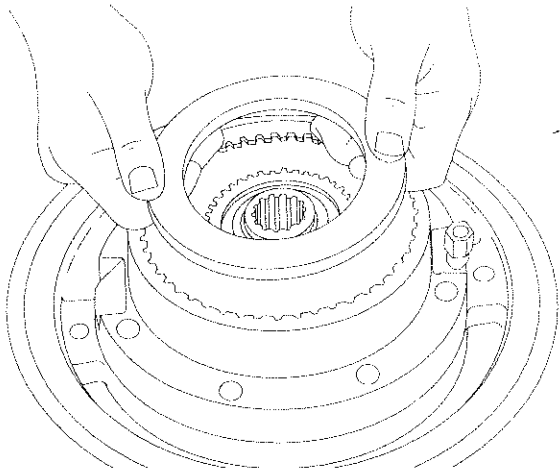
17. Before installing the brake discs and friction discs, check their condition. Both kinds of discs should be flat and their teeth should not be pointed. The friction discs should have groove in the friction material. Replace discs, if necessary.



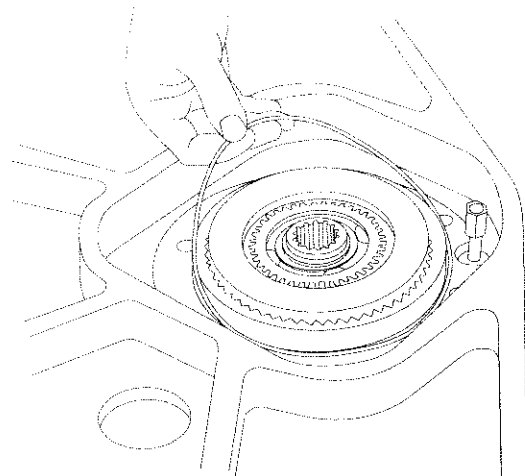
18. Install the brake discs. Start with a steel disc and end with a steel disc. Alternate steel and friction discs until there are nine (9) of the friction discs and ten (10) of the steel discs installed.



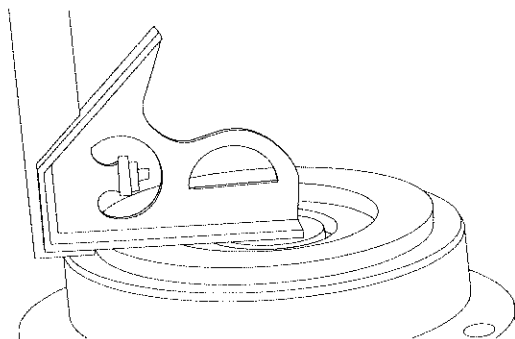
21. Install the motor end plate and then the brake cylinder nipple, using a good grade of thread sealant.



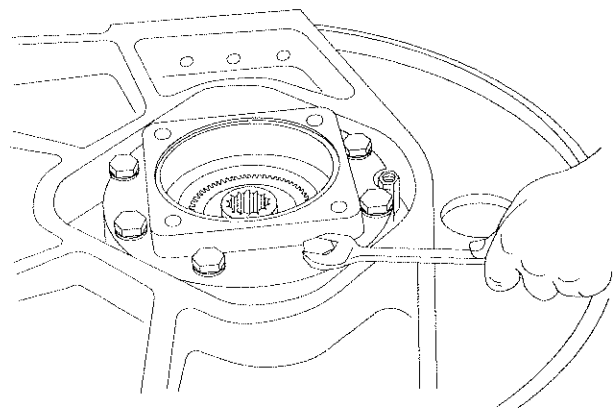
19. Install the brake plate spacer on top of the brake discs.



22. Lubricate the o-ring and install it on the outside of the brake cylinder. Push it down until it's resting against the motor end plate.

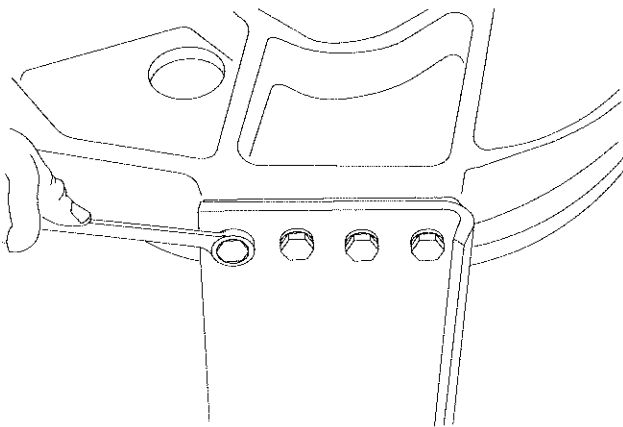


20. Measure the brake stack-up as shown. The measurement should be a minimum of  $\frac{3}{16}$ " from the top of the brake plate spacer to the top of the brake cylinder. If the measurement is less than  $\frac{3}{16}$ ", remove the brake plate spacer and add a brake disc to the top of the brake package. Replace the brake plate spacer and repeat procedure. Do not exceed an overall height of  $\frac{1}{4}$ ".

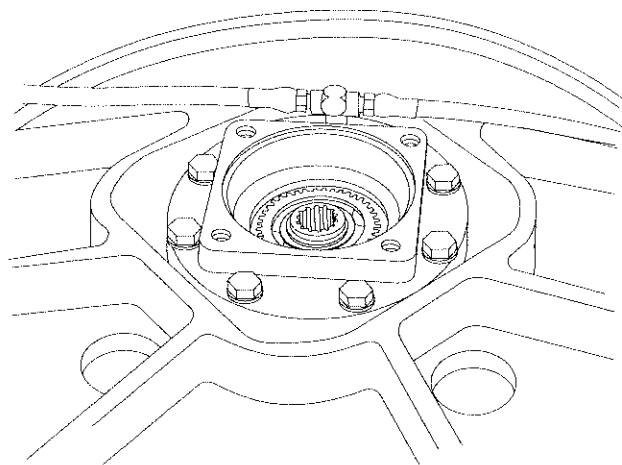


23. Install the motor adapter with eight (8) special BRADEN capscrews and lockwashers.

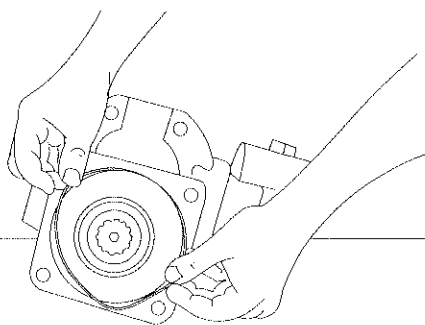




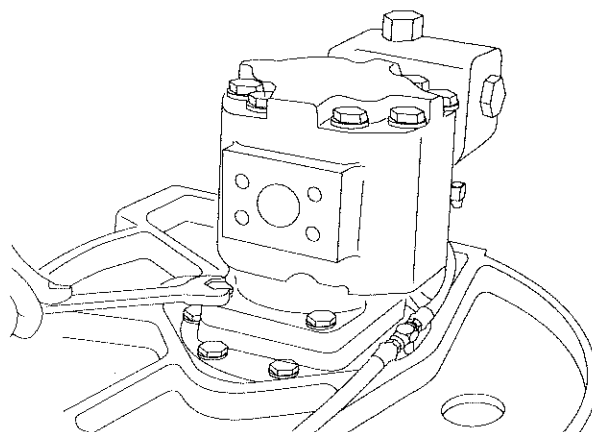
24. Install the tie plates next. Position the plates so that the curved part is toward the top of the hoist and curving away from the drum. Install the twenty four (24) cap-screws and lockwashers.



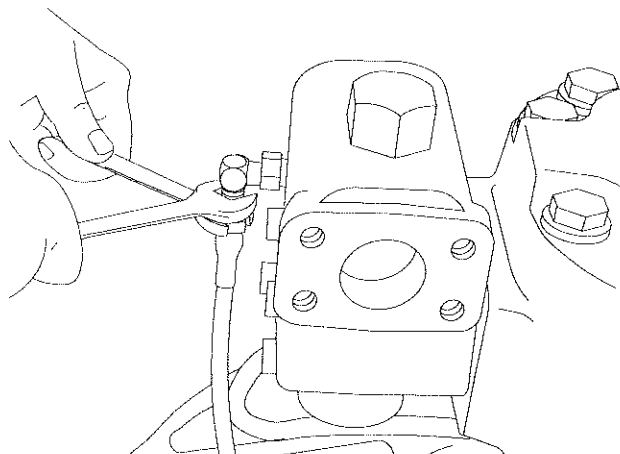
25. Install the tee and hydraulic hoses at this time. Use a good grade of thread sealant, being careful not to get it in the hydraulic lines, as it could block an orifice in the brake valve. The long hose should point to the right as viewed from the motor end.



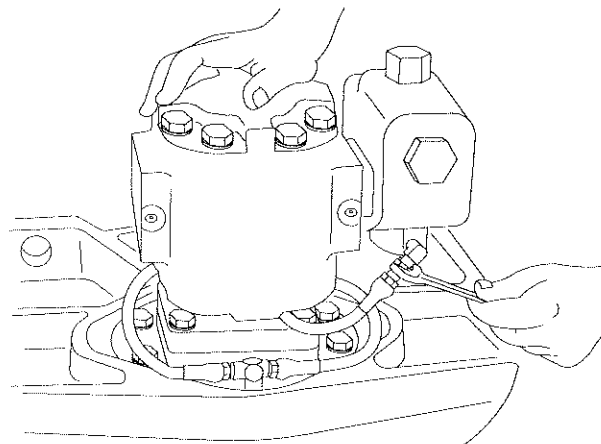
26. Lubricate and install a new O-ring around the pilot on the motor.



27. Engage the motor shaft in the brake clutch assembly inner race, and lower the motor into place. Install four (4) cap screws and lockwashers



28. Install all hydraulic hoses, then tighten.



29. After the hoist assembly is complete, check all cap-screws and fittings to make certain they have been tightened correctly. Refill the hoist with the recommended oil listed under maintenance suggestions.

30. Before returning the winch to full service, a light load should be lifted and held a few feet off the ground to be sure the static brake is functioning properly. The winch should also be able to slowly lower the load in a smooth and controlled manner. If the winch does not perform either of these functions, refer to "TROUBLE SHOOTING" for additional information.

# METRIC CONVERSION TABLE

English to Metric			Metric to English		
LINEAR					
inches (in.)	X 25.4	= millimeters (mm)	millimeters (mm)	X 0.3937	= inches (in.)
feet (ft.)	X 0.3048	= meters (m)	meters (m)	X 3.281	= feet (ft.)
miles (mi.)	X 1.6093	= kilometers (km)	kilometers (km)	X 0.6214	= miles (mi.)
AREA					
inches <sup>2</sup> (sq.in.)	X 645.15	= millimeters <sup>2</sup> (mm <sup>2</sup> )	millimeters <sup>2</sup> (mm <sup>2</sup> )	X 0.000155	= inches <sup>2</sup> (sq.in.)
feet <sup>2</sup> (sq.ft.)	X 0.0929	= meters <sup>2</sup> (m <sup>2</sup> )	meters <sup>2</sup> (m <sup>2</sup> )	X 10.764	= feet <sup>2</sup> (sq.ft.)
VOLUME					
inches <sup>3</sup> (cu.in.)	X 0.01639	= liters (l)	liters (l)	X 61.024	= inches <sup>3</sup> (cu.in.)
quarts (qts.)	X 0.94635	= liters (l)	liters (l)	X 1.0567	= quarts (qts.)
gallons (gal.)	X 3.7854	= liters (l)	liters (l)	X 0.2642	= gallon (gal.)
inches <sup>3</sup> (cu.in.)	X 16.39	= centimeters <sup>3</sup> (cc)	centimeters3 (cc)	X 0.06102	= inches <sup>3</sup> (cu.in.)
feet <sup>3</sup> (cu.ft.)	X 28.317	= liters (l)	liters (l)	X 0.03531	= feet <sup>3</sup> (cu.ft.)
feet <sup>3</sup> (cu.ft.)	X 0.02832	= meters <sup>3</sup> (m <sup>3</sup> )	meters3 (m3)	X 35.315	= feet <sup>3</sup> (cu.ft.)
fluid ounce (fl.oz.)	X 29.57	= milliliters (ml)	milliliters (ml)	X 0.03381	= fluid ounce (fl.oz.)
MASS					
ounces (oz.)	X 28.35	= grams (g)	grams (g)	X 0.03527	= ounces (oz.)
pounds (lbs.)	X 0.4536	= kilograms (kg)	kilograms (kg)	X 2.2046	= pounds (lbs.)
tons (2000 lbs.)	X 907.18	= kilograms (kg)	kilograms (kg)	X 0.001102	= tons (2000 lbs.)
tons (2000 lbs.)	X 0.90718	= metric tons (t)	metric tons (t)	X 1.1023	= tons (2000 lbs.)
tons (long) (2240 lbs.)	X 1013.05	= kilograms (kg)	kilograms (kg)	X 0.000984	= tons (long) (2240 lbs.)
PRESSURE					
inches Hg (60°F)	X 3600	= kilopascals (kPa)	kilopascals (kPa)	X 0.2961	= inches Hg (60°F)
pounds/sq.in. (PSI)	X 6.895	= kilopascals (kPa)	kilopascals (kPa)	X 0.145	= pounds/sq.in. (PSI)
pounds/sq.in. (PSI)	X 0.0703	= kilograms/sq.cm. (kg/cm <sup>2</sup> )	kilograms/sq.cm. (kg/cm2)	X 14.22	= pounds/sq.in. (PSI)
pounds/sq.in. (PSI)	X 0.069	= bars	bars	X 14.5	= pounds/sq.in. (PSI)
inches H <sub>2</sub> O (60°F)	X 0.2488	= kilopascals (kPa)	kilopascals (kPa)	X 4.0193	= inches H <sub>2</sub> O (60°F)
bars	X 100	= kilopascals (kPa)	kilopascals (kPa)	X 0.01	= bars
POWER					
horsepower (hp)	X 0.746	= kilowatts (kW)	kilowatts (kW)	X 1.34	= horsepower (hp)
ft.-lbs./min.	X 0.0226	= watts (W)	watts (W)	X 44.25	= ft.-lbs./min.
TORQUE					
pound-inches (in.-lbs.)	X 0.11298	= newton-meters (N-m)	newton-meters (N-m)	X 8.851	= pound-inches (in.lbs.)
pound-feet (ft.-lbs.)	X 1.3558	= newton-meters (N-m)	newton-meters (N-m)	X 0.7376	= pound-feet (ft.-lbs.)
pound-feet (ft.-lbs.)	X .1383	= kilograms/meter (kg-m)	kilogram/meter (kg-m)	X 7.233	= pound-feet (ft.-lbs.)
VELOCITY					
miles/hour (m/h)	X 0.11298	= kilometers/hour (km/hr)	kilometers/hour (km/hr)	X 0.6214	= miles/hour (m/h)
feet/second (ft./sec.)	X 0.3048	= meter/second (m/s)	meters/second (m/s)	X 3.281	= feet/second (ft./sec.)
feet/minute (ft./min.)	X 0.3048	= meter/minute (m/min)	meters/minute (m/min)	X 3.281	= feet/minute (ft./min.)
TEMPERATURE					
°Celsius = 0.556 (°F - 32)			°Fahrenheit = (1.8°C) + 32		
COMMON METRIC PREFIXES					
mega	(M)	= 1,000,000 or 10 <sup>6</sup>	deci	(d)	= 0.1 or 10 <sup>-1</sup>
kilo	(k)	= 1,000 or 10 <sup>3</sup>	centi	(c)	= 0.01 or 10 <sup>-2</sup>
hecto	(h)	= 100 or 10 <sup>2</sup>	milli	(m)	= 0.001 or 10 <sup>-3</sup>
deka	(da)	= 10 or 10 <sup>1</sup>	micro	(μ)	= 0.000.001 or 10 <sup>-6</sup>



PEMEX – PP LUM A  
Project

ImXport Services Corp.

# Vendor Data Book

P.O. # 0018987

Serial # 23407C

Volume: 1

## Nautilus Crane Model 340LA-80

### Section 4.10.2 (b) PD15B Series Hoist Auxiliary Hoist



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA





# BRADEN

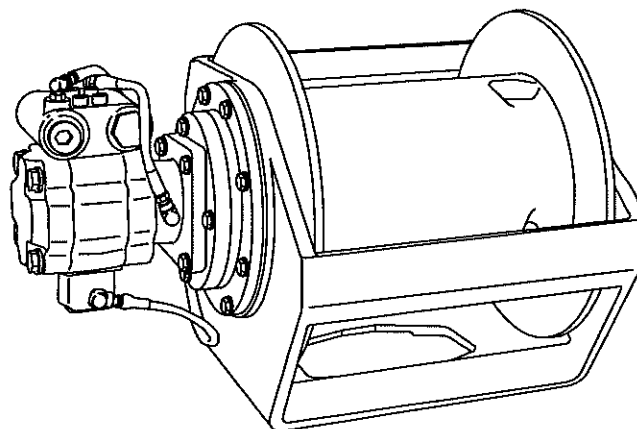
SERIES

**PD12C**

**PD15B**

**PD17A**

**HYDRAULIC WINCH**



**INSTALLATION, MAINTENANCE AND SERVICE MANUAL**

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# FOREWORD

Read this entire publication and retain it for future reference.

If you have any questions regarding your Braden Planetary Winch or this publication, call the Braden Service Department at 1-918-251-8511, 08:00-1630 hours, CT, Monday through Friday.

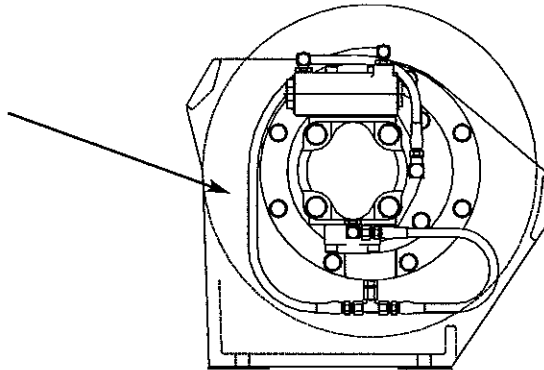
The minimum service intervals specified are for operating hours of the prime mover.

The following service instructions have been prepared to provide assembly, disassembly and maintenance information for the BRADEN Model PD12C, PD15B and PD17A series winch. It is suggested that before doing any work on these units, all assembly and disassembly instructions should be read and understood.

Some pictures in this manual may show details or attachments that are different from your winch. Also, some components have been removed for illustrative purposes. Illustrations and pictures in this manual are of a "typical" unit sold through our distribution channels. Some winches, particularly those sold directly to original equipment manufacturers, may differ slightly in appearance.

Whenever a question arises regarding your BRADEN winch, please contact BRADEN Service Department for the latest available information.

Serial Numbers and Model Numbers are located to the left hand side of the hydraulic motor, stamped into the base. Always refer to the Serial Number and Model Number when requesting information or service parts.



## EXPLANATION OF MODEL NUMBER

<u>PD</u>	<u>12</u>	<u>C</u>	-	<u>29</u>	<u>064</u>	-	<u>02</u>	-	<u>U</u>	<u>L</u>	-	<u>1</u>
POWER DRUM	MAX. RATING	DESIGN MODEL		GEAR RATIO	MOTOR SIZE		DRUM OPTION		ROTATION	BASE		OPTION

PD	DESIGNATES POWER DRUM
12	DESIGNATES 12,000 LB. APPROXIMATE FIRST LAYER LINE PULL
C	DESIGNATES THE MODEL SERIES RELATING TO DESIGN CHANGES
29	DESIGNATES TOTAL GEAR REDUCTION
064	DESIGNATES HYDRAULIC MOTOR DISPLACEMENT IN CU IN/REV (DECIMAL POINT ELIMINATED. EXAMPLE 064 = 6.4 CU IN/REV)
02	DESIGNATES THE DRUM OPTION
U	DESIGNATES UNDERWOUND CABLE DRUM – OPTIONAL
L	DESIGNATES LEFT HAND BASE – OPTIONAL
1	PERMITS TESTING AND INSPECTION PER API 2C FOR OFFSHORE CRANES

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# GENERAL SAFETY RECOMMENDATIONS

Safety and informational callouts used in this manual include:

## **WARNING**

**WARNING** – This emblem is used to warn against hazards and unsafe practice which **COULD** result in severe personal injury or death if proper procedures are not followed.

## **CAUTION**

**CAUTION** – This emblem is used to warn against potential or unsafe practices which **COULD** result in personal injury and product or property damage if proper procedures are not followed.

Safety for operators and ground personnel is of prime concern. Always take the necessary precautions to ensure safety to others as well as yourself. To ensure safety, the prime mover and winch must be operated with care and concern by the operator for the equipment and a thorough knowledge of the machine's performance capabilities. The following recommendations are offered as a general safety guide. Local rules and regulations will also apply.

1. Be certain equipment (boom, sheave blocks, pendants, etc.) is either lowered to the ground or blocked securely before servicing, adjusting, or repairing winch.
2. Be sure personnel are clear of work area **BEFORE** operating winch.
3. Read all warning and caution tag information provided for safe operation and service of winch.
4. Inspect rigging and winch at the beginning of each work shift. Defects should be corrected immediately.
5. Keep equipment in good operating condition. Perform scheduled servicing and adjustments listed in the "Preventive Maintenance" section of this manual.
6. An equipment warm-up procedure is recommended for all start-ups and essential at ambient temperatures below +40°F (4°C). Refer to "Warm-up Procedure" listed in the "Preventive Maintenance" section of this manual.
7. Operate winch line speeds to match job conditions.
8. Leather gloves should be used when handling wire rope.
9. Never attempt to handle wire rope when the hook end is not free. Keep all parts of body and clothing clear of cable rollers, cable entry area of fairleads and winch drum.
10. When winding wire rope on the winch drum, never attempt to maintain tension by allowing wire rope to slip through hands. Always use "Hand-Over-Hand" technique.
11. Never use wire rope with broken strands. Replace wire rope.
12. Do not weld on any part of the winch.
13. Use recommended hydraulic oil and gear lubricant.
14. Keep hydraulic system clean and free from contamination at all times.
15. Use correct anchor for wire rope and pocket in drum.
16. Do not use knots to secure or attach wire rope.
17. The BRADEN designed wire rope anchors are capable of supporting the rated load when installed properly. For additional safety, **ALWAYS** maintain a minimum of five (5) wraps of wire rope on the drum.
18. Never attempt to clean, oil or perform any maintenance on a machine with the engine or prime mover running, unless instructed to do so in this manual.
19. Never operate winch controls unless you are properly positioned at the operators station and you are sure personnel are clear of the work area.
20. Assure that personnel who are responsible for hand signals are clearly visible and that the signals to be used are thoroughly understood by everyone.
21. Ground personnel should stay in view of the operator and clear of winch drum. Do not allow ground personnel near winch line under tension. A safe distance of at least 1 \_ times the length of the cable should be maintained.
22. Do not exceed the maximum pressure, PSI (kPa), or flow, GPM (LPM), stated in the winch specifications for hydraulically driven winches.
23. Install guarding to prevent personnel from getting any part of body or clothing caught at a point where the cable is wrapped onto the drum or drawn through guide rollers.
24. "Deadman" controls, which automatically shut off power to the winch whenever the operator leaves his station, should be installed whenever practicable.
25. Never allow anyone to stand under a suspended load.
26. Avoid sudden "shock" loads or attempting to "jerk" load free. This type of operation may cause heavy loads, in excess of rated capacity, which may result in failure of cable and winch.



# THEORY OF OPERATION

## DESCRIPTION OF WINCH

The winch has four basic component parts:

1. Winch base
2. Hydraulic motor and brake valve
3. Brake cylinder and motor support
4. Drum assembly

The drum assembly consists of three basic assemblies:

1. Drum with integral ring gear
2. Output planetary gear set
3. Primary planetary gear set

The hydraulic motor is bolted to the motor support which in turn is bolted to the brake cylinder and the base. The motor end of the drum, running on a ball bearing, is supported by the brake cylinder. The other end of the drum runs on a ball bearing on the support bolted to the base. The ring gear for both planetary sets is machined into the drum's inside surface.

## WINCH OPERATION

The hydraulic motor drives the sun gear of the primary planetary gear set through the splined inner race of the brake clutch. When driven by the sun gear, the primary planet gears walk around the ring gear in the drum and drive the primary planet carrier.

The primary planet carrier drives the output planet sun gear which, in turn drives the output planet gears. The output planet carrier is splined to the bearing support and cannot rotate. Therefore, as the output planet gears are driven by the sun gear, they will drive the ring gear/drum.

## Dual Brake System – Description

The dual brake system consists of a dynamic brake system and a static brake system.

The dynamic brake system has two operating components:

1. Brake valve assembly
2. Hydraulic motor

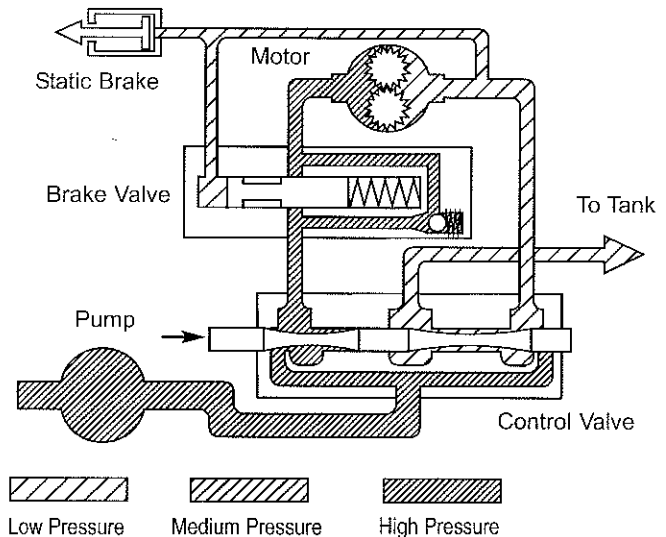
The brake valve is basically a counterbalance valve. It contains a check valve to allow free flow of oil to the motor in the hoisting direction and a pilot operated, spring-loaded spool valve that blocks the flow of oil out of the motor when the control valve is placed in neutral. When the control valve is placed in the lowering position, the spool valve remains closed until sufficient pilot pressure is applied to the end of the spool to shift it against spring pressure and open a passage. After the spool valve cracks open, the pilot pressure becomes flow-dependent and modulates the spool valve opening which controls the lowering speed.

Figures 2, 3 and 4.

The static brake system has three operating components:

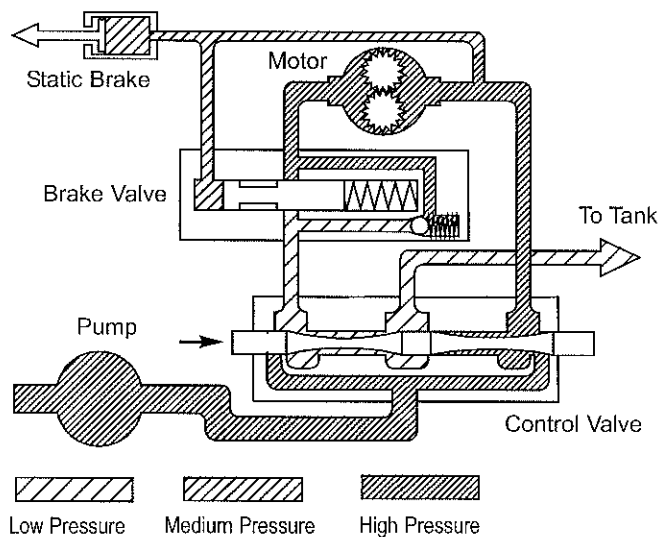
1. Spring Applied, Multiple Friction Disc Static Brake
2. Brake Clutch Assembly
3. Hydraulic Piston and Cylinder

Figure 2



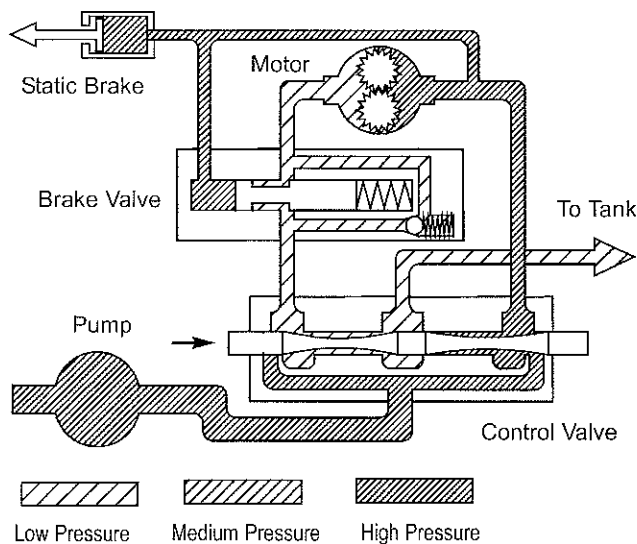
## HOISTING

Figure 3



## LOWERING 1

**Figure 4**



## LOWERING 2

The static brake is released by the brake valve pilot pressure at a pressure lower than that required to open the pilot operated spool valve. This sequence assures that dynamic braking takes place in the brake valve and that little, if any, heat is absorbed by the friction brake.

The friction brake is a load holding brake only and has nothing to do with dynamic braking or rate of descent of a load.

The brake clutch is splined to the primary sun gear shaft between the motor and the primary sun gear. It will allow this shaft to turn freely in the direction to raise a load and lock up to force the brake discs to turn with the shaft in the direction to lower a load. Figures 5 and 6.

The hydraulic cylinder, when pressurized, will release the spring pressure on the brake discs, allowing the brake discs to turn freely.

## Dual Brake System – Operation

When hoisting a load, the brake clutch which connects the motor shaft to the primary sun gear, allows free rotation. The sprag cams lay over and permit the inner race to turn free of the outer race. Figure 5. The friction brake remains fully engaged. The winch, in raising a load, is not affected by any braking action. Figure 2.

When the lifting operation is stopped, the load attempts to turn the primary sun gear in the opposite direction. This reversed input causes the sprag cams to instantly roll upward and firmly lock the shaft to the fully engaged friction brake. Figure 6.

When the winch is powered in reverse, to lower the load, the motor cannot rotate until sufficient pilot pressure is present to open the brake valve. Figures 3

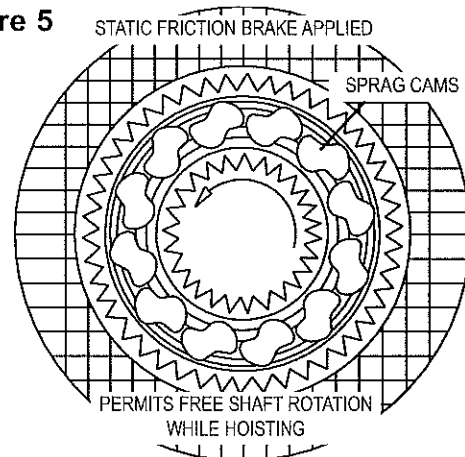
& 4. The friction brake within the winch will completely release at a pressure lower than that required to open the brake valve. The extent to which the brake valve opens will determine the amount of oil that can flow through it and the speed at which the load will be lowered. Increasing the flow of oil to the winch motor will cause the pressure to rise and the opening in the brake valve to enlarge, speeding up the descent of the load. Decreasing this flow causes the pressure to lower and the opening in the brake valve to decrease thus slowing the descent of the load.

When the control valve is shifted to neutral, the pressure will drop and the brake valve will close, stopping the load. The friction brake will engage and hold the load after the brake valve has closed.

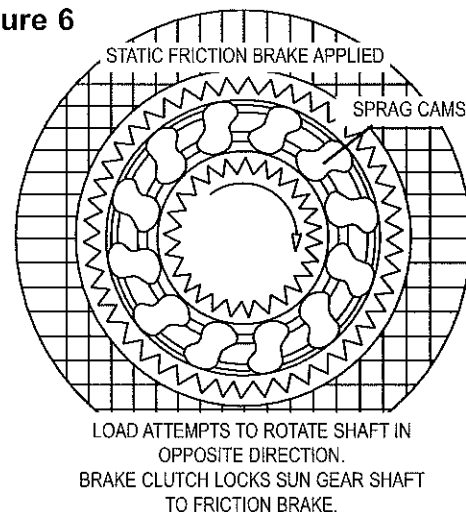
When lowering a load very slowly for precise positioning, no oil flow actually occurs through the winch motor. The pressure will build up to a point where the brake will release sufficiently to allow the load to rotate the motor through its own internal leakage. This feature results in a very slow speed and extremely accurate positioning.

The friction brake receives very little wear in the lowering operation. All of the heat generated by the lowering and stopping of a load is absorbed by the hydraulic oil where it can be readily dissipated.

**Figure 5**

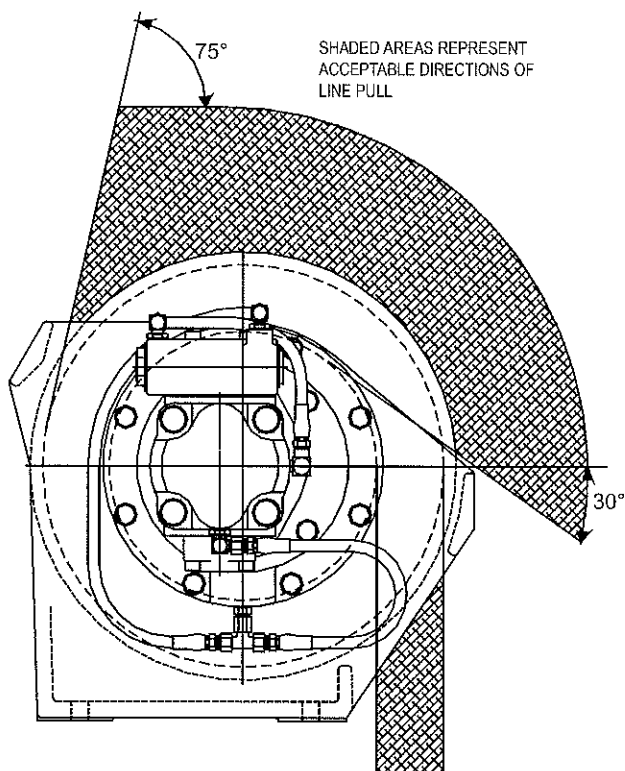


**Figure 6**



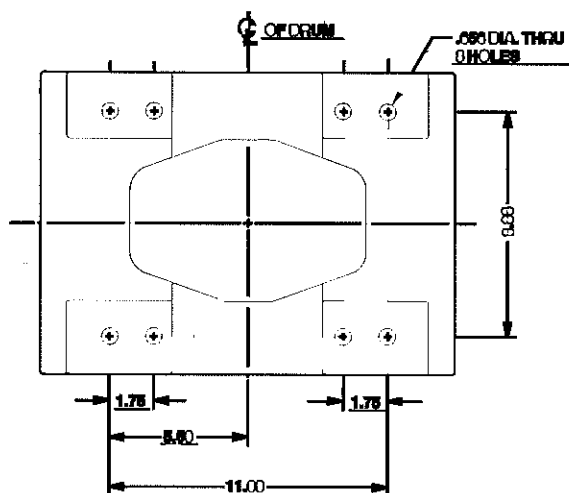
# WINCH INSTALLATION

1. The winch should be mounted with the centerline of the drum in a horizontal position. The mounting plane of the base may be rotated in any position around this centerline.



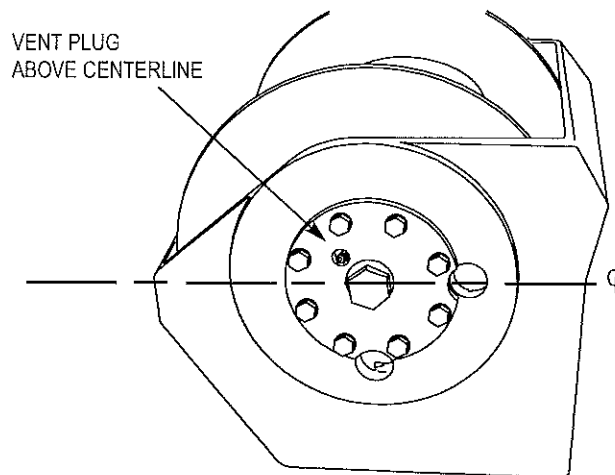
2. Because of the design of the mounting base, the direction of line pull should only be as shown in the above illustration. Line pulls in any other direction must be approved by BRADEN Engineering.

3.



When mounting the winch, use all eight (8) mounting holes and grade 5 or better bolts and nuts. Tighten to recommended torque.

It is important that the winch is mounted on a surface that will not flex when the winch is in use, and cause binding of the gear train. Binding in the gear train will result in accelerated wear and heat. Also, be sure the winch is mounted on a flat surface. If necessary, use shim stock to insure the mounting surface is flat within 0.020 in. (0.5 mm).

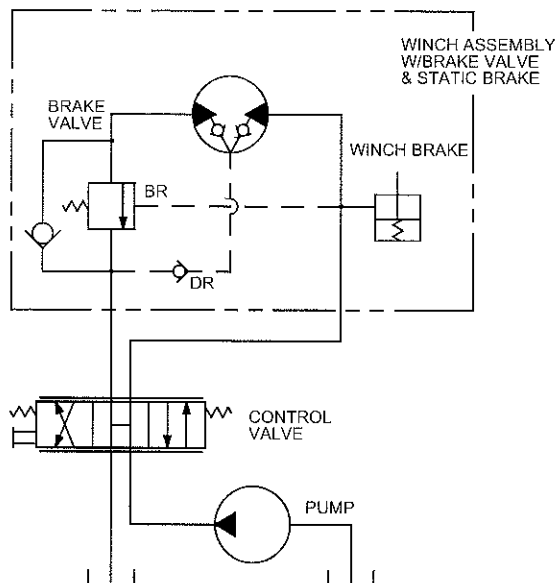


4. The vent plug must always be located above the horizontal centerline. If the winch is mounted on a pivoting surface, be sure vent plug remains above the centerline in all positions. If necessary, reposition bearing support and vent plug as follows:

- A. Remove bearing support bolts.
- B. Rotate bearing support until vent plug is positioned correctly and bolt holes are aligned.
- C. Evenly tighten bolts to recommended torque.

5. Hydraulic lines and components that operate the winch should be of sufficient size to assure minimum back pressure at the winch. The motor manufacturer recommends that the back pressure not to exceed 100 psi (690 kPa) for optimum motor seal life. 150 psi (1,030 kPa) is the maximum allowable back pressure. The standard winch is supplied with the motor internally drained. If high back pressures are encountered, the motor may be externally drained directly to tank to improve motor seal life. For back pressures exceeding 150 psi (1,030 kPa) consult BRADEN Service Department.

6. The winch should be mounted perpendicular to an imaginary line from the center of the drum to the first sheave to insure even spooling. Make certain the fleet angle does not exceed 1-1/2 degrees.



7. The winch directional control valve must be a three position four way valve with a motor spool such that when the valve is in the center position both work ports are open to tank (open center, open port).
8. High quality hydraulic oil is essential for satisfactory performance and long hydraulic system component life.

Oil having 150 to 330 SUS viscosity at 100°F (38°C) and viscosity index of 100 or greater will give good results under normal temperature conditions. The use of an oil having a high viscosity index will minimize cold-start trouble and reduce the length of warm-up periods. A high viscosity index will minimize changes in viscosity with corresponding changes in temperature.

Maximum cold weather start-up viscosity should not exceed 5000 SUS with a pour point at least 20°F (11°C) lower than the minimum temperature.

Under continuous operating conditions the temperature of the oil at any point in the system must not exceed 180° (82°C). Optimum oil temperature is generally considered to be 120-140°F (49-60°C).

In general terms; for continuous operation at ambient temperatures between 50 and 110°F (10 to 43°C) use SAE 20W; for continuous operation between 10 and 90°F (-12 to 32°C) use SAE 10W; for applications colder than 10°F (-12°C), contact the BRADEN Service Department. The use of multi-viscosity oils is generally not recommended.

9. The hydraulic oil filter should have a 10 micron nominal rating and be full flow type.

## RECOMMENDED FASTENER TORQUE

Higher or lower torques for special applications will be specified such as the use of spanner nuts, nuts on shaft ends, jam nuts and where distortion of parts or gaskets is critical.

Lubricated torque values based on use of SAE 30wt engine oil applied to threads and face of bolt or nut.

Avoid using thread lubricants as the applied torque may vary by 10-40% depending upon product used.

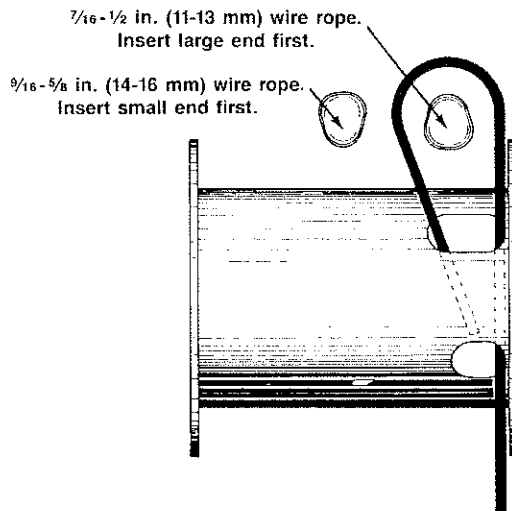
Bolt Dia. Inches	Thds Per Inch	Torque (LB-FT)			
		Grade 5		Grade 8	
		Dry	Lubed	Dry	Lubed
1/4	20 28	8	6	12	9
5/16	18 24	17	13	24	18
3/8	16 24	31	23	45	35
7/16	14 20	50	35	70	50
1/2	13 20	75	55	110	80
9/16	12 18	110	80	150	110
5/8	11 18	150	115	210	160

Bolt Dia. Inches	Thds Per Inch	Torque (LB-FT)			
		Grade 5		Grade 8	
		Dry	Lubed	Dry	Lubed
3/4	10 16	265	200	380	280
7/8	9 14	420	325	600	450
1	8 14	640	485	910	680
1 1/8	7 12	790	590	1290	970
1 1/4	7 12	1120	835	1820	1360
1 3/8	6 12	1460	1095	2385	1790
1 1/2	6 12	1940	1460	3160	2370

To convert lb. ft. to kg·m, multiply lb. ft. value by 0.1383.

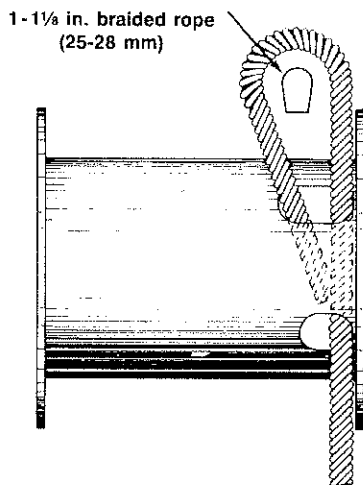
# WIRE AND BRAIDED ROPE INSTALLATION

## ANCHORING WIRE ROPE



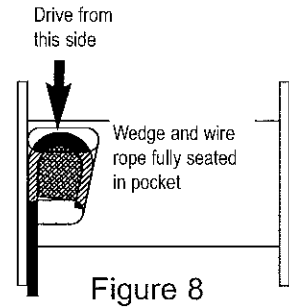
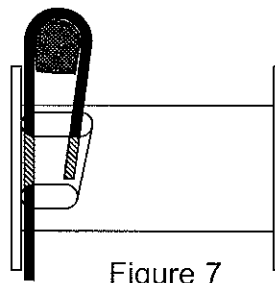
Take the free end of the wire rope and insert it through the small opening of the anchor pocket. Loop the wire rope and push the free end about  $\frac{1}{2}$  of the way back through the pocket. Install the wedge, then pull the slack out of the wire rope. The wedge will slip into the pocket and secure the wire rope into the drum. The anchor is designed to accommodate several different sizes of wire rope. You may anchor 7/16 and 1/2 in. (11 & 13 mm) wire rope by inserting the wedge, large end first. Anchor 9/16 and 5/8 in. (14 & 16 mm) wire rope by inserting the wedge, small end first.

## ANCHORING BRAIDED ROPE

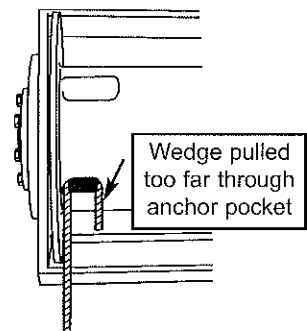
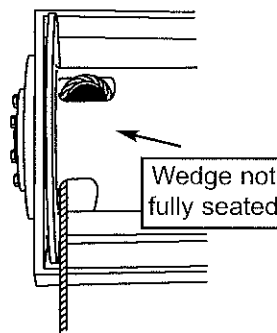


A special wedge is used to anchor 1 and 1 1/8 in. (25 & 28 mm) braided rope. The installation procedure is the same as for anchoring wire rope.

## Correct Installation



## Incorrect Installation



## TWO SPEED MOTOR CASE DRAIN PLUMBING

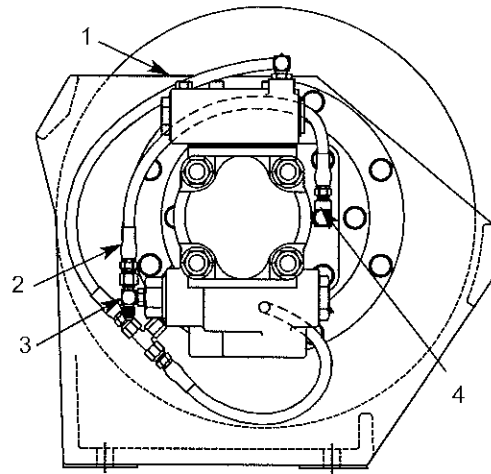
Winches built prior to 1991 with two speed motor, Part No. 26182, have the motor case drain connected to the drain port of the brake valve. This may result in accelerated motor shaft wear and leakage. The following modification should be made to the motor hydraulic piping to prevent this type of seal damage.

1. Remove the motor case drain hose from the brake valve drain port and install plug, Item 1, into the valve port. Remove the hose from the case drain port elbow, Item 4.
2. Install a new case drain hose, Item 2, onto the motor case drain elbow, Item 4.
3. Install the tee adapter, Item 3, into the two-speed motor shift valve drain port (identified by long end cap).
4. Install the new motor case drain hose, Item 2, onto the tee adapter.

5. Install a case drain hose for the tee directly to the reservoir. Minimum hose size is -6, 3/8 in. (9.5 mm). Maximum drain line back pressure is 100 PSI (7 Kg/cm<sup>2</sup>) measured at the motor case drain port.

Parts needed for modification:

Item	Qty	P/N	Description
1	1	25663	Plug -4 (Aeroquip 900598-4S)
2	1	13707	Hose 17 in. OAL (-4 JIC Fml Svl/-4 Hose / 1/8 NPT ml)
3	1	29078	Tee -4 (Aeroquip 203003-4-4S)



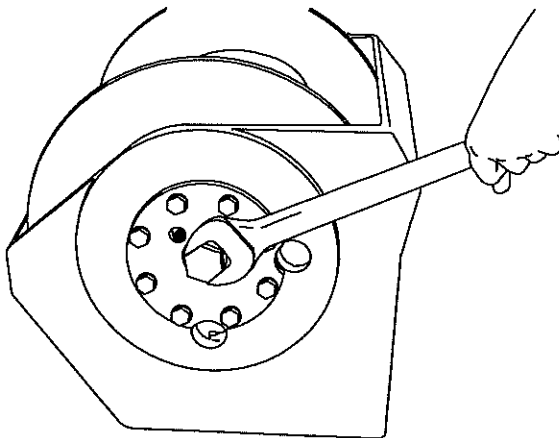
## PREVENTIVE MAINTENANCE

A regular program of preventive maintenance for your planetary winch is strongly recommended to minimize the need for emergency servicing and promote safe, reliable winch operation.

Field experience, supported by engineering tests, indicate the three (3) service procedures listed below are the **MOST** critical to safe, reliable winch operation and must be observed.

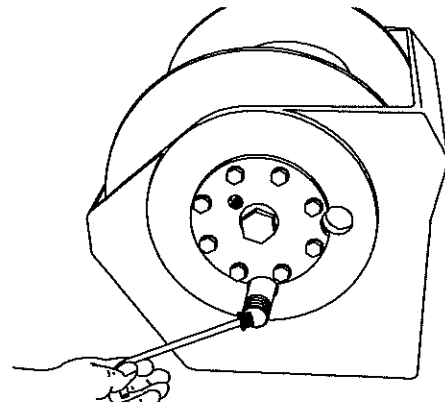
- **Regular Gear Oil Changes** – every 1000 hours or six (6) months
- **Use of Proper Gear Oil** – recommended type for prevailing ambient temperature
- **Annual Disassembly and Inspection of All Wear Items** – in compliance with American National Standards Institute (ANSI) specification B30.5c 1987 and American Petroleum Institute (API) recommended practice RP 2D section 3.

The following minimum service intervals are specified for operating hours of the prime mover.



### 1. Oil Level

The gear oil level should be checked every 500 operating hours or three (3) months, whichever occurs first. To check the oil level, remove the large plug located in the center of the drum support. The oil should be level with the bottom of this opening. If additional oil is needed, refer to "Recommended Planetary Gear Oil".



### 2. Oil Change

The gear oil should be changed after the first one hundred (100) hours of operation, then every 1,000 operating hours or six (6) months, whichever occurs first. The gear oil must be changed to remove wear particles that impede the reliable and safe operation of the brake clutch and erode bearings, gears and seals. Failure to change gear oil at these suggested minimum intervals may contribute to intermittent brake slippage which could result in property damage, severe personal injury or death.

The gear oil should also be changed whenever the ambient temperature changes significantly and an oil from a different temperature range would be more appropriate. Oil viscosity with regard to ambient temperature is critical to reliable brake

clutch operation. Our tests indicate that excessively heavy or thick gear oil may contribute to intermittent brake clutch slippage. Make certain that the gear oil viscosity used in your winch is correct for your prevailing ambient temperature. Failure to use the proper type and viscosity of planetary gear oil may contribute to brake clutch slippage which could result in property damage, severe personal injury or death. Refer to "Recommended Planetary Gear Oil" for additional information.

### 3. Vent Plug

The vent plug is located in the drum support as shown. It is very important to keep this vent clean and unobstructed. Whenever gear oil is changed, remove vent plug, clean in solvent and reinstall.

Do not paint over the vent or replace with a solid plug.

### 4. Hydraulic System

The original filter element should be replaced after the first fifty (50) hours of operation, then every 500 operating hours or three (3) months, or in accordance with the equipment manufacturer's recommendations.

### 5. Wire Rope

Inspect entire length of wire rope according to wire rope manufacturers recommendations.

### 6. Mounting Bolts

Tighten all winch base mounting bolts to recommended torque after the first one hundred (100) hours of operation, then every 1000 operating hours or six (6) months, whichever occurs first.

### 7. Warm-up Procedures

A warm-up procedure is recommended at each start-up and is essential at ambient temperatures below +40°F (4°C).

The prime mover should be run at its lowest recommended RPM with the hydraulic winch control valve in neutral allowing sufficient time to warm up the system. The winch should then be operated at low speeds, forward and reverse, several times to prime all lines with warm hydraulic oil, and to circulate gear lubricant through the planetary gear sets.

#### **⚠ WARNING ⚠**

Failure to properly warm up the winch, particularly under low ambient temperature conditions, may result in temporary brake slippage due to high back pressures attempting to release the brake, which could result in property damage, severe personal injury or death.

### 8. Recommended Planetary Gear Oil

Field experience, supported by extensive engineering tests, indicates the use of the proper planetary gear oil is essential to reliable and safe operation of the brake clutch and obtaining long gear train life.

#### **⚠ WARNING ⚠**

Failure to use the proper type and viscosity of planetary gear oil may contribute to intermittent brake clutch slippage which could result in property damage, severe personal injury or death. Some gear lubricants contain large amounts of EP (extreme pressure) and anti-friction additives which may contribute to brake clutch slippage and damage to brake friction discs or seals. Oil viscosity with regard to ambient temperature is also critical to reliable brake clutch operation. Our tests indicate that excessively heavy or thick gear oil may contribute to intermittent brake clutch slippage. Make certain that the gear oil viscosity used in your winch is correct for your prevailing ambient temperature.

For simplicity, BRADEN has listed one (1) readily available product in each temperature range which has been tested and found to meet our specifications. This is not to say that other lubricant brands would not perform equally as well.

If the following lubricant brands are not available in your area, make certain your lubricant vendor supplies you with oil that is equivalent to those products listed below.

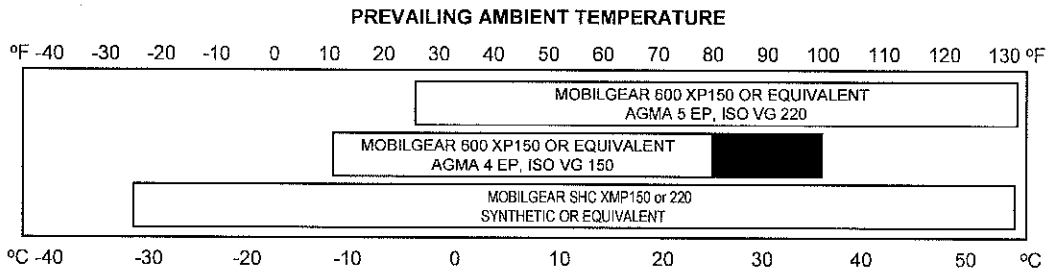
BRADEN planetary winches are factory filled with Texaco Meropa 150 or equivalent AGMA No. 4EP gear oil.

### 9. Inspection

In compliance with ANSI specification number B30.5c1987 and API Recommended Practice RP 2D section 3, we recommend that the winch be disassembled for a thorough inspection of all wear items every 2,000 hours of operation or twelve (12) months, whichever occurs first.

- A. **Bearings and Gears** – Refer to DISASSEMBLY OF WINCH, page 15; and PLANET CARRIER SERVICE, page 20.
- B. **Brake Cylinder** – Refer to MOTOR SUPPORT – BRAKE CYLINDER SERVICE, pages 22 and 23.
- C. **Brake Clutch** – Refer to BRAKE CLUTCH SERVICE, page 26.

## RECOMMENDED PLANETARY GEAR OIL



**NOTE:** SHADED TEMPERATURE RANGE IN THE CHART ABOVE NOT RECOMMENDED FOR SEVERE APPLICATIONS SUCH AS: OFFSHORE CRANES, SUSTAINED FAST DUTY CYCLES OR FREQUENT LIFTING.

Planetary hoists are factory filled with Mobilgear 600 XP 150, or equivalent. Consult your oil supplier for other equivalent oils if required.

Mobil	Shell	Chevron	Texaco
Mobilgear 600 XP 150	Omala 150	Gear Compounds EP 150	Meropa 150
Mobilgear 600 XP 220	Omala 220	Gear Compounds EP 220	Meropa 220

**OIL CAPACITIES:** (PD12C/PD15B) 01, 02 & 22 DRUM - 6 PINTS 04, 05 & 23G DRUM - 7 PINTS (PD17A) - 14 PINTS

**NOTE:** Capacities are approximate. Refer to "Oil Level" earlier in this section

## TROUBLESHOOTING

### ⚠ WARNING ⚠

If a winch ever exhibits any sign of erratic operation, or load control difficulties (i.e. load creeping or chattering) appropriate troubleshooting tests and repairs should be performed immediately. Continued operation in this manner may result in property damage, serious personal injury or death.

TROUBLE	PROBABLE CAUSE	REMEDY
<p><b>A</b></p> <p>The winch will not lower the load or not lower the load smoothly.</p>	<ol style="list-style-type: none"> <li>1. The problem could be a plugged or loose pilot orifice. The pilot orifice is a small pipe plug with a hole drilled through it, located behind the pilot port fitting on the brake valve. If it becomes plugged, it will prevent the pilot pressure, from the manifold, from opening the brake valve. If it becomes loose, it will allow an unregulated amount of oil in to operate the brake valve which cause erratic brake valve operation.</li> <li>2. The friction brake may not be releasing as a result of a defective brake cylinder seal.</li> </ol> <p><b>NOTE:</b> If the brake cylinder seal is defective you will usually find oil leaking from the winch vent plug.</p> <ol style="list-style-type: none"> <li>3. Friction brake will not release as a result of damaged brake discs.</li> </ol>	<p>Remove the pilot hose and fitting from the brake valve, then use a 5/32 inch Allen wrench to remove the pilot orifice. The diameter of the orifice is approximately .020 inches. Clean and install the pilot orifice tightly in the brake valve.</p> <p>Check brake cylinder seal as follows:</p> <ol style="list-style-type: none"> <li>A. Disconnect the swivel tee from the brake release port. Connect a hand pump with accurate 0-2000 psi gauge and shut-off valve to the -4 J.I.C. fitting in the brake release port.</li> <li>B. Apply 1000 psi to the brake. Close shut-off valve and let stand for five (5) minutes.</li> <li>C. If there is any loss of pressure in five (5) minutes, the brake cylinder should be disassembled for inspection of the sealing surfaces and replacement of the seals. Refer to "Motor Support-Brake Cylinder Service".</li> </ol> <p>Disassemble brake to inspect brake discs. Check stack-up height as described in "Motor Support-Brake Cylinder Service".</p>



TROUBLE	PROBABLE CAUSE	REMEDY
<p><b>B</b></p> <p>Oil leaks from vent plug.</p>	<p>1. Same as A2.</p> <p>2. Motor seal may be defective as a result of high system back pressure or contaminated oil.</p>	<p>Same as A2.</p> <p>System back pressure must not exceed 150 psi. Inspect hydraulic system for a restriction in the return line from the control valve to the reservoir. Be sure control valve and plumbing is properly sized to winch motor.</p> <p>Oil analysis may indicate contamination has worn motor shaft and seal. Thoroughly flush entire hydraulic system and install new filters and oil. Install new motor seal.</p>
<p><b>C</b></p> <p>The brake will not hold a load with the control lever in neutral.</p>	<p>1. Excessive system back pressure acting on the brake release port.</p> <p>2. Friction brake will not hold due to worn or damaged brake discs.</p> <p>3. Brake clutch is slipping.</p>	<p>The same as Remedy 2 of Trouble B2.</p> <p>Same as Remedy 3 of Trouble A3.</p> <p>Improper planetary gear oil may cause the brake clutch to slip. Drain old gear oil and flush winch with solvent. Thoroughly drain solvent and refill winch with recommended planetary gear oil listed in "Preventive Maintenance".</p> <p>Brake clutch may be damaged or worn. Disassemble and inspect brake clutch as described in "Brake Clutch Service".</p>
<p><b>D</b></p> <p>The winch will not hoist the rated load.</p>	<p>1. The winch may be mounted on an uneven or flexible surface which causes distortion of the winch base and binding of the gear train. Binding in the gear train will absorb horsepower needed to hoist the rated load and cause heat.</p> <p>2. System relief valve may be set too low. Relief valve needs adjustment or repair.</p>	<p>Reinforce mounting surface.</p> <p>If necessary, use shim stock to level winch. Refer to "Winch Installation".</p> <p>First loosen, then evenly retighten all winch mounting bolts to recommended torque.</p> <p>Check relief pressure as follows:</p> <p>A. Install an accurate 0-4000 psi (27,580 kPa) gauge into the inlet port of the brake valve.</p>

TROUBLE	PROBABLE CAUSE	REMEDY
TROUBLE "D" CONTINUED FROM PREVIOUS PAGE	<p>3. Be certain hydraulic system temperature is not more than 180 degrees F. Excessive hydraulic oil temperatures increase motor internal leakage and reduce motor performance.</p> <p>4. Winch line pull rating is based on 1st layer of wire rope.</p> <p>5. Rigging and sheaves not operating efficiently.</p>	<p>B. Apply a stall pull load on the winch while monitoring pressure.</p> <p>C. Compare gauge reading to winch specifications. Adjust relief valve as required.</p> <p>NOTE: If pressure does not increase in proportion to adjustment, relief valve may be contaminated or worn out. In either case, the relief valve may require disassembly or replacement.</p> <p>Same as remedies for Trouble D1 &amp; D2.</p> <p>Same as remedies for Trouble E2.</p> <p>Refer to winch performance charts for additional information.</p> <p>Perform rigging service as recommended by crane manufacturer.</p>
<p><b>E</b></p> <p>The winch runs hot.</p>	<p>1. Same as D1.</p> <p>2. Be certain that the hydraulic system temperature is not more than 180 degrees F. Excessive hydraulic oil temperatures may be caused by:</p> <p>A. Plugged heat exchanger.</p> <p>B. Too low or too high oil level in hydraulic reservoir.</p> <p>C. Same as D2.</p> <p>D. Hydraulic pump not operating efficiently.</p> <p>3. Excessively worn or damaged internal winch parts.</p>	<p>Same as remedies for Trouble D1.</p> <p>Thoroughly clean exterior and flush interior.</p> <p>Fill/drain to proper level.</p> <p>Same as remedies for Trouble D2.</p> <p>Prime mover low on horsepower or R.P.M. Tune/adjust prime mover.</p> <p>Check suction line for damage.</p> <p>If pump is belt driven, belts are slipping. Replace/tighten belts.</p> <p>Pump worn. Replace pump.</p> <p>Disassemble winch to inspect/replace worn parts.</p>

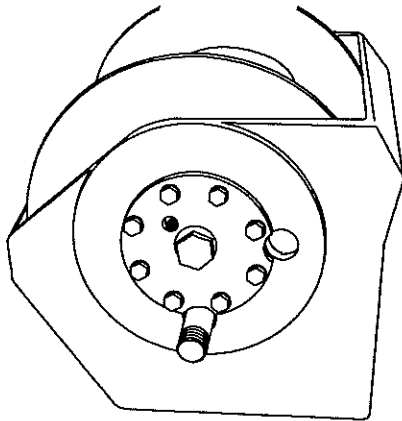
TROUBLE	PROBABLE CAUSE	REMEDY
<p style="text-align: center;"><b>F</b></p> <p>Winch "chatters" while raising rated load.</p>	<ol style="list-style-type: none"> <li>1. Same as D2.</li> <li>2. Hydraulic oil flow to motor may be too low.</li> <li>3. Controls being operated too quickly.</li> </ol>	<p>Same as remedies for Trouble D2.</p> <p>Same as remedies for Trouble E2.</p> <p>Conduct operator training as required.</p>
<p style="text-align: center;"><b>G</b></p> <p>The wire rope does not spool smoothly on the drum.</p>	<ol style="list-style-type: none"> <li>1. The winch may be mounted too close to the main sheave, causing the fleet angle to be more than 1-1/2 degrees.</li> <li>2. The winch may not be mounted perpendicular to an imaginary line between the center of the cable drum and the first sheave.</li> <li>3. Could possibly be using the wrong lay rope. There is a distinct advantage in applying rope of the proper direction of lay. When the load is slacked off, the several coils on the drum will stay closer together and maintain an even layer. If rope of improper lay is used, the coils will spread apart each time the load is removed. Then, when winding is resumed, the rope has a tendency to criss-cross and overlap on the drum. The result is apt to be a flattened and crushed rope.</li> <li>4. The winch may have been overloaded, causing permanent set in the wire rope.</li> </ol>	<p>Check mounting distance and fleet angle. Reposition winch as required.</p> <p>Refer to "Winch Installation".</p> <p>Consult wire rope manufacturer for recommendation of wire rope that best suits your application.</p> <p>Replace wire rope and conduct operator/rigger training as required.</p>

# DISASSEMBLY OF WINCH

## SERVICE PRECAUTIONS

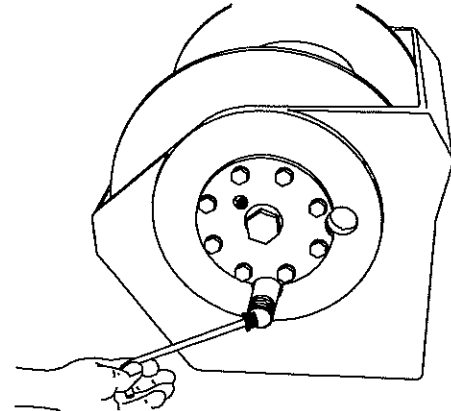
- Before any part is removed from the winch, all service instructions should be read and understood.
- Work in a clean, dust free area as cleanliness is of utmost importance when servicing hydraulic equipment.
- Inspect all replacement parts, prior to installation, to detect any damage which might have occurred in shipment.
- Use only genuine BRADEN replacement parts for optimum results. Never reuse expendable parts such as oil seals and O-rings.
- Inspect all machined surfaces for excessive wear or damage . . . before reassembly operations are begun.
- Lubricate all O-rings and oil seals with gear oil prior to installation.
- Use a sealing compound on the outside surface of oil seals and a light coat of thread sealing compound on pipe threads. Avoid getting thread compound inside parts or passages which conduct oil.
- Thoroughly clean all parts in a good grade of non-flammable safety solvent. Wear protective clothing as required.

After troubleshooting the winch and its hydraulic system as covered in the "Troubleshooting" section, and the problem is determined to be in the winch, use the following procedure to disassemble the winch.

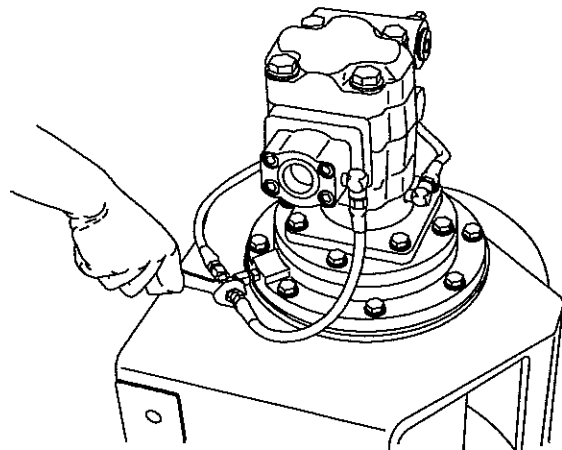


1. Remove the wire rope from the winch drum and align the drain hole in the drum with a hole in the support side plate before removing the hoses and mounting bolts. After the winch is removed from its mounting, thoroughly clean the outside surfaces. To drain the oil, install a short piece of

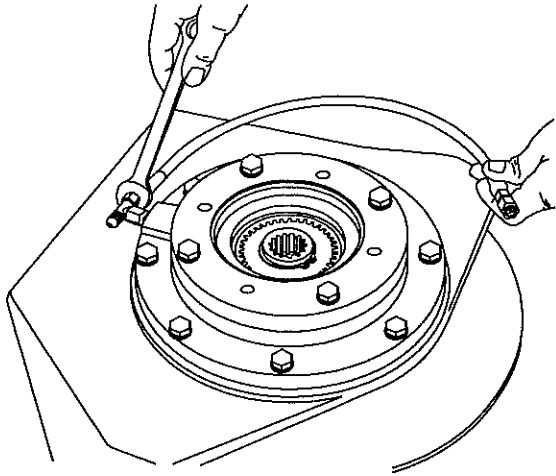
1 inch pipe in the larger threads of the drain hole. If necessary, insert a bar into the anchor pocket and manually rotate the drum in the direction to hoist a load until the drain holes are aligned.



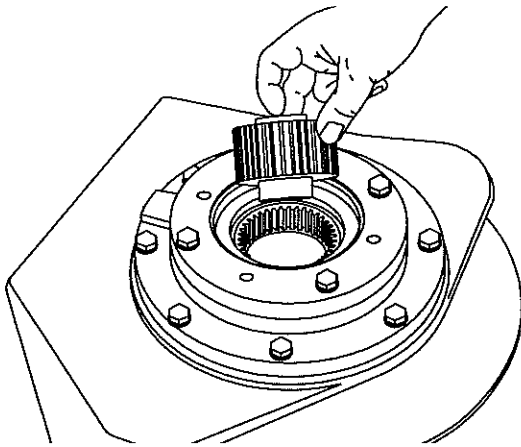
2. Use a 5/16 inch Allen wrench to remove the drain plug through the pipe.



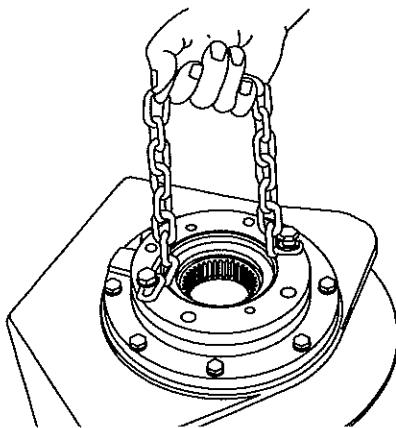
3. Begin disassembly by removing the oil level plug and standing the winch on the bearing support end. Tag and remove the hydraulic hoses that connect the brake valve and manifold to the brake cylinder.
4. Remove the capscrews securing the motor, and lift the motor off the winch. Remove and discard the O-ring installed on the pilot of the motor.



5. Tag and remove the hoses and fittings from the brake cylinder release port.



6. Remove the brake clutch assembly from the motor support. Refer to "Brake Clutch Service" for additional information.

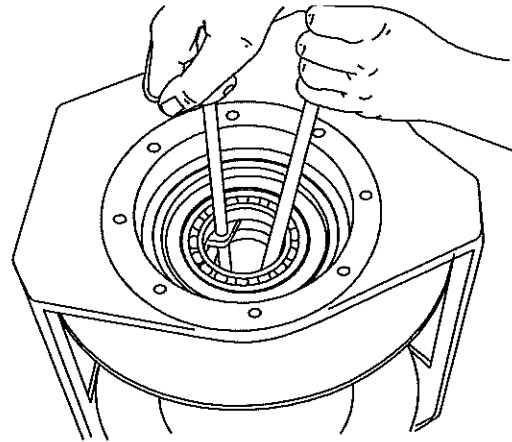


7. Remove the motor support capscrews and install two (2) capscrews and a short piece of chain into the motor mounting bolt holes. Using the chain as a handle, lift the motor support out of the brake cylinder being careful to avoid damaging the sealing surfaces. Remove and discard the O-

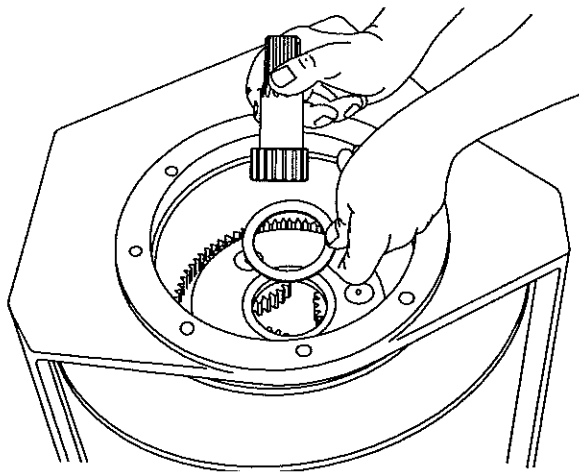
ring and back-up ring from the motor support. Refer to "Motor Support-Brake Cylinder Service" for additional information.

8. Remove the brake cylinder capscrews and install two (2) capscrews and a short piece of chain into the motor support mounting bolt holes. Using the chain as a handle, lift the brake cylinder out of the drum and base, being careful to avoid damaging the sealing or bearing surfaces. Refer to "Motor Support-Brake Cylinder Service" for additional information.

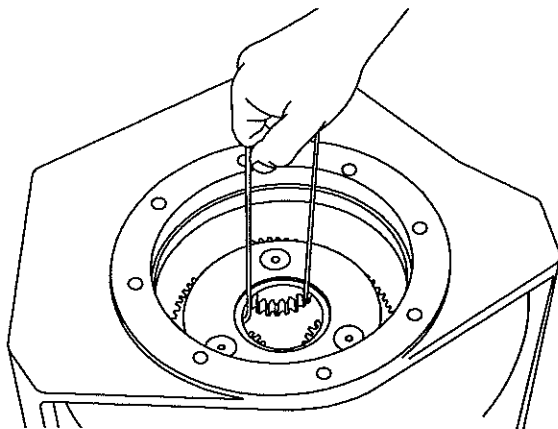
**For PD15B winches**, the drum closure cannot be removed through the opening in the base. If your winch has a cast base, remove the bearing support, as described in step 15, and remove the drum from the base. Then proceed with steps 9 thru 14. If your winch has a three piece base, remove the motor end side plate and continue with step 9.



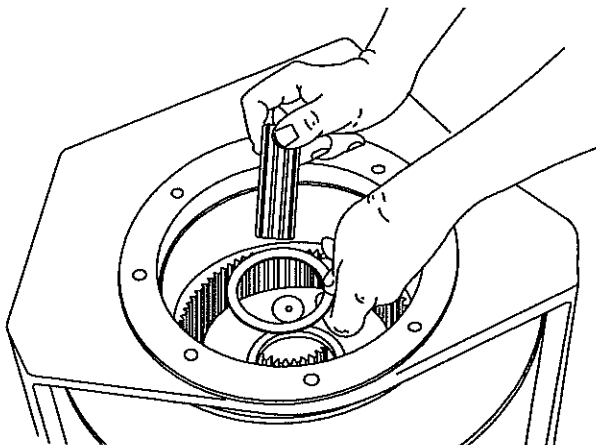
9. Using two heel type pry bars placed between the primary planet carrier and the drum closure, pry upward to remove the drum closure. Remove and discard the O-ring from the outside of the drum closure.
10. Remove the seal and bearing from inside of closure.



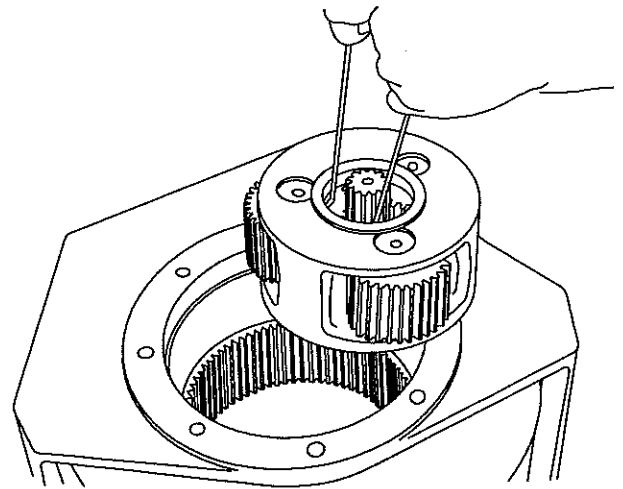
11. Remove the primary sun gear and thrust washer from the primary planet carrier.



12. Remove the primary planet carrier from the drum. Refer to "Planet Carrier Service" for additional information.



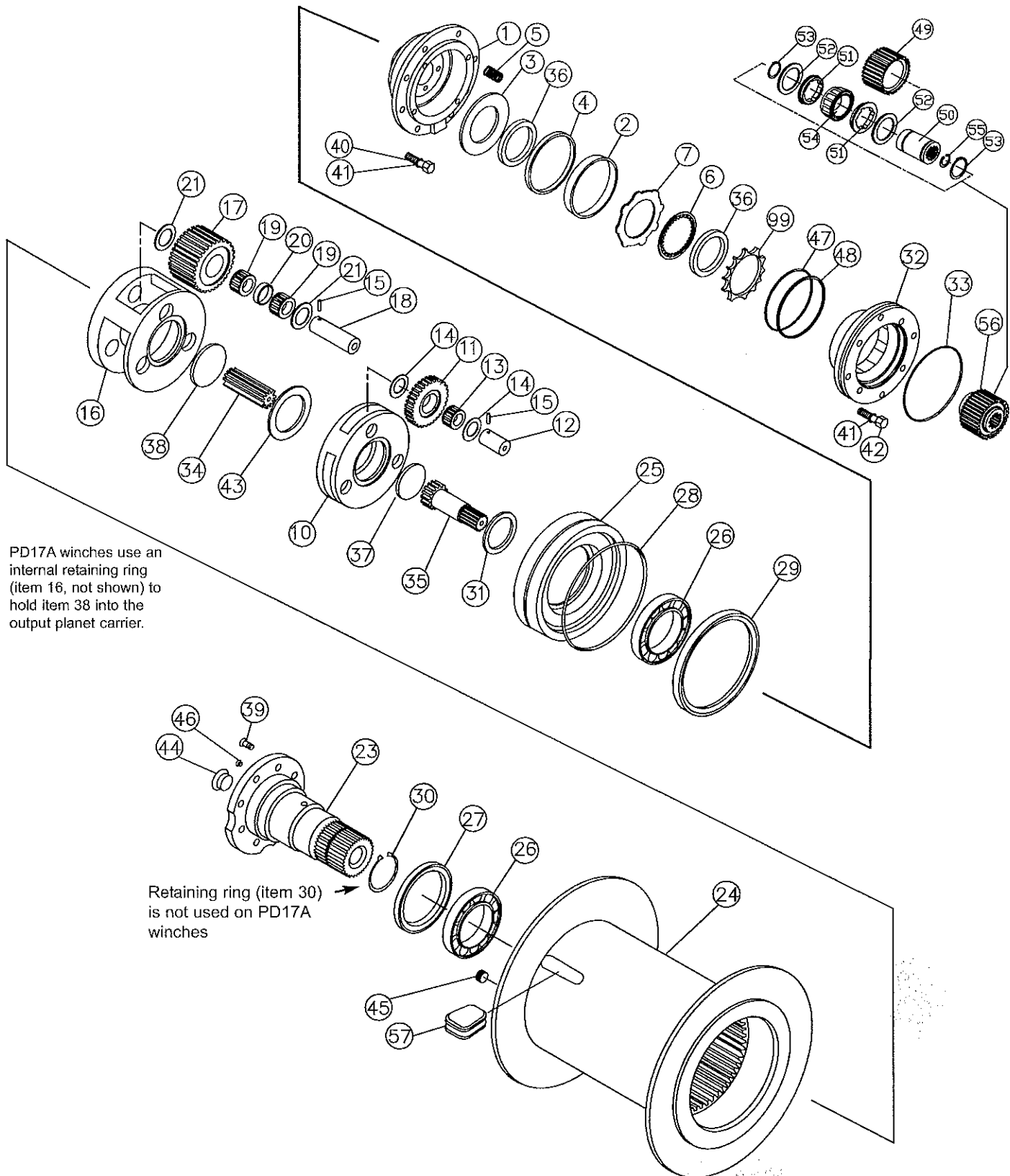
13. Remove the output sun gear and thrust washer from the output planet carrier.

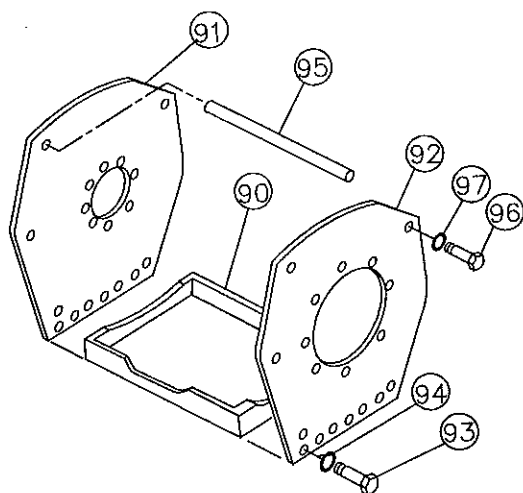
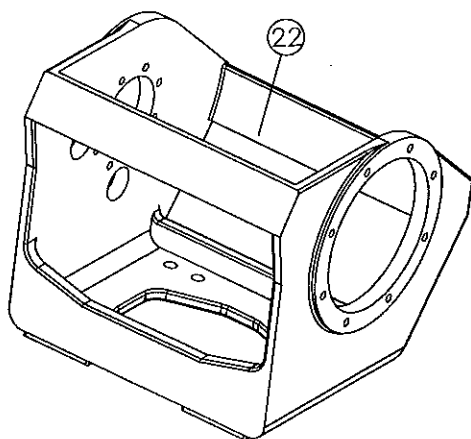
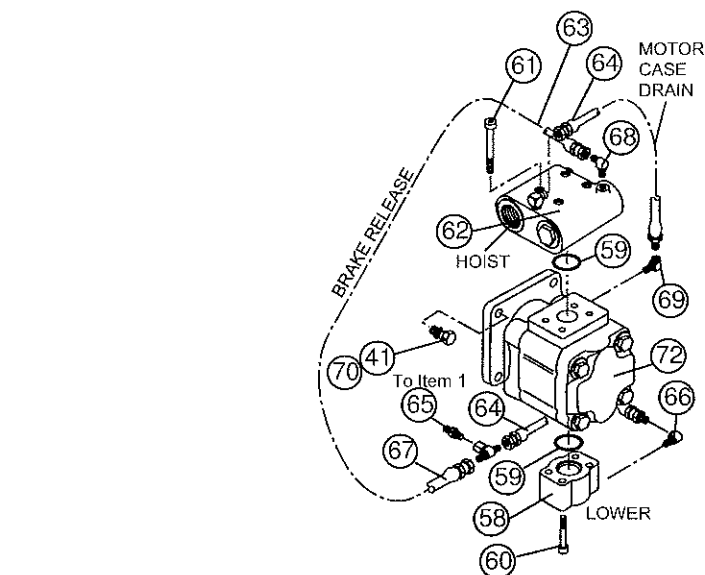


14. Remove the output planet carrier from the drum. Refer to "Planet Carrier Service" for additional information.
15. Stand winch on motor end with bearing support up; then remove eight (8) bearing support capscrews and bearing support being careful to avoid damaging the sealing or bearing surfaces.
16. Slide drum out of base onto a work bench and remove seal and bearing from support end.
17. Thoroughly clean and inspect drum and base. Check ring gear (machined into inside surface of drum) teeth for nicks, spalling or excessive wear. Replace if wear is greater than 0.015 in. (0.4 mm) when compared to unworn area of teeth.

# BRADEN PD12C/PD15B/PD17A COMPONENTS

PD17A winches use only 1 each of items 52 and 53 due to the shoulder on item 50. (shoulder is toward motor)





For actual part numbers, refer to:  
 PD12C Material List PB-109  
 PD15B Material List PB-229  
 PD17A Material List LIT2099

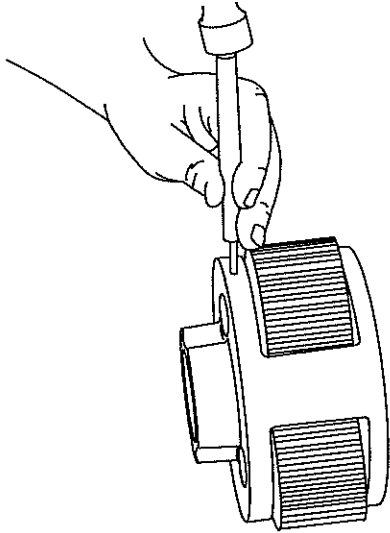
## PD12C/PD15B/PD17A PARTS KEY

ITEM	QUANTITY	DESCRIPTION
1	1	Brake Cylinder
2	1	Piston Seal
3	1	Pressure Plate
4	1	Piston Back-up Ring
5	12	Spring
6	7	Disc-friction
7	8	Disc-brake
10	1	Primary Planet Carrier
11	3	Primary Planet Gear
12	3	Primary Planet Gear Shaft
13	3	Roller Bearing
14	6	Thrust Washer
15	6	Spirot Pin
16	1	Output Planet Carrier
17	3	Output Planet Gear
18	3	Output Planet Gear Shaft
19	6	Roller Bearing
20	3	Bearing Spacer
21	6	Thrust Washer
22	1	Base
23	1	Bearing Support
24	1	Cable Drum
25	1	Cable Drum Closure
26	2	Ball Bearing
27	1	Oil Seal
28	1	O-Ring
29	1	Oil Seal
30	1	Retaining Ring
31	1	Thrust Washer
32	1	Motor Support
33	1	O-ring
34	1	Output Sun Gear
35	1	Primary Sun Gear
36	2	Spacer
37	1	Primary Thrust Plate
38	1	Output Thrust Plate
40	16	Capscrew
41	24	Lockwasher
42	4	Capscrew
43	1	Thrust Washer
44	1	Plug - Hex. Head
45	1	Plug - Flush
46	1	Vent Plug
47	1	O-ring
48	1	Back-up Ring
49	1	Brake Race - Outer
50	1	Brake Race - Inner
51	2	Sprag Bushing
52	2	Sprag Bushing Retainer
53	2	Retaining Ring
54	1	Sprag Clutch
55	1	Retaining Ring
57	1	Cable Clamp
58	1	Manifold
59	2	O-ring
60	4	Capscrew - Socket Head
61	4	Capscrew - Socket Head
62	1	Brake Valve
63	1	Hose Assembly
64	2	Hose Assembly - 12 In.
65	1	Adapter - Straight
66	1	Elbow
67	1	Swivel Tee
68	1	Elbow
69	1	Reducer Elbow
70	4	Capscrew
72	1	Hydraulic Motor
90	1	Base Plate
91	1	Side Plate (bearing support end)
92	1	Side Plate (motor end)
93	16	Capscrew (special)
94	16	Washer
95	1/2	Tie Bar
96	2 1/4	Capscrew
97	2 1/4	Lockwasher
99	1	Spring Spacer

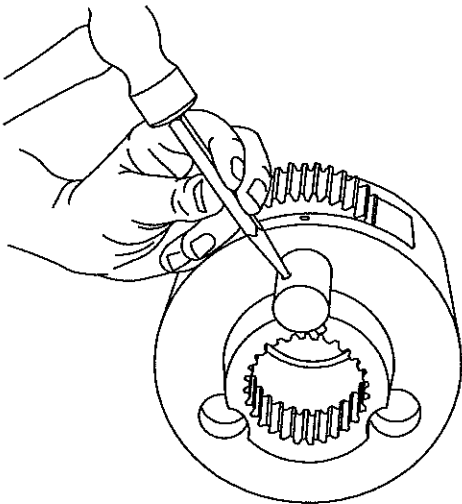


# PLANET CARRIER SERVICE

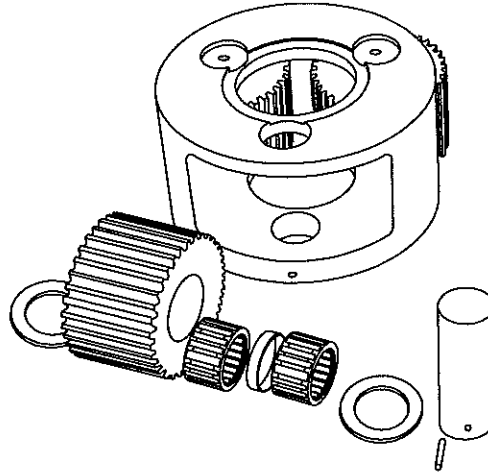
## OUTPUT PLANET CARRIER DISASSEMBLY



1. Remove the planet gears by driving the roll pins into the center of the planet shafts.

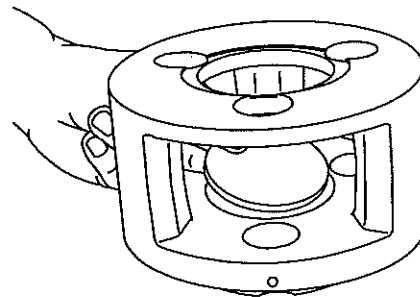


2. Use a punch to drive the roll pins from the planet shafts. Do not reuse the roll pins.



3. Now you can remove the planet shafts, bearings, spacer, thrust washers and gears. Thoroughly clean all parts and inspect for damage and wear. The bearing rollers should not exhibit any irregularities. If the rollers show any sign of spalling, corrosion, discoloration, material displacement or abnormal wear, the bearing should be replaced. Likewise, the cage should be inspected for unusual wear or deformation, particularly the cage bars. If there is any damage that will impair the cage's ability to separate, retain and guide the rollers properly, the bearing should be replaced. The thrust washer contact areas should be free from any surface irregularities that may cause abrasions or friction. The gears and shafts should be inspected for abnormal wear or pitting. Replace if necessary.

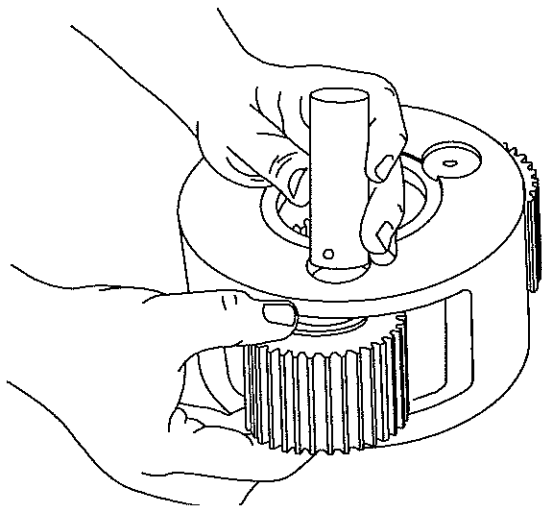
## ASSEMBLY



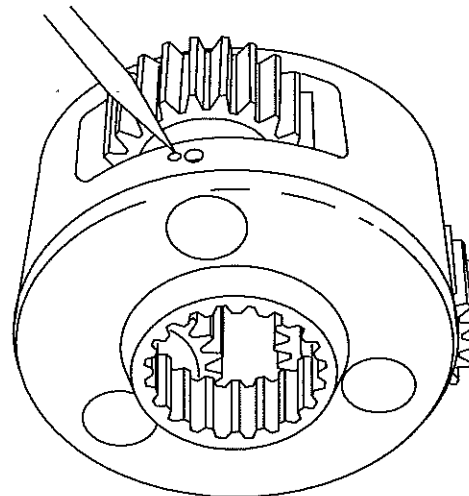
1. Place the output planet carrier on workbench with splined coupling side down. Install output thrust plate in center of carrier.

### ⚠ CAUTION ⚠

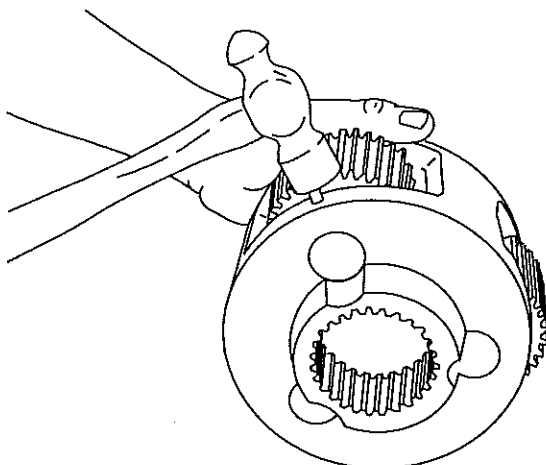
PD17A winches have an internal retaining ring to hold the thrust plate into the carrier. This retaining ring **MUST** be properly installed and fully seated before the planet gears are installed.



2. Insert two (2) bearings and a bearing spacer into a gear with the spacer between the bearings. Place a thrust washer on each side of the gear and position in a carrier opening. Slide the shaft through the carrier, thrust washer, bearing-gear sub-assembly and remaining thrust washer.



4. Note that the roll pin is slightly recessed in the carrier when properly installed. With a center punch, stake the carrier next to the pin hole as shown. This will distort the hole so the pin will not back out... Repeat these steps for each of the three planet gears.



3. Carefully align the pin hole in the carrier with the hole in the planet gear shaft and drive the roll pin into place. Always use NEW roll pins. When properly positioned, 50% of the roll pin will engage the planet gear shaft and 50% will remain in the planet carrier.

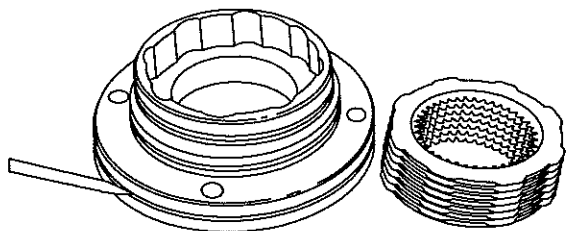
### PRIMARY PLANET CARRIER

1. To service the primary planet carrier, the steps are the same as for the output carrier except there is only one bearing for each gear and no bearing spacer.

**i** **NOTE:** PD17A winches DO NOT have a thrust plate in the primary planet assembly.

# MOTOR SUPPORT-BRAKE CYLINDER SERVICE

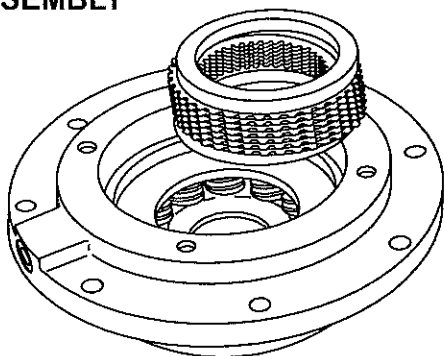
NOTE: Starting mid-year 1996, Braden changed the steel brake separator discs from a splined tooth design to a lobed design. This required a change to the motor support and brake cylinder and the addition of a spring spacer. A winch with the lobed discs can be identified by a machined groove on the outside diameter of the motor support. When replacing steel brake discs, the motor support or brake cylinder, care must be taken to properly identify the correct parts. Splined discs, and their mating motor support and brake cylinder will remain available as spare parts.



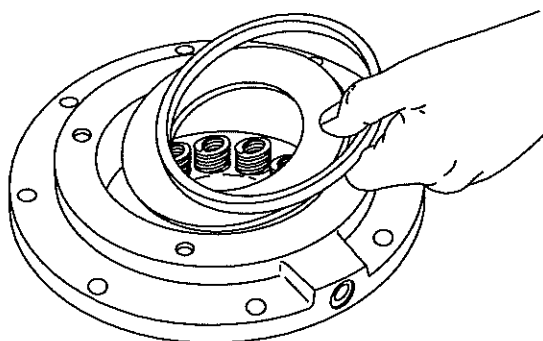
New lobed steel brake separator plates and motor support. Note groove on outside diameter of motor support.

Although most photos in this section show splined discs, all procedures are the same except where specifically noted.

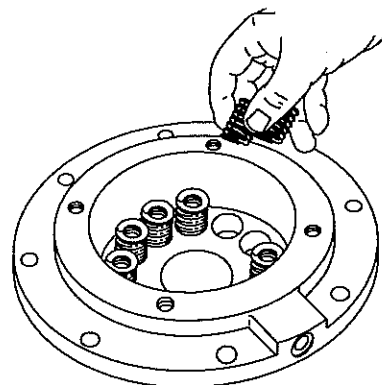
## DISASSEMBLY



1. After removing the motor support and brake clutch assembly, continue brake cylinder disassembly by removing the spacers, friction brake discs and steel brake discs.

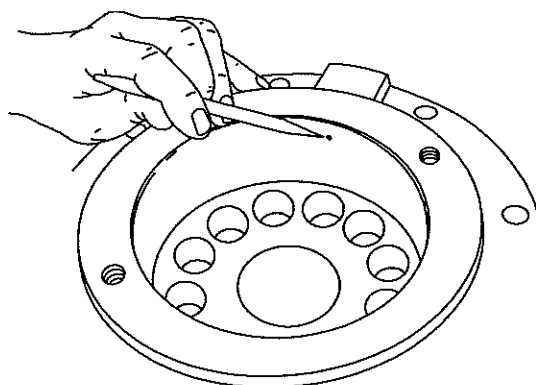


2. Remove the piston back-up ring and pressure plate.

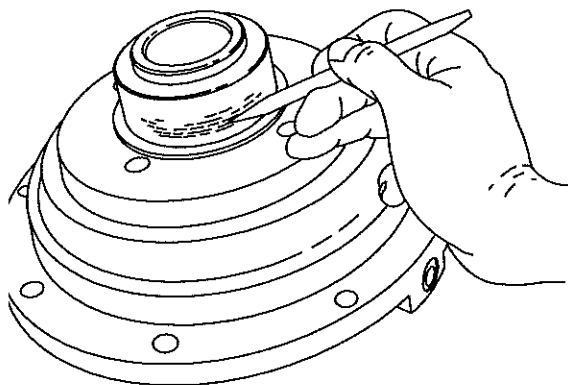


3. Remove the brake springs.

## CLEAN AND INSPECT

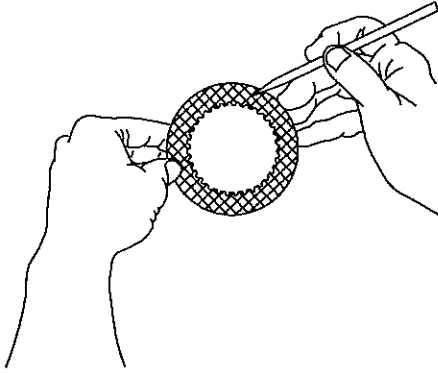


1. Thoroughly clean and inspect all parts at this time. Check brake piston sealing surfaces on brake cylinder and motor support. Be sure brake release port is free of contamination.

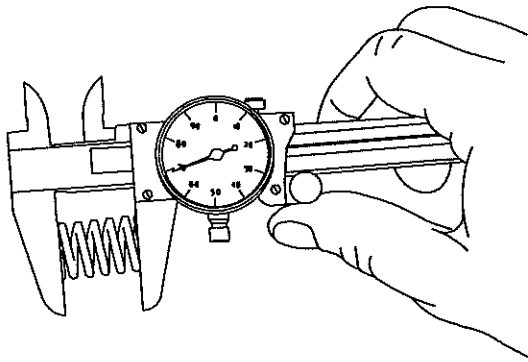


2. Check oil seal and bearing surfaces on brake cylinder for damage or wear.

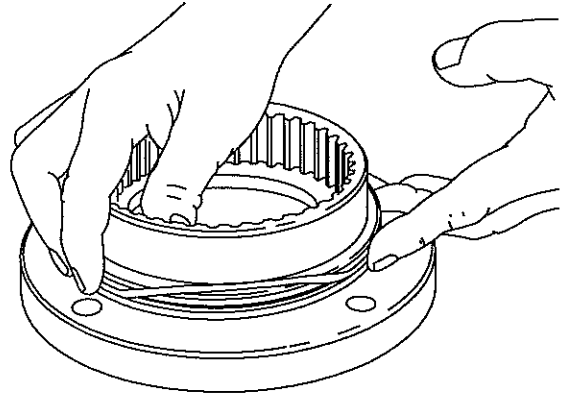
## ASSEMBLY



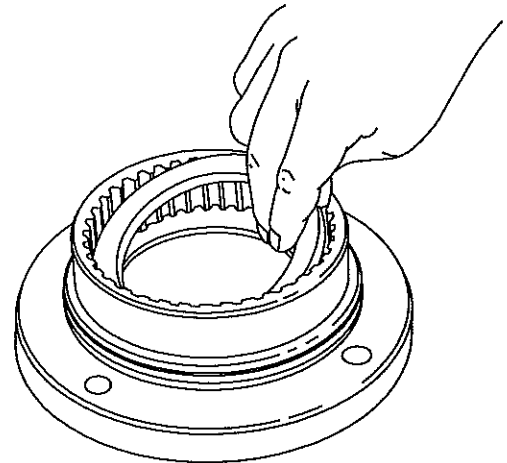
3. Place friction brake disc on flat surface and check for distortion with a straight edge. Friction material should appear even across entire surface with groove pattern visible. Replace friction disc if splines are worn to a point, disc is distorted, friction material is worn unevenly, or groove pattern is worn away.
4. Place steel brake disc on flat surface and check for distortion with a straight edge. Check surface for signs of material transfer or heat. Replace steel disc if splines are worn to a point, disc is distorted or heat discolored.



5. Check brake spring free length; minimum free length is 1 3/16 in. (30.2 mm). Check springs for any sign of cracking or failure. If a brake spring must be replaced for any reason, then ALL brake springs must be replaced.



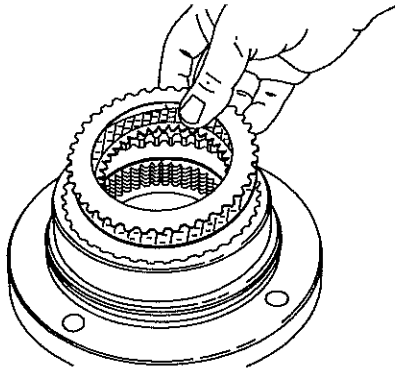
1. Begin assembly by placing motor support on workbench with motor mounting surface down. Install new O-ring and back-up ring as shown.



2. Install a brake spacer into the motor support. (Not required with lobed discs.)

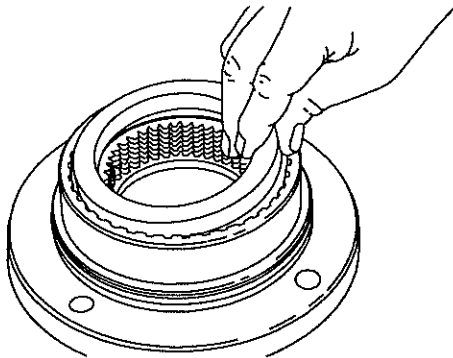
### **CAUTION**

Failure to replace brake springs as a set may result in uneven brake application pressure and repeated brake spring failure.

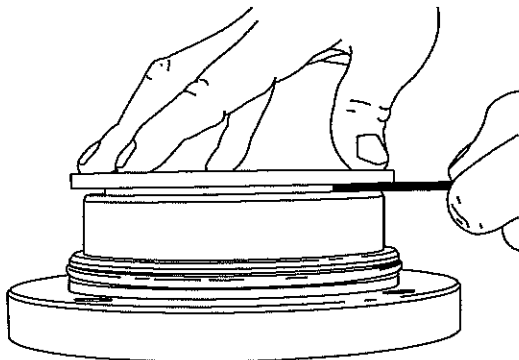


3. Insert first, a steel brake disc against the spacer followed by a friction brake disc then alternate steel and friction discs until seven (7) friction and eight (8) steel discs have been installed. Finish with a steel brake disc on top.

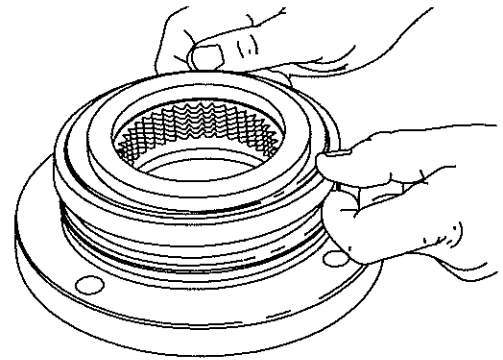
NOTE: It is a good practice to pre-lubricate the discs in light motor oil prior to assembly.



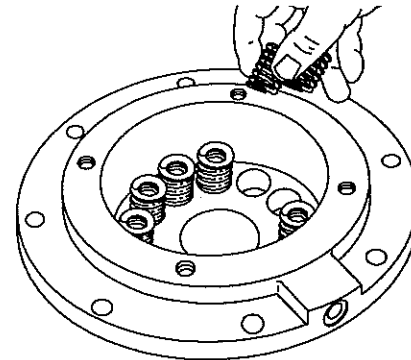
4. Install the remaining brake spacer on top of the last steel brake disc. (This is the only spacer used with lobed discs.)



5. To check brake stack height, place pressure plate on top of brake spacer. Hold pressure plate down firmly by hand and measure clearance in three places between motor support and pressure plate. Average gap must measure between .153 in. (4 mm) maximum and .080 in. (2 mm) minimum. If the gap exceeds the maximum limit, there are too many brake discs in stack-up or the discs are distorted. If the gap is less than the minimum, there are too few discs in stack-up or the discs are worn out. When stack height is correct, remove pressure plate and continue assembly.

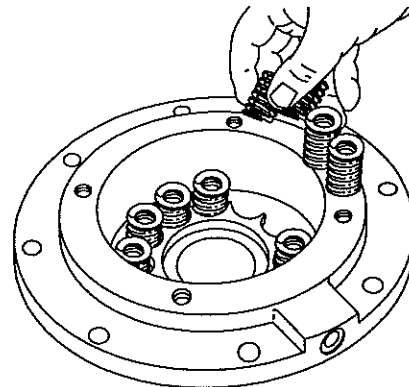


6. Lubricate the brake piston seal and motor support sealing surface with petroleum jelly or hydraulic oil. Install new piston seal to motor support, seal lip down.



### OLDER STYLE BRAKE CYLINDER

7. Install brake springs into brake cylinder

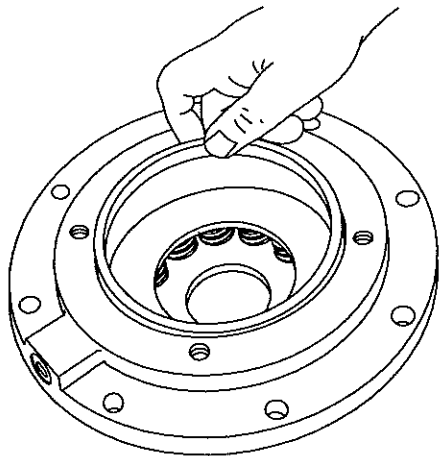


### NEW STYLE BRAKE CYLINDER

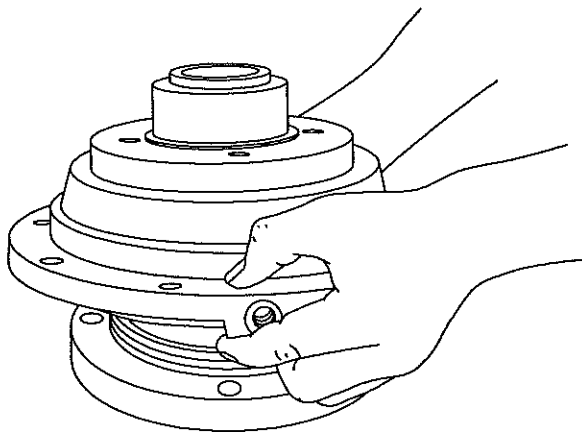
- 7A. When using the new style brake cylinder without milled spring pockets, install the spring spacer, then the brake springs.

### ⚠ WARNING ⚠

Always use the molded spring spacer with the new brake cylinder. The brake springs must be properly positioned by the spring spacer. Failure to install the spring spacer may allow the springs to contact each other and become damaged. This could result in loss of load control, property damage, injury or death.

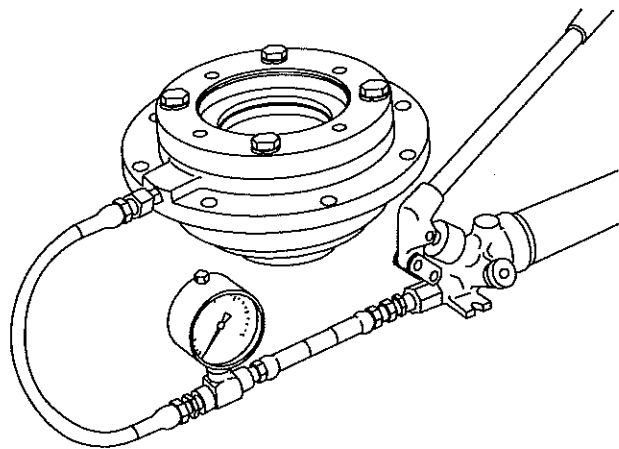


8. Install pressure plate into brake cylinder followed by the piston back-up ring. The close-fitting piston back-up ring may be depressed slightly to one side to lodge the back-up ring in the brake cylinder bore and temporarily hold the pressure plate and springs in place while you lower the brake cylinder over the motor support.



9. Apply petroleum jelly to the entire sealing surface of the brake cylinder and to the piston seal. Install the brake cylinder over the motor support being careful to avoid damaging the piston seal or motor support O-ring. (A press may be necessary to avoid cocking the brake cylinder during installation.)
10. Install motor support capscrews and evenly tighten to recommended torque.

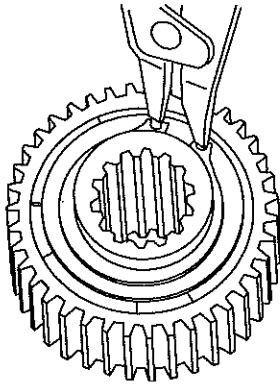
## BRAKE CYLINDER PRESSURE TEST



1. Install the -4 J.I.C. fitting into the brake release port. Connect a hand pump with accurate 0-2000 psi (0-13,800 kPa) gauge and shut-off valve to this fitting. Apply 1000 psi (6,900 kPa) to the brake. Close shut-off valve and let stand for five (5) minutes. If there is any loss of pressure in five (5) minutes, the brake cylinder should be disassembled for inspection of the sealing surfaces and brake piston.
2. WHILE PRESSURE IS APPLIED AND THE BRAKE RELEASED, install the brake clutch assembly in the brake pack, short end of the inner race toward motor. Turn the clutch back and forth as you align the outer race splines with the brake disc splines.
3. Release the pressure on the brake cylinder then remove the brake clutch assembly. The brake cylinder assembly is now complete and ready to be installed in the winch.

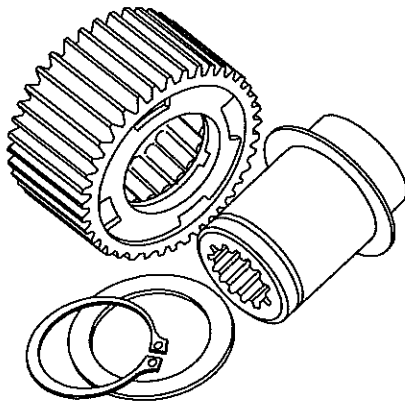
# BRAKE CLUTCH SERVICE

## DISASSEMBLY

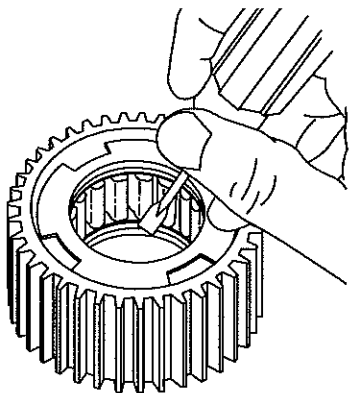


1. Remove the snap ring and sprag bushing retainer from one end only.

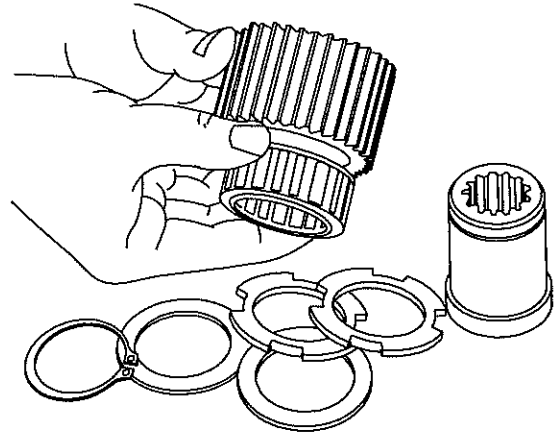
**i** **NOTE:** The brake clutch on PD17A winches uses a stepped inner race, which eliminates one retaining ring and bushing retainer. The larger end of the inner race is toward the motor.



2. Pull the inner race out. Examine the race for scoring, wear or indentations caused by the sprag cams.



3. Use a screwdriver and mallet to remove the sprag bushing from one end of the outer race. There are four special cut-outs in the bushing for this purpose. Be careful not to damage the bushing inside surface. If a bushing's inside surface is damaged or shows wear, replace it.

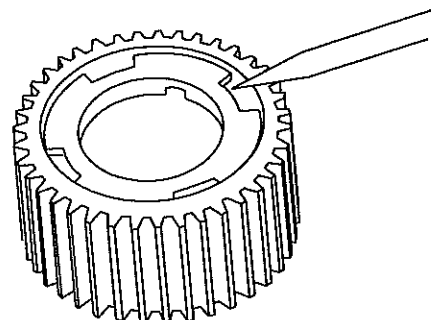


4. Next, slide the sprag clutch out, inspect the sprag clutch closely for abnormal wear, cracks, pitting or corrosion. Check small clips for breakage or bright spots; the signs of excessive wear. Unless the outer race or remaining sprag bushing is damaged or shows excessive wear, there is no need for further disassembly. If disassembly is necessary, remove the bushing according to the procedure covered in Step No. three (3). All brake clutch assembly parts should be thoroughly cleaned and inspected before assembly.

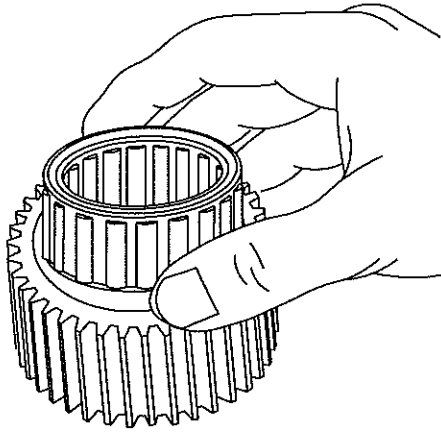
## ⚠ WARNING ⚠

The polished surfaces of the races and sprag cams must be perfectly smooth to insure positive engagement of the clutch. The slightest defect may reduce brake clutch effectiveness, which may lead to loss of load control and result in property damage, personal injury or death. It is generally recommended to replace the entire brake clutch assembly if any component is defective.

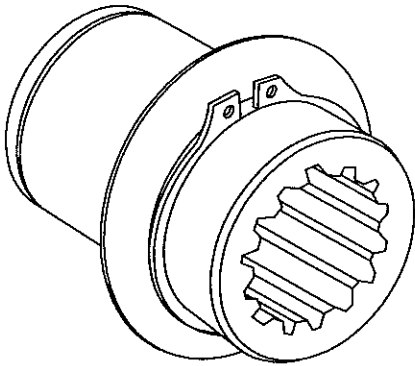
## ASSEMBLY



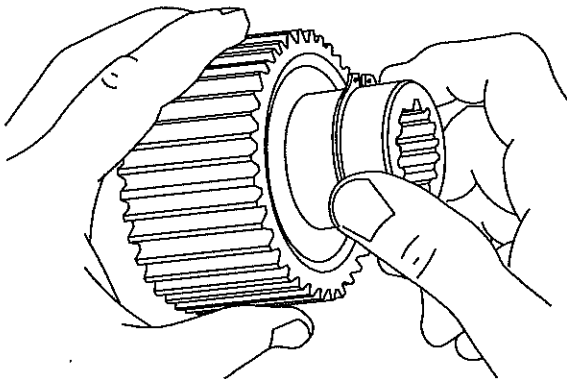
1. Press a sprag bushing into the outer race, using a mechanical or hydraulic press. A flat plate of approximately the same diameter as the bushing flange outside diameter should be placed between the press and bushing during assembly to protect the bushing. Be certain the bushing flange is against the shoulder in the outer race.



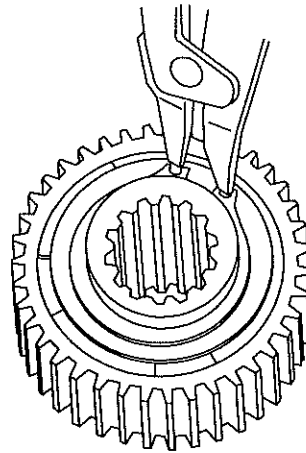
2. Turn the assembly over and install the sprag clutch in the bore of the outer race.
3. Press the remaining bushing into the race. Again, make sure the bushing is against the shoulder.



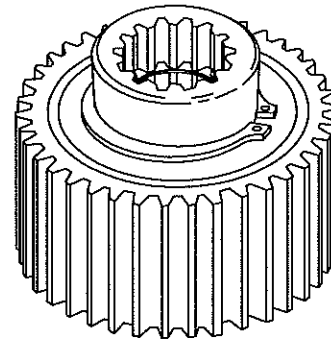
4. Next, install a sprag bushing retainer, then a snap ring on the inner race. Be sure the snap ring is seated in the snap ring groove. NOT necessary on PD17A due to stepped design.



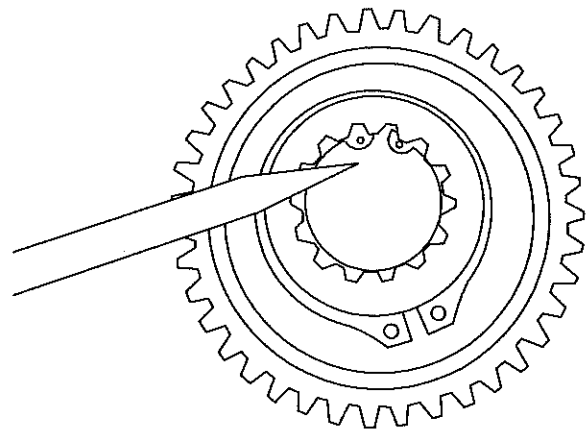
5. Slide the inner race through the bushings and sprag clutch (the race will have to be rotated in the free-wheeling direction to start it through the sprag clutch). If the inner race will not go through the bushings, the bushings have probably been damaged and should be replaced.



6. Turn the assembly over with the snap ring down. Install the second retainer and snap ring. Make certain the snap ring is seated in the groove properly.



7. This is a completed brake clutch assembly.



### ⚠ WARNING ⚠

Be certain the snap ring is seated in the groove in the splined bore of the inner race. This snap ring will keep the brake clutch assembly correctly positioned in the center of the friction brake pack. Binding of the brake or brake failure may occur if this snap ring is omitted.



# WINCH ASSEMBLY

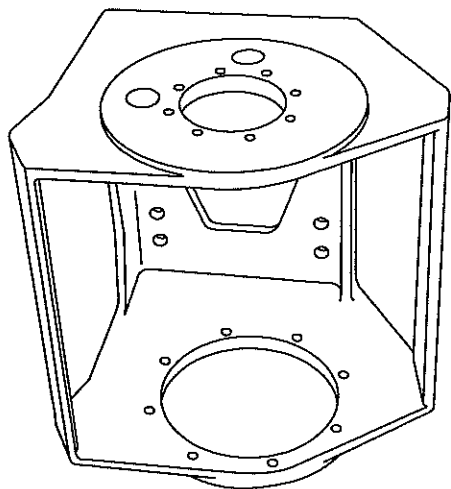
## NOTE: PD15B winches ONLY

The drum closure will not fit through the opening in the base. For winches with a three piece base, first assemble the bearing support side plate (91) to the base plate (90). Go to step 1 and follow the assembly procedure. Install the motor end side plate and tie bar(s) after installing the drum closure in step 10.

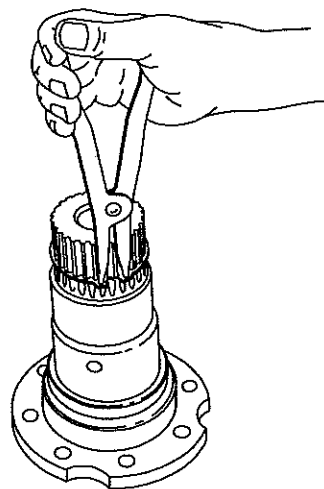
For winches with a one piece cast base, use the following assembly procedure. With the drum horizontal, install the output planet carrier assembly, output sun gear (34), thrust washer (43), primary planet carrier assembly, thrust washer (31) and drum closure. (Apply a light coat of grease to the thrust washer to hold them in position.) Position the drum in the base and install the bearing support. (Refer to step 3 for two caution statements.) You may have to rotate the bearing support or planet gears to engage the bearing support with the output planet carrier. Install and hand tighten the bearing support capscrews. Stand winch on bearing support end and visually check to verify the primary thrust plate is properly positioned. (Refer to caution and drawings in step 16.) Install the primary sun gear and proceed to step 11 to complete winch assembly. Tighten bearing support capscrews to recommended torque after motor is installed.

### ⚠ CAUTION ⚠

Winches with a three piece fabricated base use special shoulder capscrews to fasten side plates to the base plate. DO NOT use standard capscrews in their place.

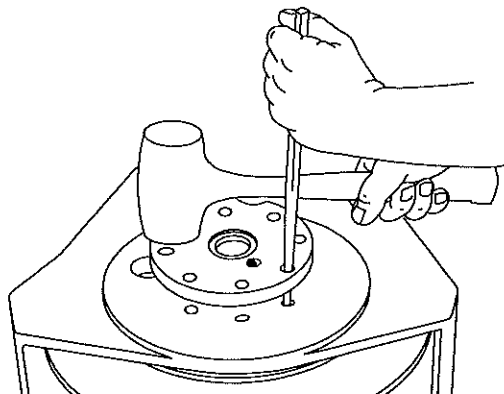


1. Place winch base on side with bearing support end up.
2. Install a new bearing in the drum if replacement is necessary. Apply a non-hardening sealant on the outside diameter of the new seal. Install the spring side of the seal next to the bearing, then press into the drum, using a flat plate to avoid distortion. Be sure drain plug is installed securely.



### ⚠ CAUTION ⚠

Make certain the snap ring is installed on the bearing support. This snap ring will keep the output planet carrier correctly positioned in the winch. Gear train damage may occur if this snap ring is omitted.

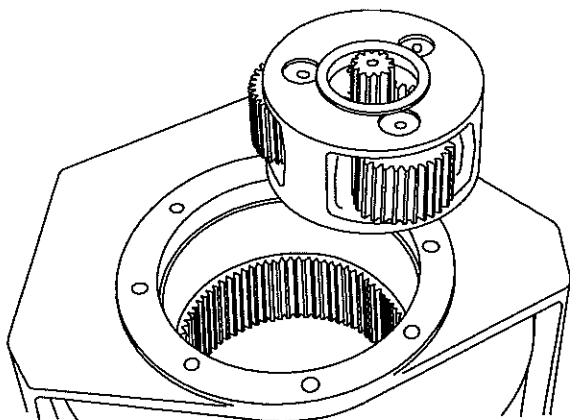


3. Center the drum in the opening of the base. Lubricate the bearing support with petroleum jelly or gear oil and install in base and drum.

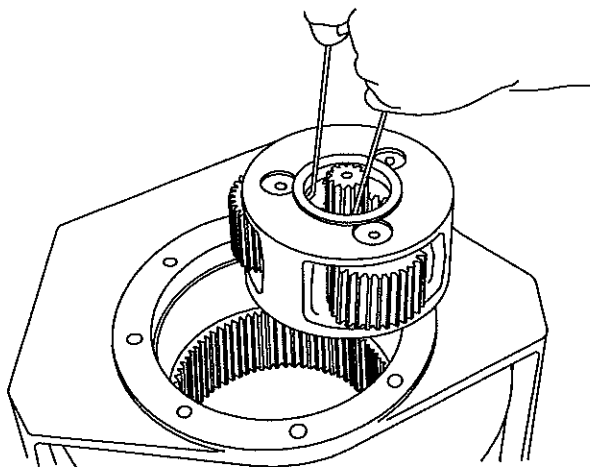
## ⚠ CAUTION ⚠

Be sure the vent plug is located above the horizontal centerline for the intended application. Oil leakage may occur if vent is positioned incorrectly.

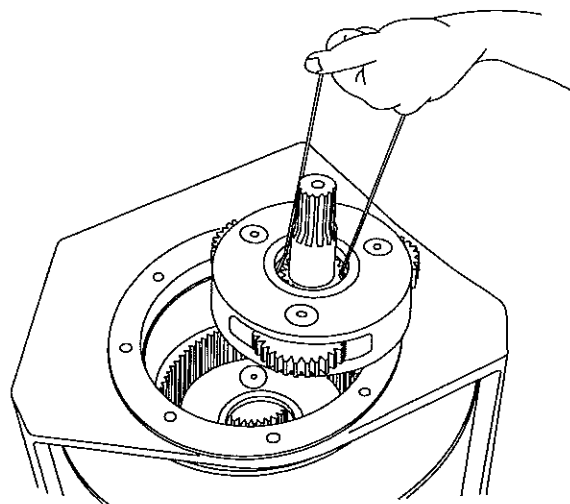
4. Tighten the bearing support capscrews to the recommended torque.



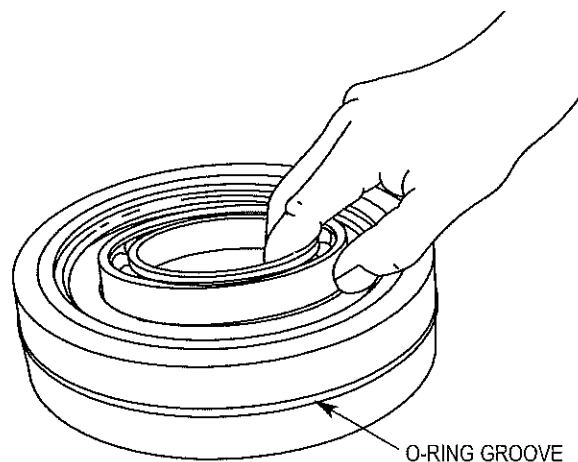
5. Stand with one foot on bearing support end. Install the output sun gear and thrust washer into output planet carrier.



6. Install the output planet carrier into the drum while meshing the planet gears with the ring gear and the planet housing with the bearing support.
7. Install the primary sun gear and thrust washer into the primary planet carrier.

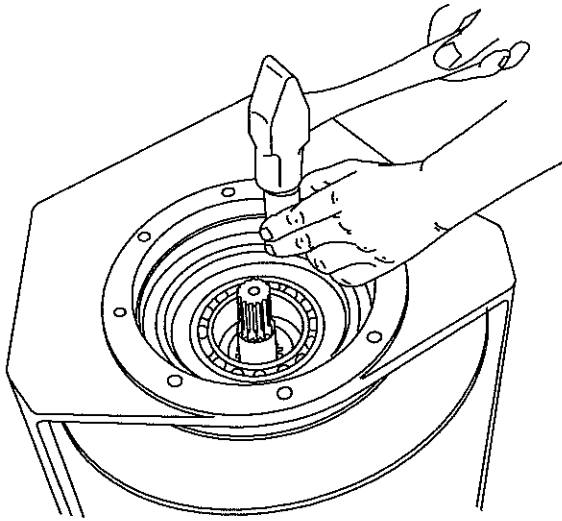


8. Install the primary planet carrier, meshing the planet gears with the ring gear and the planet housing with the output sun gear.

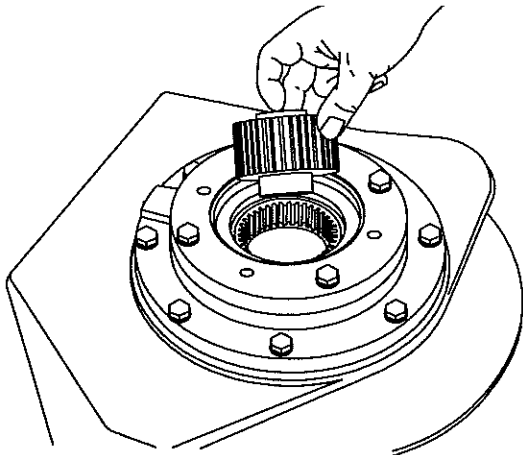


9. Install a new bearing in the drum closure as required. Use sealant on the outside surface of the oil seal. Install with spring side of the seal toward bearing, using a flat plate to avoid distortion.

Install a new O-ring in the groove on the O.D. of the drum closure.



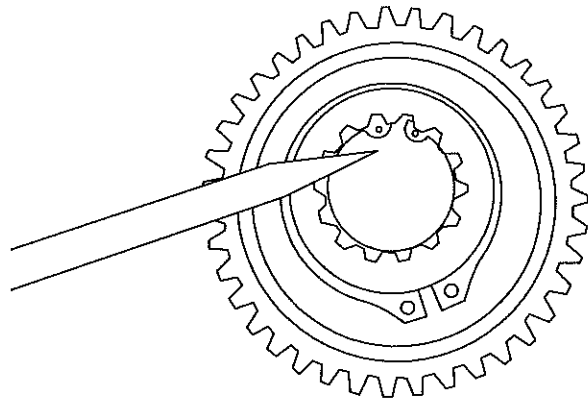
10. Lubricate the O-ring and drum opening with petroleum jelly or gear oil and install the drum closure into the drum.
11. Lubricate the pilot, oil seal and bearing surfaces of the brake cylinder and carefully install brake cylinder into base and drum. Locate the brake release port toward the lower rear corner of the base. Tighten brake cylinder capscrews to recommended torque.



12. Install the brake clutch assembly with the short end of the inner race toward motor.

When installed correctly, the inner race should turn freely in the opposite direction the drum turns to pull wire rope in. An easy way to check the rotation is to hold the outer race in one hand, and rotate the inner race.

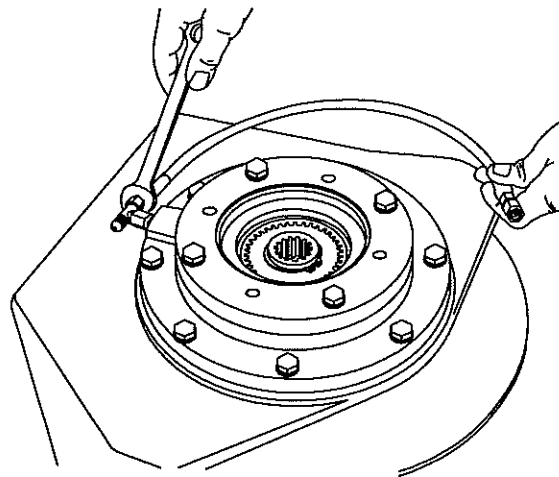
If the clutch free wheels in the wrong direction, disassemble the clutch and reverse the inner race. Refer to "Brake Clutch Service" for additional information.



### **⚠ WARNING ⚠**

Be certain the snap ring is seated in the groove in the splined bore of the inner race. This snap ring will keep the brake clutch assembly correctly positioned in the center of the friction brake pack. Binding of the brake or brake failure may occur if this snap ring is omitted.

13. If the brake discs are misaligned, preventing the installation of the clutch, then with a hand pump, apply 750-1000 psi to the brake release port. The brake discs will move freely with the brake released, permitting alignment of the discs, brake clutch and input sun gear.



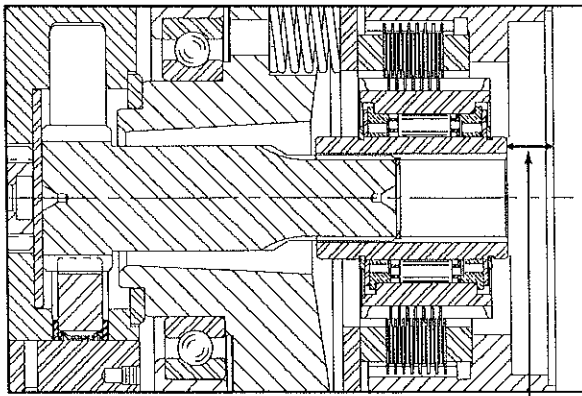
14. Install the hoses and fittings to the brake cylinder release port.

15. Install a new O-ring on the motor pilot then lubricate with petroleum jelly or gear oil.

**i NOTE:** The following caution DOES NOT apply to PD17A winches. Proceed to step 16.

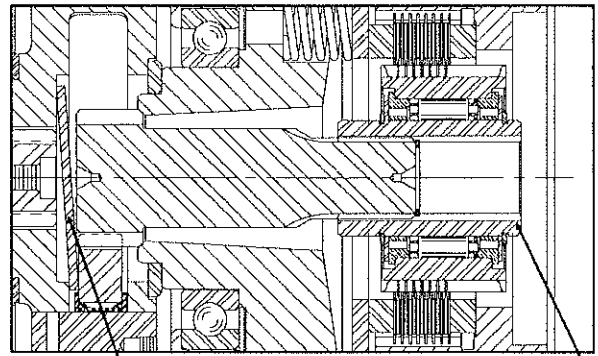
### ⚠ CAUTION ⚠

Care must be taken to assure the primary thrust plate remains properly located in its counterbore when the motor is installed for the first time, or is being reinstalled on the winch. It is possible for the primary thrust plate to drop out of its counterbore and become wedged between the planet gears and the planet carrier. If the winch is operated with the primary thrust plate wedged between primary gears and the planet carrier, or with a thrust washer out of position, severe damage to internal winch components could result.



MEASURE THIS DISTANCE

Measure the distance from the motor mounting surface to the inner brake race. With all components properly installed, this distance should be 11/16 in. (17.5 mm) to 3/4 in. (19.1 mm). If this distance is less than 9/16 in. (14.3 mm), the primary spacer may be positioned as shown below and should be checked.

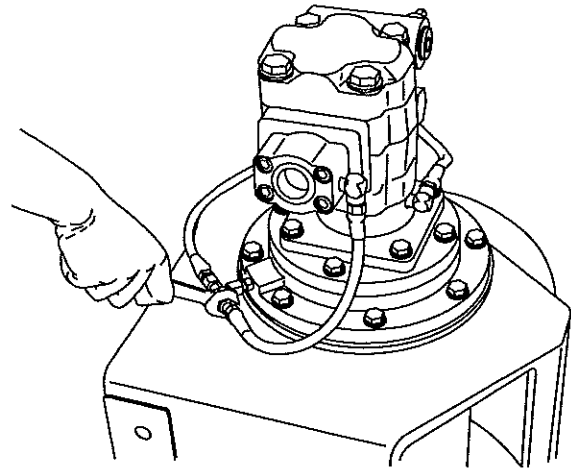


PRIMARY THRUST PLATE

BRAKE CLUTCH  
INNER BRAKE RACE

The Primary Thrust Plate is shown wedged between the planet gears and the planet carrier. Note that the Primary Sun Gear and the entire Brake Clutch Assembly have moved to the right (toward the hydraulic motor).

16. Engage the motor shaft with the brake clutch inner race and lower motor into place. Tighten capscrews to recommended torque.



17. Install the hoses that connect the manifold and brake valve to the brake cylinder.
18. After the winch assembly is complete, check all capscrews and fittings to make certain they have been tightened correctly.

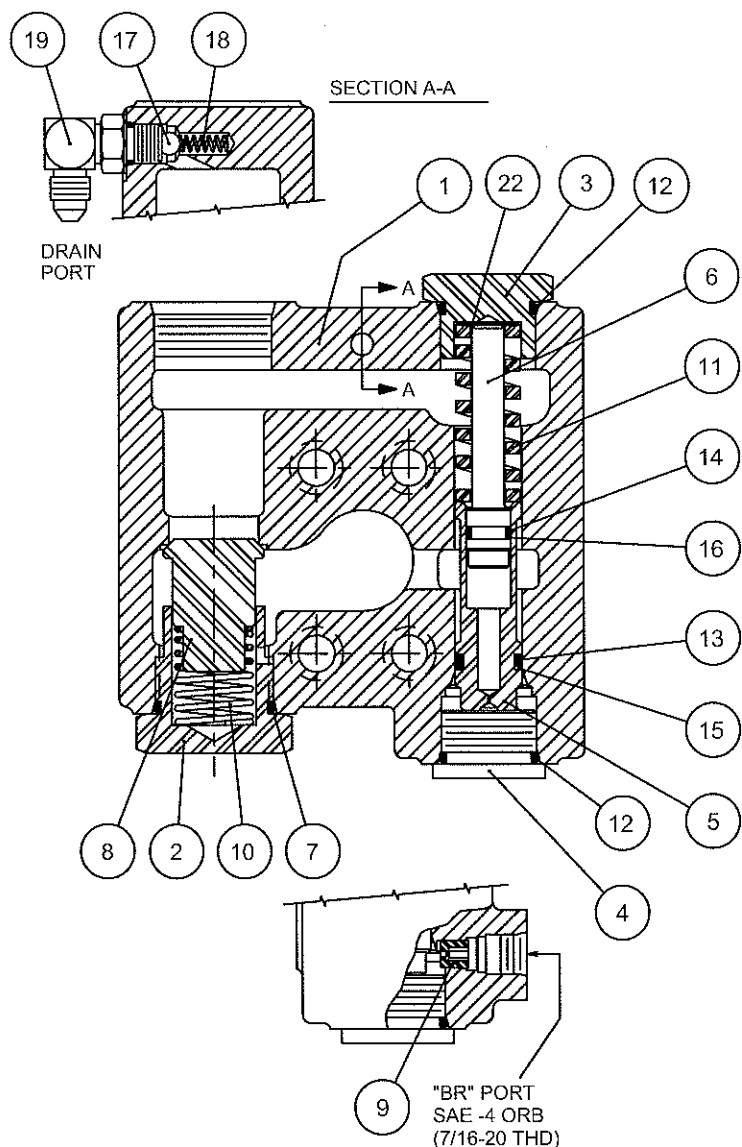
Refill the winch with the recommended oil listed under "Preventive Maintenance", and install the oil level plug.

# BRAKE VALVE SERVICE

The BRADEN brake valve is a reliable hydraulic valve with internal components manufactured to close tolerances. Due to the close tolerances and mating of components, the valve housing, spool, piston and check poppet are not available as replacement parts.

Before disassembling the brake valve, be sure you have conducted all applicable troubleshooting operations and are certain the brake valve is causing the malfunction.

Thoroughly clean the outside surfaces of the valve and work in a clean dust free area, as cleanliness is of utmost importance when servicing hydraulic components.

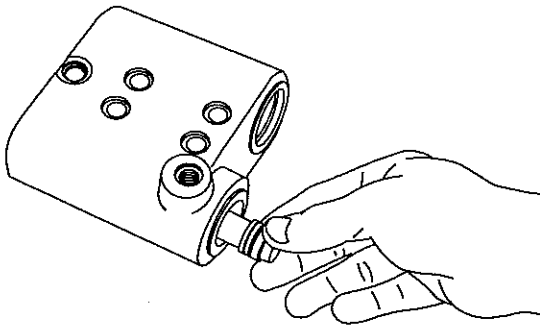


BRAKE VALVE ASSEMBLY		
ITEM	DESCRIPTION	QTY.
1	Valve Housing (NSS)	1
2	Check Valve Retainer (NSS)	1
3	Spring Retainer (NSS)	1
4	Plug (NSS)	1
5	Spool (NSS)	1
6	Damper Piston (NSS)	1
7	O-Ring	1
8	Check Valve Poppet (NSS)	1
9	Pilot Orifice	1
10	Check Valve Spring	1
11	Spool Spring	1
12	O-Ring	2
13	O-Ring	1
14	O-Ring	1
15	Back-up Ring	1
16	Back-up Ring	1
17	Check Ball (1/4 in.)	1
18	Check Ball Spring	1
19	Elbow Fitting	1
22	Shim	A.R.

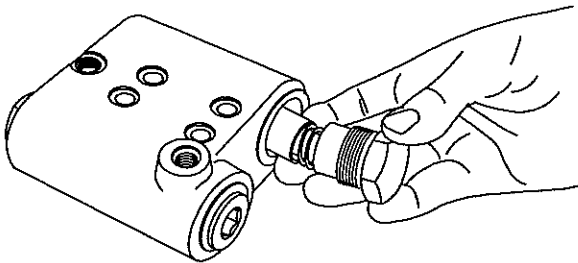
NSS - NOT SERVICED SEPARATELY. REPLACE COMPLETE VALVE ASSEMBLY

## DISASSEMBLY

1. Remove the pilot orifice from the brake release (BR) port using a 5/32 in. Allen wrench.
2. Remove the elbow fitting, motor drain check ball and spring.
3. Remove the spool spring retainer and spool spring. Check spring free length. Replace spring if less than 1 15/16 in. (49.2 mm) long.



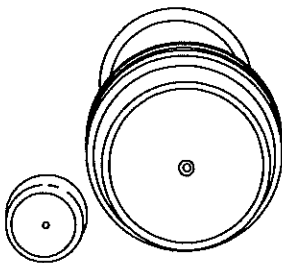
4. Remove spool plug and carefully remove spool assembly.
5. Remove the damper piston from the spool. The piston will come out slowly, because of a partial vacuum formed as it is removed. Use extreme care to avoid damaging the polished surfaces of the piston or spool.



6. Remove the check valve spring retainer, spring and check valve poppet. Check spring free length. Replace spring if less than 1-1/2 in. (38.1 mm) long.

## CLEAN AND INSPECT

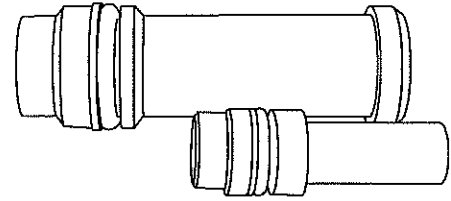
1. Discard all O-rings and back-up rings. Clean all parts in solvent and blow dry. Inspect polished surfaces of spool and damper piston for damage that may cause binding or leakage. Inspect spool bore in valve housing for damage or scoring. Inspect check valve seat in valve housing and check valve poppet. If the spools, bores or valves are damaged, the entire valve must be replaced as these parts are not serviced separately.



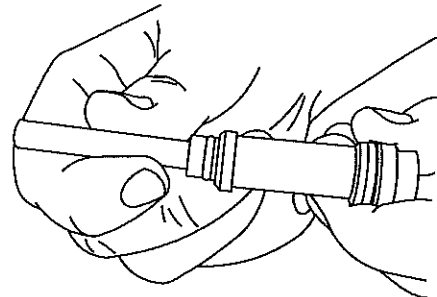
2. Inspect the .020 inch orifice in the end of the spool and the pilot orifice to be certain they are open.

## ASSEMBLY

1. Install new O-rings on the plug and spring retainers.



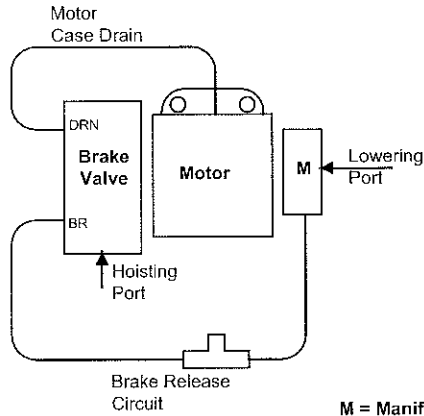
2. Install new O-rings and back-up rings on the spool and damper piston as shown. It is important that each back-up ring is on the correct side of its O-ring. Take care not to cut the O-rings during assembly. Let the spool and damper piston set for ten minutes before installing them in their respective bores. This will allow the O-rings to return to their original size after being stretched.
3. Lubricate the spool and damper piston O-rings with hydraulic oil. Carefully install the damper piston into the spool.



4. Lubricate the spool bore and spool O-rings with hydraulic oil. Carefully install the spool into the valve housing. Always install the spool from the plug end as shown to minimize the possibility of damaging the O-ring. Install the plug, spool spring and spring retainer.
5. Install the check valve poppet, spring and check valve spring retainer.
6. Install the motor drain check ball, spring and elbow fitting.
7. Install the pilot orifice into the valve housing.
8. The brake valve is complete and ready to be installed on winch motor.

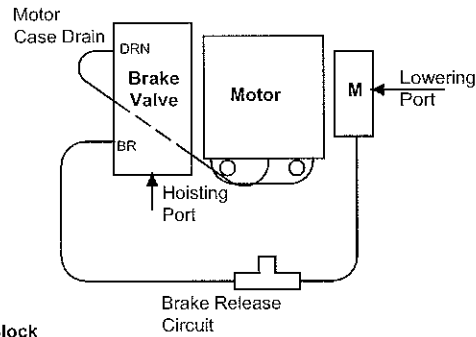
# REVERSING DIRECTION OF DRUM ROTATION

(029, 034, 039, 051, 064 & 049/024 motors ONLY)



"A"

M = Manifold Block



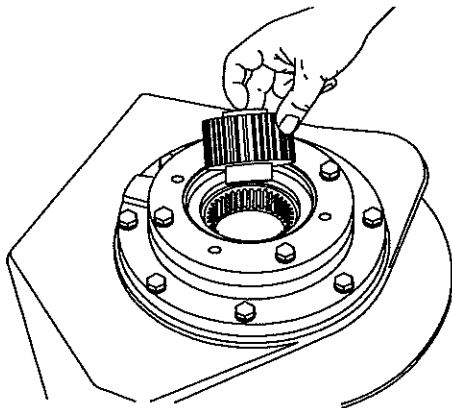
"B"

In order to change the direction of rotation, 2 things must be changed on the winch. First, the motor must be made to rotate in the opposite direction. This is done by exchanging positions of the brake valve and manifold block on the motor. Secondly, the brake clutch assembly must be made effective for the opposite direction of rotation. This is done by reversing the inner race of the brake clutch assembly.

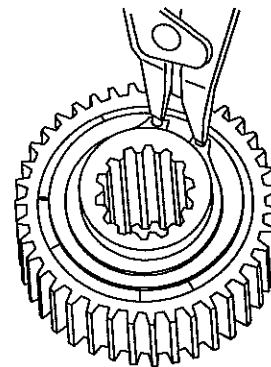
Figures "A" and "B" above show typical PD12C motor installations. Note that the only difference between the two drawings is the motor is rotated 180° (the "belly" of the motor moves to the opposite side). If the motor shaft rotates clockwise in figure 'A' when the hoisting port is pressurized, it will rotate counterclockwise in figure "B".

1. Remove the four capscrews securing the brake valve to the motor. Remove the four capscrews securing the manifold block to the motor. Disconnect the motor case drain hose at the motor. NOTE: Some installations have the brake release hose connected directly to the motor, instead of to the manifold block. In this case, disconnect the brake release hose at the motor port. Stand winch up on drum support with the motor end up and secure in this position.

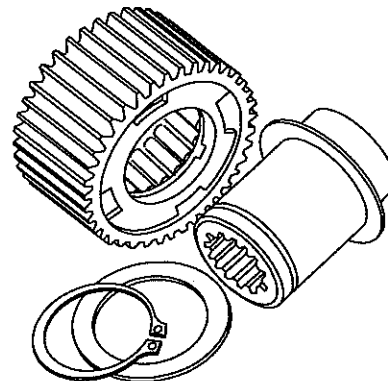
2. Before removing the motor, it is a good idea to note or mark the position of the motor in relation to the winch, since it will be rotated 180° when reinstalled. Remove the capscrews securing the motor to the winch and carefully remove the motor.



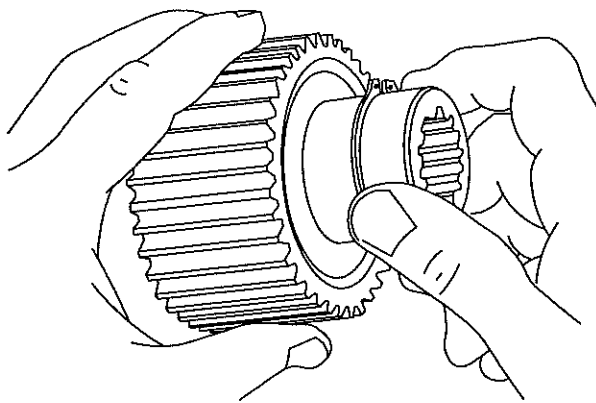
3. Remove the brake clutch assembly from the motor support.



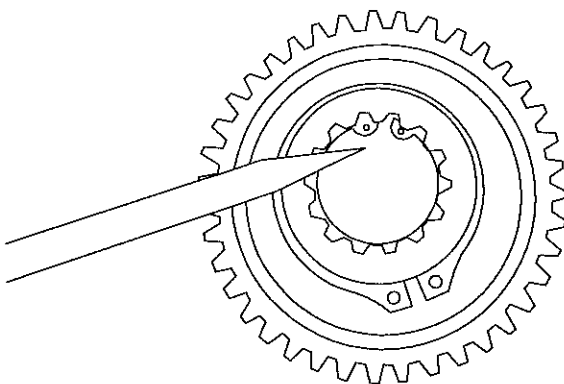
4. Remove the snap ring and sprag bushing retainer from one end only of the brake clutch assembly.



5. Pull the inner race out. Examine the race for scoring, wear or indentations caused by the sprag cams. If the inner race is not completely smooth, the assembly should be replaced.



6. Turn the sprag assembly around and slide the inner race (with 1 snap ring and bushing retainer) through the bushings and sprag clutch (the race will have to be rotated in the free-wheeling direction to start it through the sprag clutch). Install the remaining bushing retainer and snap ring. Make certain the snap ring is properly seated in the groove.



### ⚠ WARNING ⚠

Be certain the snap ring is seated in the groove in the splined bore of the inner race. This snap ring will keep the brake clutch assembly correctly positioned in the center of the friction brake pack. Binding of the brake or brake failure may occur if this snap ring is omitted.

7. Before installing the brake clutch, be sure the inner race turns free in the opposite direction the drum will turn to haul-in wire rope. An easy way to check the rotation is to hold the outer race in one hand and rotate the inner race. Install the brake clutch with the short end of the inner race toward the motor.
8. Install a new O-ring on the motor pilot. Rotate the motor 180° from its original position and install it onto the winch. Install and tighten motor capscrews to recommended torque.
9. Install new O-rings in the brake valve and manifold block. Attach the brake valve and manifold block to the motor using the original capscrews and tighten to recommended torque.
10. Connect the motor case drain hose to the motor case drain port. **NOTE:** On two speed motors, the case drain and shift drain should be connected directly to tank. **DO NOT** use the drain connection on the brake valve. See "TWO SPEED MOTOR CASE DRAIN PLUMBING" for additional information.
11. If your winch had the brake release hose connected directly to the motor, the original motor port must be plugged and the hose connected to the motor pressure port near the manifold block (lowering port).
12. Operate the winch slowly in both directions and check for oil leaks and/or unusual sounds from the winch. The winch should operate smoothly in both directions. Refer to "WIRE AND BRAIDED ROPE INSTALLATION" and properly install rope onto the winch drum.
13. Before returning the winch to full service, a light load should be lifted and held a few feet off the ground to be sure the static brake is functioning properly. The winch should also be able to slowly lower the load in a smooth and controlled manner. If the winch does not perform either of these functions, refer to "TROUBLESHOOTING" for additional information.



## PD17A Rotation Indicator Proximity Sensor

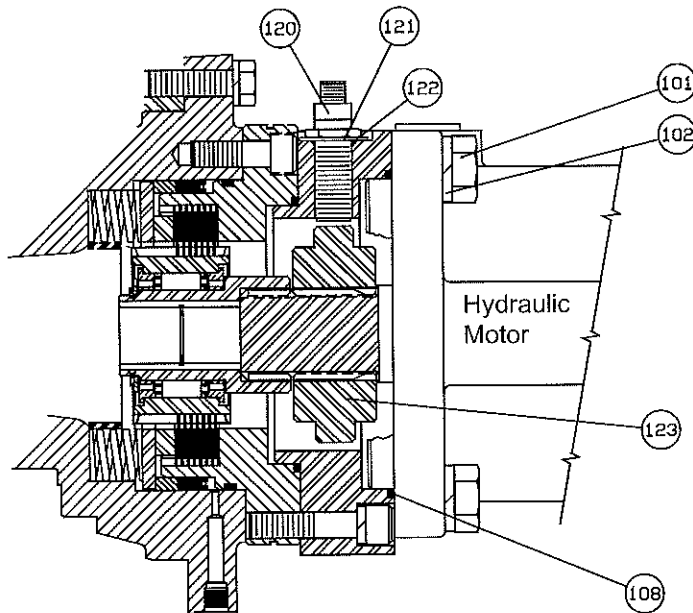
Some PD17A models have a rotation indicator proximity sensor and hub between the motor and the winch. If the sensor is removed or replaced, use the following procedure for adjustment and testing. Refer to the drawing below for item numbers.

Install a new O-ring (item 108) onto motor pilot. Install sensor hub (item 123) onto motor shaft, positioning the sensor hub so that one of the lobes will be directly under the sensor port. Install the motor onto the winch. Install capscrews and lockwashers (items 101 & 102) securing the motor to motor adapter.

### ⚠ CAUTION ⚠

If sensor hub is not correctly positioned with a lobe directly under the sensor port, proper adjustment may not be possible and severe damage to the sensor and internal winch components may result.

Install flatwasher (item 121) and O-ring (item 122) onto new sensor (item 120). Apply a small amount of silicone sealant to the threads just below the washer and O-ring. DO NOT apply sealant to the end of the sensor or to the threads of the sensor port where it could be pushed into the winch. Install the sensor into the motor adapter until it contacts the sensor hub. Back sensor out of the port 2 complete turns. Attach wire harness to sensor to verify proper sensor operation. IT IS NOT necessary to operate the winch motor. If sensor light is on, hold sensor from turning and tighten jam nut against motor adapter. If light is off or blinks intermittently, adjust sensor inward toward sensor hub until light remains on, then tighten jam nut.



# METRIC CONVERSION TABLE

## English to Metric

## Metric to English

### LINEAR

inches (in.)	X 25.4	= millimeters (mm)	millimeters (mm)	X 0.3937	= inches (in.)
feet (ft.)	X 0.3048	= meters (m)	meters (m)	X 3.281	= feet (ft.)
miles (mi.)	X 1.6093	= kilometers (km)	kilometers (km)	X 0.6214	= miles (mi.)

### AREA

inches <sup>2</sup> (sq.in.)	X 645.15	= millimeters <sup>2</sup> (mm <sup>2</sup> )	millimeters <sup>2</sup> (mm <sup>2</sup> )	X 0.000155	= inches <sup>2</sup> (sq.in.)
feet <sup>2</sup> (sq.ft.)	X 0.0929	= meters <sup>2</sup> (m <sup>2</sup> )	meters <sup>2</sup> (m <sup>2</sup> )	X 10.764	= feet <sup>2</sup> (sq.ft.)

### VOLUME

inches <sup>3</sup> (cu.in.)	X 0.01639	= liters (l)	liters (l)	X 61.024	= inches <sup>3</sup> (cu.in.)
quarts (qts.)	X 0.94635	= liters (l)	liters (l)	X 1.0567	= quarts (qts.)
gallons (gal.)	X 3.7854	= liters (l)	liters (l)	X 0.2642	= gallon (gal.)
inches <sup>3</sup> (cu.in.)	X 16.39	= centimeters <sup>3</sup> (cc)	centimeters <sup>3</sup> (cc)	X 0.06102	= inches <sup>3</sup> (cu.in.)
feet <sup>3</sup> (cu.ft.)	X 28.317	= liters (l)	liters (l)	X 0.03531	= feet <sup>3</sup> (cu.ft.)
feet <sup>3</sup> (cu.ft.)	X 0.02832	= meters <sup>3</sup> (m <sup>3</sup> )	meters <sup>3</sup> (m <sup>3</sup> )	X 35.315	= feet <sup>3</sup> (cu.ft.)
fluid ounce (fl.oz.)	X 29.57	= milliliters (ml)	milliliters (ml)	X 0.03381	= fluid ounce (fl.oz.)

### MASS

ounces (oz.)	X 28.35	= grams (g)	grams (g)	X 0.03527	= ounces (oz.)
pounds (lbs.)	X 0.4536	= kilograms (kg)	kilograms (kg)	X 2.2046	= pounds (lbs.)
tons (2000 lbs.)	X 907.18	= kilograms (kg)	kilograms (kg)	X 0.001102	= tons (2000 lbs.)
tons (2000 lbs.)	X 0.90718	= metric tons (t)	metric tons (t)	X 1.1023	= tons (2000 lbs.)
tons (long) (2240 lbs.)	X 1013.05	= kilograms (kg)	kilograms (kg)	X 0.000984	= tons (long) (2240 lbs.)

### PRESSURE

inches Hg (60°F)	X 3600	= kilopascals (kPa)	kilopascals (kPa)	X 0.2961	= inches Hg (60°F)
pounds/sq.in. (PSI)	X 6.895	= kilopascals (kPa)	kilopascals (kPa)	X 0.145	= pounds/sq.in. (PSI)
pounds/sq.in. (PSI)	X 0.0703	= kilograms/sq.cm. (kg/cm <sup>2</sup> )	kilograms/sq.cm. (kg/cm <sup>2</sup> )	X 14.22	= pounds/sq.in. (PSI)
pounds/sq.in. (PSI)	X 0.069	= bars	bars	X 14.5	= pounds/sq.in. (PSI)
inches H <sub>2</sub> O (60°F)	X 0.2488	= kilopascals (kPa)	kilopascals (kPa)	X 4.0193	= inches H <sub>2</sub> O (60°F)
bars	X 100	= kilopascals (kPa)	kilopascals (kPa)	X 0.01	= bars

### POWER

horsepower (hp)	X 0.746	= kilowatts (kW)	kilowatts (kW)	X 1.34	= horsepower (hp)
ft.-lbs./min.	X 0.0226	= watts (W)	watts (W)	X 44.25	= ft.-lbs./min.

### TORQUE

pound-inches (in.-lbs.)	X 0.11298	= newton-meters (N-m)	newton-meters (N-m)	X 8.851	= pound-inches (in.-lbs.)
pound-feet (ft.-lbs.)	X 1.3558	= newton-meters (N-m)	newton-meters (N-m)	X 0.7376	= pound-feet (ft.-lbs.)
pound-feet (ft.-lbs.)	X .1383	= kilograms/meter (kg-m)	kilogram/meter (kg-m)	X 7.233	= pound-feet (ft.-lbs.)

### VELOCITY

miles/hour (m/h)	X 0.11298	= kilometers/hour (km/hr)	kilometers/hour (km/hr)	X 0.6214	= miles/hour (m/h)
feet/second (ft./sec.)	X 0.3048	= meter/second (m/s)	meters/second (m/s)	X 3.281	= feet/second (ft./sec.)
feet/minute (ft./min.)	X 0.3048	= meter/minute (m/min)	meters/minute (m/min)	X 3.281	= feet/minute (ft./min.)

### TEMPERATURE

$$^{\circ}\text{Celsius} = 0.556 (^{\circ}\text{F} - 32)$$

$$^{\circ}\text{Fahrenheit} = (1.8^{\circ}\text{C}) + 32$$

### COMMON METRIC PREFIXES

mega	(M)	= 1,000,000 or 10 <sup>6</sup>	deci	(d)	= 0.1 or 10 <sup>-1</sup>
kilo	(k)	= 1,000 or 10 <sup>3</sup>	centi	(c)	= 0.01 or 10 <sup>-2</sup>
hecto	(h)	= 100 or 10 <sup>2</sup>	milli	(m)	= 0.001 or 10 <sup>-3</sup>
deka	(da)	= 10 or 10 <sup>1</sup>	micro	(μ)	= 0.000.001 or 10 <sup>-6</sup>



PEMEX – PP LUM A  
Project

ImXport Services Corp.

# Vendor Data Book

P.O. # 0018987

Serial # 23407C

Volume: 1

## Nautilus Crane Model 340LA-80

### Section 4.10.2 (c) CH230B Series Hoist Boom Hoist



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA



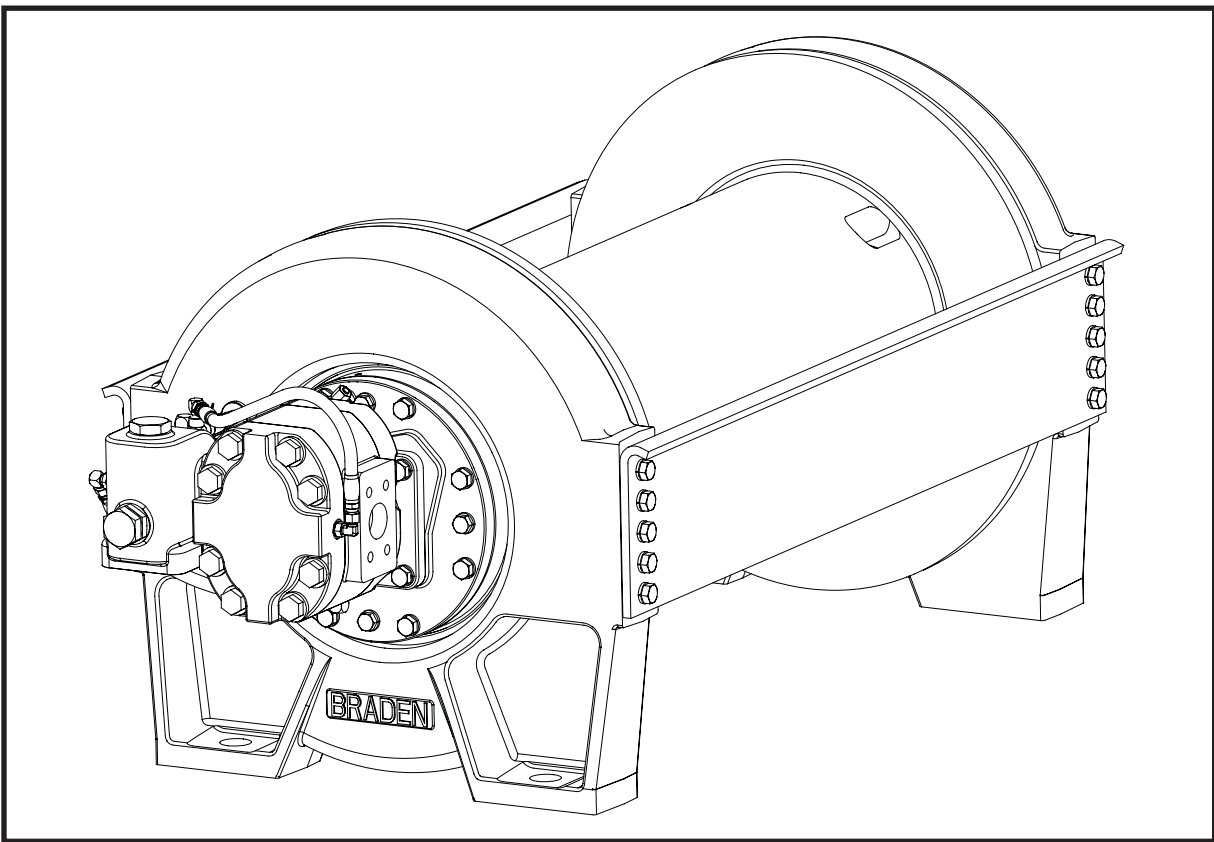


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# BRADEN

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## CH165A & CH230B PLANETARY HOIST



## INSTALLATION, MAINTENANCE AND SERVICE MANUAL

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## FOREWORD

### CH165A & CH230B

The following service instructions have been prepared to provide assembly, disassembly and maintenance information for the BRADEN Model CH165A & CH230B series hoist. It is suggested that before doing any work on these units, all assembly and disassembly instructions should be read and understood.

Some illustrations in this manual may show details or attachments that are different from your hoist. Also, some components have been removed for illustrative purposes.

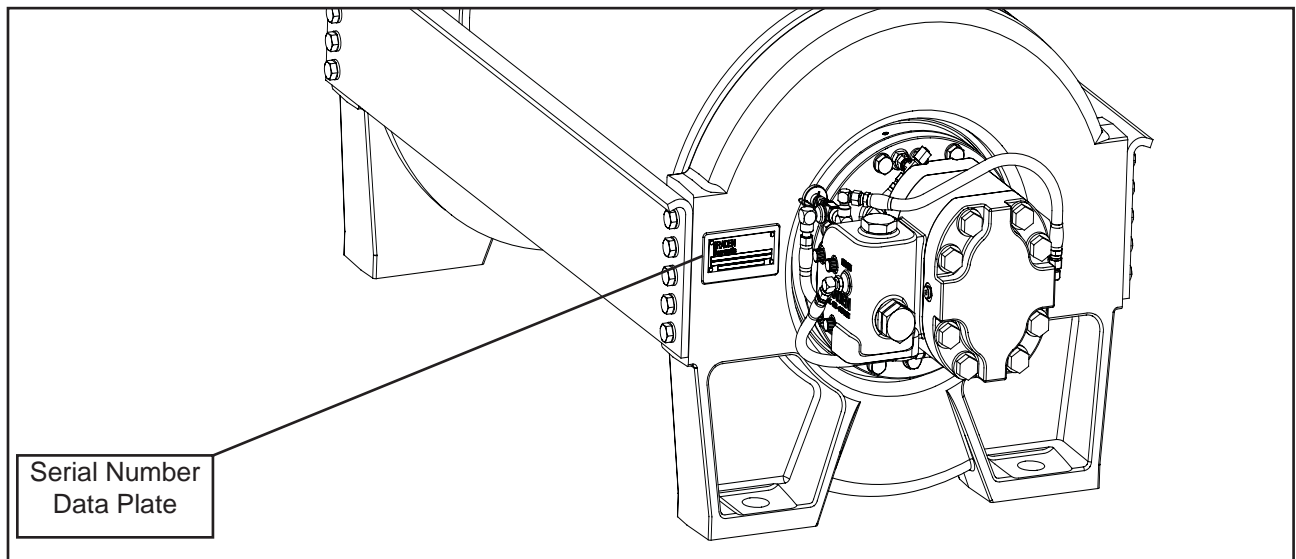
Continuing product improvement may cause changes in your hoist, which are not included in this manual. Whenever a question arises regarding your BRADEN hoist or this manual, please contact BRADEN Product Support Department for the latest available information.

Telephone- 1-918-251-8511

08:00-16:30 Central Time Zone, Monday thru Friday

FAX- 1-918-259-1575

[www.paccarwinch.com](http://www.paccarwinch.com)



### EXPLANATION OF SERIAL NUMBER

<b>CH</b>	<b>165</b>	<b>B</b>	-	<b>35</b>	<b>110</b>	-	<b>01</b>	-	<b>1</b>
CONSTRUCTION HOIST	MAX RATING	DESIGN RATING		GEAR RATIO	MOTOR SIZE		DRUM SIZE		OPTION

**CH** DESIGNATES CONSTRUCTION HOIST

**165** DESIGNATES 16,500 (CH165) OR 23,000 (CH230) LB DESIGN FIRST LAYER LINE PULL

**B** DESIGNATES THE MODEL SERIES RELATING TO DESIGN CHANGES

**35** DESIGNATES TOTAL GEAR REDUCTION (CH165= 25, 26; CH230= 35, 36)

**110** DESIGNATES HYDRAULIC MOTOR DISPLACEMENT IN CU IN/REV (110 = 11.0 CU IN REV)

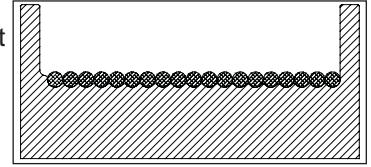
**01** DESIGNATES THE DRUM OPTION

**1** PERMITS TESTING AND INSPECTION PER API 2C FOR OFFSHORE CRANES

# GLOSSARY OF TERMS

**Brake Valve** - A hydraulic counterbalance valve is usually bolted to the hoist port of the hydraulic motor. It allows oil to flow freely through the motor in the hoisting direction. When oil pressure tries to rotate the motor in the lowering direction, the brake valve blocks the flow of oil out of the motor until the internal static brake is released. It then controls lowering speed based on the load and flow of oil to the motor. All the heat generated by controlling the speed of the load is dissipated by the hydraulic system, not by the internal static brake.

**Grooved Drum** - A cable drum with grooves on the barrel to ensure the first layer of cable spools properly onto the drum. The grooves can be cast or machined into the drum, or cast or machined into separate pieces that are mechanically fastened to the drum. NOTE: Only one size cable can be used on a grooved drum.



**Sprag or Over-Running Clutch** - A mechanical one-way clutch on the input shaft of the hoist, between the input shaft and the static mechanical brake. The clutch allows the input shaft to turn freely in the direction required to spool cable onto the drum (i.e. lift a load), then immediately locks the hoist gear train to the mechanical brake when the hoist is stopped, holding the load in place.

**Static, Mechanical, or Load-Holding Brake** - A multi-disc, spring applied, hydraulically released brake that works together with the sprag clutch to hold a suspended load. This brake is not designed to stop a load being lowered, but holds the load in place when the hoist is not being operated.

**First Layer Line Pull Rating** - The maximum rated line pull (in pounds or kilograms) on the first layer of cable. The maximum rating for any particular hoist is based on maintaining an acceptable structural design factor and service life. Certain combinations of drum, gear ratio, motor and hydraulic pressure, may reduce this rating.

**First Layer Line Speed Rating** - The maximum rated line speed (in feet or meters per minute) on the first layer of cable. Certain combinations of drum, gear ratio, motor and hydraulic flow may reduce or increase this rating.

**D/d Ratio** - The ratio of cable drum barrel diameter (D) to wire rope diameter (d). Current ANSI standards require a minimum of 17:1.

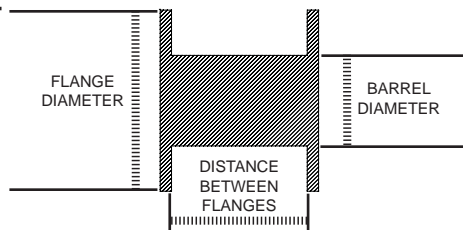
## EXAMPLES:

If you know the cable diameter you want to use, multiply it by 17 to get the MINIMUM cable drum barrel diameter. (i.e.  $\frac{1}{2}$  inch wire rope  $\times 17 = 8.5$  inches - this is the minimum hoist barrel diameter)

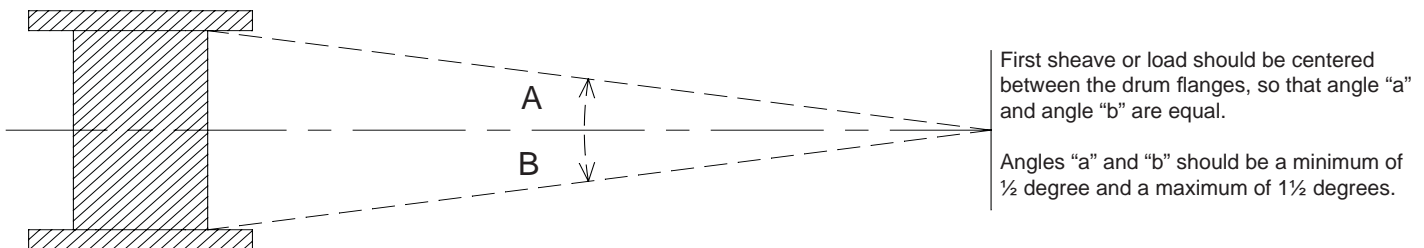
If you know the barrel diameter, divide it by 17 to get the MAXIMUM wire rope diameter.

(i.e. 10 inch barrel diameter  $\div 17 = 0.588$ , or 9/16 inch - this is the maximum wire rope diameter)

## Cable Drum Dimensions -



**Fleet Angle** - The angle between the wire rope's position at the extreme end wrap on a drum, and a line drawn perpendicular to the axis of the drum, through the center of the nearest fixed sheave or load attachment point.



**Wrap** - A single coil of wire rope wound on a drum.

**Layer** - All wraps of wire rope on the same level between drum flanges.

**Freeboard** - The amount of drum flange that is exposed radially past the last layer of wire rope. Minimum freeboard varies with the regulatory organization. ASME B30.5 requires  $\frac{1}{2}$  in. minimum freeboard.



# GENERAL SAFETY RECOMMENDATIONS

Safety for operators and ground personnel is of prime concern. Always take the necessary precautions to ensure safety to others as well as yourself. To ensure safety, the prime mover and hoist must be operated with care and concern for the equipment and a thorough knowledge of the machine's performance capabilities. The following recommendations are offered as a general safety guide. Local rules and regulations will also apply.

1. Be certain equipment (boom, sheave blocks, pendants, etc.) is either lowered to the ground or blocked securely before servicing, adjusting, or repairing hoist.
2. Be sure personnel are clear of work area BEFORE operating hoist.
3. Read all warning and caution tags provided for safe operation and service of the hoist and become familiar with the operation and function of all controls before operating the hoist.
4. Inspect rigging and hoist at the beginning of each work shift. Defects should be corrected immediately. Do not operate a hoist with defects.
5. Keep equipment in good operating condition. Perform scheduled servicing and adjustments listed in the "Preventive Maintenance" section of this manual.
6. An equipment warm-up procedure is recommended for all start-ups and essential at ambient temperatures below +40°F (+4°C). Refer to "Warm-up Procedure" listed in the "Preventive Maintenance" section of this manual.
7. Do not exceed the maximum pressure (PSI, kPa) or flow (GPM, lpm) stated in the hoist specifications found in the specific sales brochure.
8. Operate hoist line speeds to match job conditions.
9. Protective gloves should be used when handling wire rope.
10. Never attempt to handle wire rope when the hook end is not free. Keep all parts of body and clothing clear of cable rollers, cable entry area of fairleads, sheaves and hoist drum.
11. When winding wire rope on the hoist drum, never attempt to maintain tension by allowing wire rope to slip through hands. Always use "Hand-Over-Hand" technique.
12. Never use wire rope with broken strands. Replace wire rope that is damaged. Refer to wire rope supplier manual.
13. Do not weld on any part of the hoist without approval from PACCAR Winch Engineering.
14. Use recommended hydraulic oil and gear lubricant.
15. Keep hydraulic system clean and free from contamination at all times.
16. Use correct anchor for wire rope and pocket in drum.
17. Do not use knots to secure or attach wire rope.
18. The BRADEN designed wire rope anchors are not intended to support the rated load. ALWAYS maintain a minimum of five (5) wraps of wire rope on the drum. It is recommended that the last five (5) wraps of wire rope be painted bright red to serve as a visual reminder.
19. Never attempt to clean, oil or perform any maintenance on a machine with the engine or prime mover running, unless instructed to do so in this manual.
20. Never operate hoist controls unless you are properly positioned at the operators station and you are sure personnel are clear of the work area.
21. Assure that personnel who are responsible for hand signals are clearly visible and that the signals to be used are thoroughly understood by everyone.
22. Ground personnel should stay in view of the operator and clear of the hoist drum. Do not allow ground personnel near wire rope under tension. A safe distance of 1½ times the working length of the wire rope should be maintained.
23. Install guarding to prevent personnel from getting any part of body or clothing caught at a point where the cable is wrapped onto the drum or drawn through guide rollers or potential "pinch points".
24. Install switches or valves that will shut off power to the hoist, in locations where they can be reached by anyone entangled in the wire rope before being drawn into the hoist or any "pinch point".
25. "Deadman" controls, which automatically shut off power to the hoist whenever the operator leaves his station or releases the hoist control lever, should be installed whenever practical.
26. Never allow anyone to position any part of body under a suspended load.
27. Avoid sudden "shock" loads or attempting to "jerk" a load free. This type of operation may cause heavy loads, in excess of rated capacity, which may result in failure of wire rope, hoist or crane structure.
28. Whenever possible, install the hoist in a location that is not immediately adjacent to a "normal" operator's station.
29. All hoist controls shall be located within easy reach of the operator. The controls shall be installed in such a location that the operator is removed from the electrical path to ground if the load, rigging, or wire rope come in contact with or within proximity to an electrically energized conductor.

30. Before operating the hoist, be sure ALL safety procedures for the equipment or vehicle the hoist is mounted on are properly followed and/or in place.

If there is any question regarding the preceding safety recommendations, or the safe operation of your hoist, please contact the Braden Product Support Department at 1-918-251-8511, Monday through Friday from 0800 to 1630 hours, CST, by fax at 1-918-259-1575, or via the internet at [www.paccarwinch.com](http://www.paccarwinch.com) for the latest available information.

**Safety and informational callouts used in this manual include:**

**⚠ WARNING ⚠**

**WARNING** – This emblem is used to warn against hazards and unsafe practice which **COULD** result in severe personal injury or death if proper procedures are not followed.

**⚠ CAUTION ⚠**

**CAUTION** – This emblem is used to warn against potential or unsafe practices which **COULD** result in personal injury and product or property damage if proper procedures are not followed.

# BASIC OPERATION

## DESCRIPTION OF HOIST

The CH165A & CH230B hoists are made up of the following sub-assemblies:

1. Hydraulic motor and brake valve
2. Brake cylinder and brake clutch assembly
3. Hoist base components
4. Hoist drum and gear train

(Refer to illustration on page 9)

## THEORY OF OPERATION

The primary sun gear is directly coupled to the hydraulic motor by the inner race of the brake clutch assembly. As the motor turns in the hoisting direction (clockwise for -01 drums) the planetary assemblies reduce the input speed of the motor and rotate the ring gear and winch drum. Since the output planet carrier is held from turning by the drum bearing support on -01 drums, the drum rotates in the opposite direction of the motor input shaft. On -02 and -21 drums the output carrier is splined to the drum, and the drum rotates in the same direction as the input shaft. In the hoisting direction, the static brake remains fully applied and the input shaft rotates freely through the sprag clutch. When the motor is stopped, the load tries to rotate the hoist gear train in the opposite direction. The sprag clutch on the input shaft immediately locks up, allowing the fully applied static brake to hold the load from dropping. See Dual Brake System - Operation for a detailed description of the lowering sequence of operation.

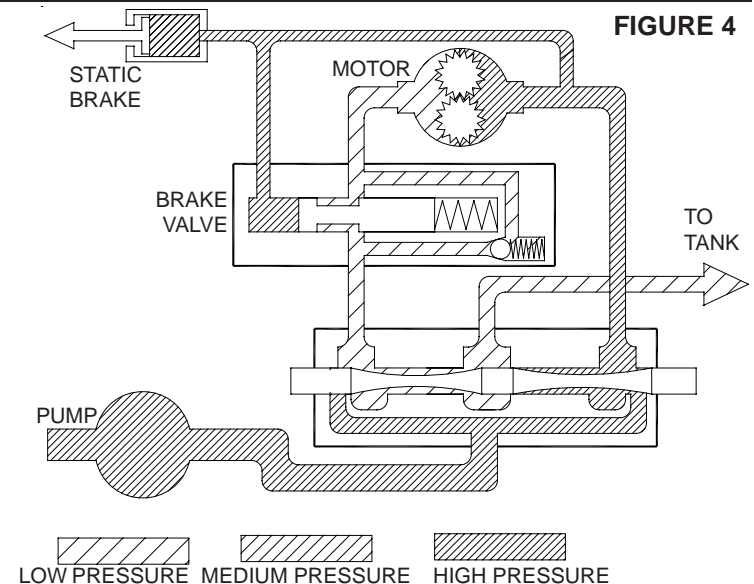
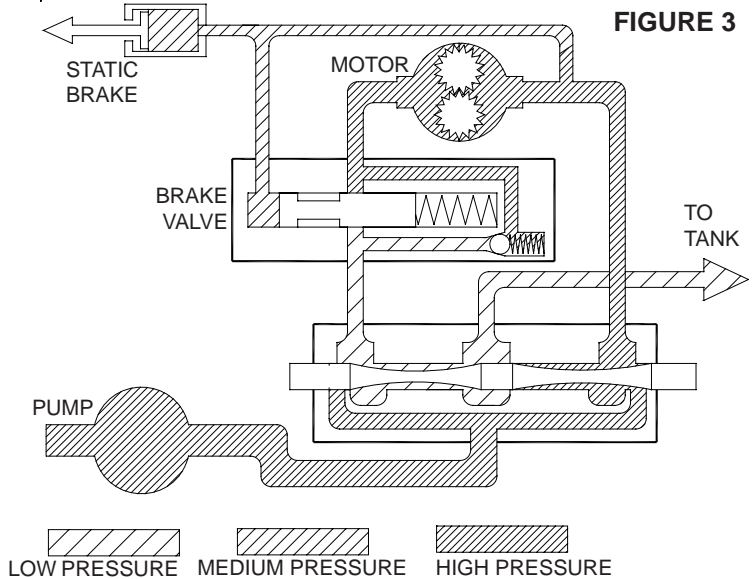
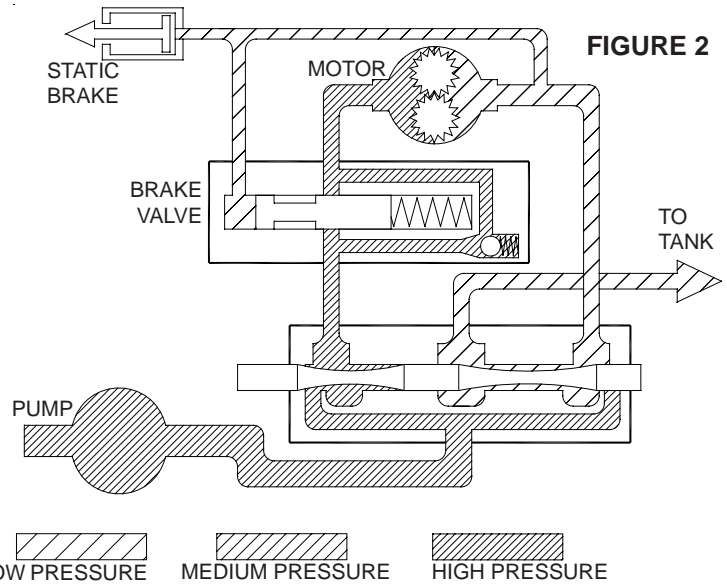
## Dual Brake System – Description

The dual brake system consists of a dynamic brake system and a static brake system.

The dynamic brake system has two operating components:

1. Brake valve assembly
2. Hydraulic motor

The brake valve is basically a counterbalance valve with improved metering. It contains a check valve to allow free flow of oil



The static brake is released by the brake valve pilot pressure at a pressure lower than that required to open the pilot operated spool valve. This sequence assures that dynamic braking takes place in the brake valve and that little, if any, heat is absorbed by the friction brake.

The static friction brake is a load holding brake only and has nothing to do with dynamic braking or rate of descent of a load.

The brake clutch is splined to the primary sun gear shaft between the motor and the primary sun gear. It will allow this shaft to turn freely in the direction to raise a load and lock up to force the brake discs to turn with the shaft in the direction to lower a load. Figures 5 and 6.

The hydraulic cylinder, when pressurized, will release the spring pressure on the brake discs, allowing the brake discs to turn freely.

### Dual Brake System – Operation

When hoisting a load, the brake clutch which connects the motor shaft to the primary sun gear, allows free rotation. The sprag cams lay over and permit the inner race to turn free of the outer race. Figure 5. The static friction brake remains fully engaged. The hoist, in raising a load, is not affected by any braking action. Figure 2.

When the lifting operation is stopped, the load attempts to turn the primary sun gear in the opposite direction. This reversed input causes the sprag cams to instantly roll upward and firmly lock the shaft to the fully engaged friction brake. Figure 6.

When the hoist is powered in reverse, to lower the load, the motor cannot rotate until sufficient pilot pressure is present to open the brake valve. Figures 3 & 4. The friction brake within the hoist will completely release at a pressure lower than that required to open the brake valve. The extent to which the brake valve opens will determine the amount of oil that can flow through it and the speed at which the load will be lowered. Increasing the flow of oil to the hoist motor will cause the pressure to rise and the opening in the brake valve to enlarge, speeding up the descent of the load. Decreasing this flow causes the pressure to lower and the opening in the brake valve to decrease thus slowing the descent of the load.

When the control valve is shifted to neutral, the pressure will drop and the brake valve will close, stopping the load. The friction brake will engage and hold the load after the brake valve has closed.

When lowering a load very slowly for precise positioning, very little oil flow actually occurs through the hoist motor. The pressure will build up to a point where the static brake will release sufficiently to allow the load to rotate

the motor through its own internal leakage. This feature results in a very slow speed and extremely accurate positioning.

The friction brake receives very little wear in the lowering operation. All of the heat generated by the lowering and stopping of a load is absorbed by the hydraulic oil where it can be readily dissipated.

### Satic Friction Brake Applied

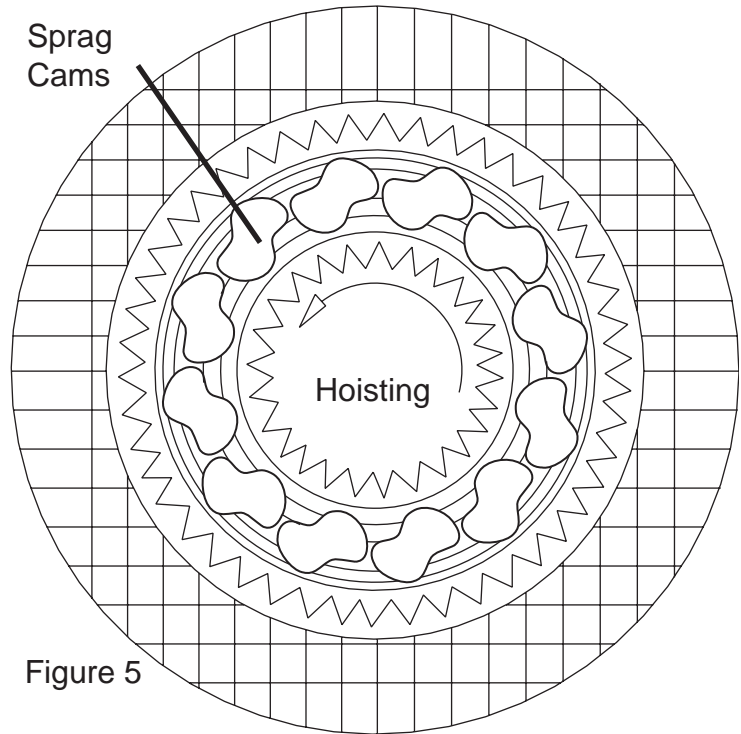


Figure 5

### Satic Friction Brake Applied

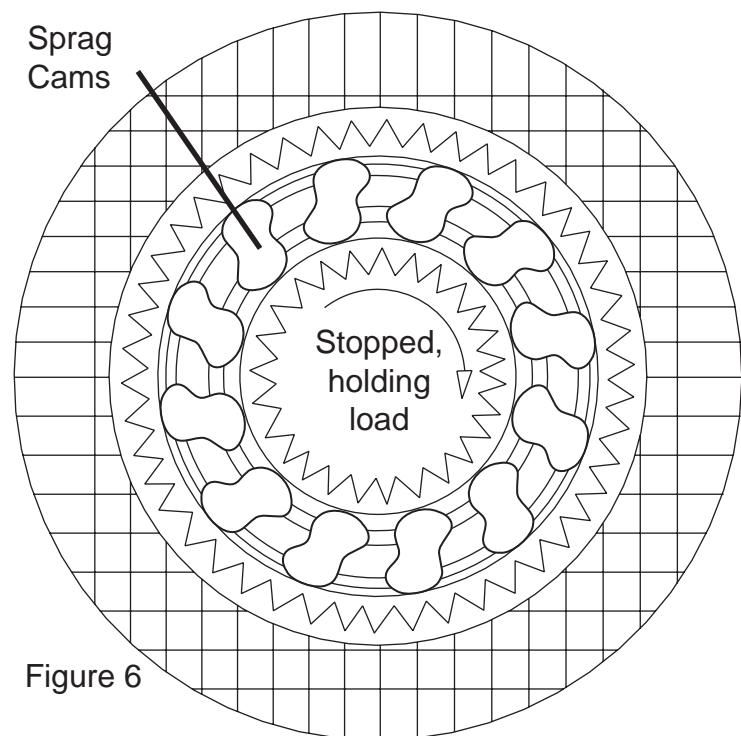
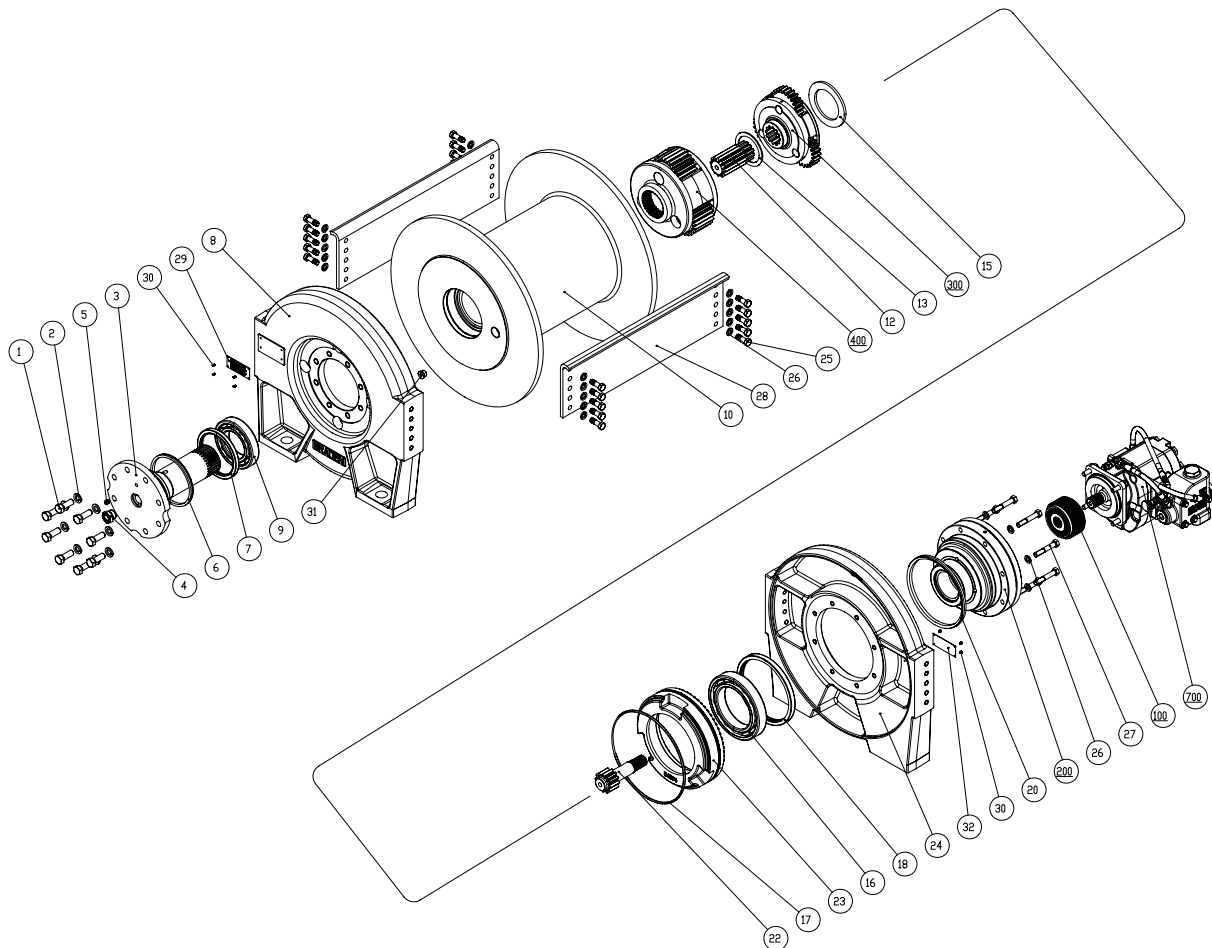
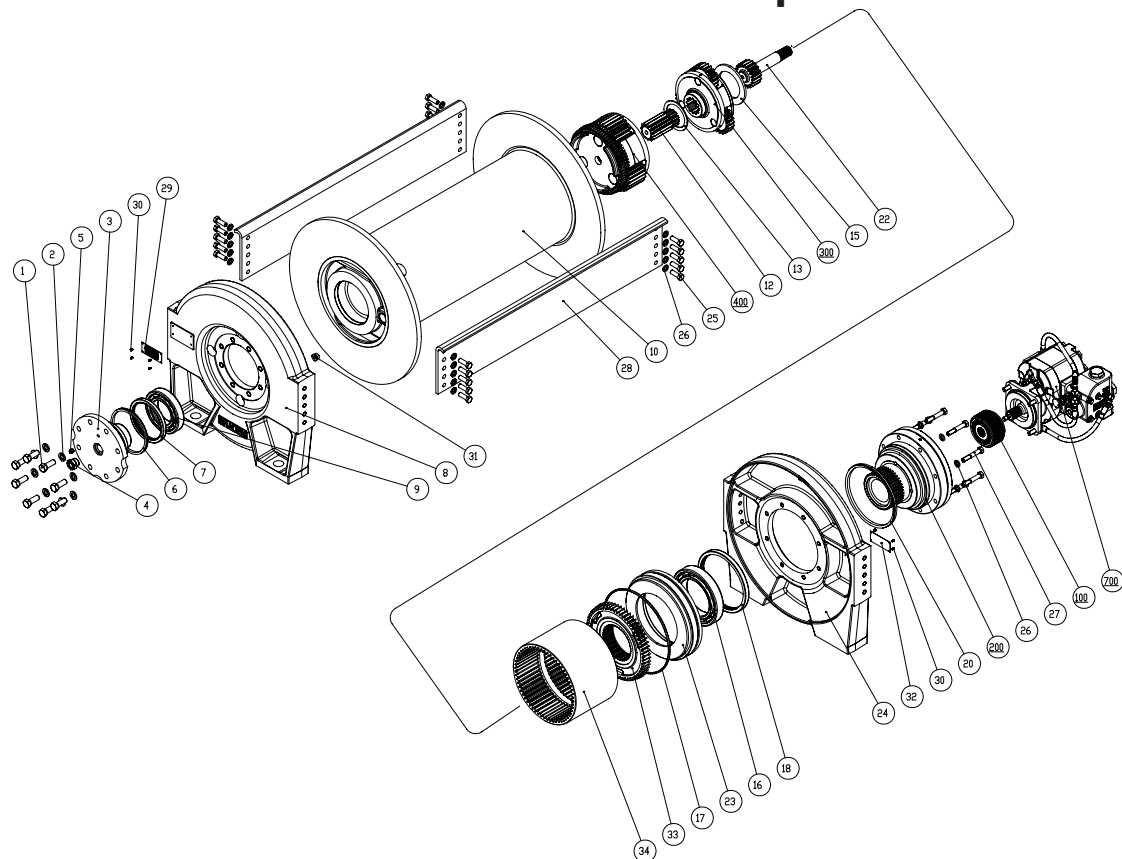


Figure 6

## CH230B/ CH165 -01 Drum Components



## CH230B/ CH165 -02 Drum Components





# INSTALLATION

## GENERAL REQUIREMENTS

1. The hoist must be mounted with the centerline of the drum in a horizontal position. The mounting plane can be rotated to any position around this centerline, providing the vent plug is positioned above the oil level.

2. When mounting the hoist, use four 1¼ in. grade 8 capscrews or bolts and nuts using both mounting holes in each end plate. Use narrow, hardened washers under the bolt heads and nuts

### ⚠ WARNING ⚠

**DO NOT** weld hoist to mounting surface. Welding may not provide adequate structural support for winch loads. This may cause loss of load control, which could result in property damage, injury or death. Welding may also damage bearings and seals, resulting in premature failure.

3. The vent plug must always be located above the horizontal centerline of the hoist drum. If the hoist is mounted on a pivoting surface, be sure the vent remains above the centerline at all times. If necessary, reposition the bearing support.

4. It is important that the hoist be mounted on a surface that will not flex when the hoist is in use, since this could bind the working parts of the hoist. Also, be sure the hoist is mounted on a flat surface. If necessary, use shim stock to insure proper mounting. The mounting surface must be flat within 6 0.020 inches (.5 mm).

5. Hydraulic lines and components that operate the hoist should be of sufficient size to assure minimum back pressure at the hoist motor ports. To insure adequate static brake load holding ability, back pressure on the hoist should not exceed 100 psi (690 kPa).

6. Make certain that the hoist drum is centered behind the first sheave and the fleet angle does not exceed 1½ degrees.

The hoist should also be mounted perpendicular to an imaginary line from the center of the drum to the first sheave to ensure even spooling. (ref. drawing on page 4)

### ⚠ WARNING ⚠

**DO NOT** use a control valve with any detents or latching mechanism that would hold the control valve in an actuated or running position when the operator releases the control handle. Use of the wrong type of control valve could lead to unintentional operation of the hoist, which could result in property damage, personal injury or death.

7. The hoist directional control valve must be a three-position, four-way valve without detents and with a spring centered motor spool such that the valve returns to the centered position whenever the handle is released, and both work ports are opened to tank (open center, open port, see schematic below).

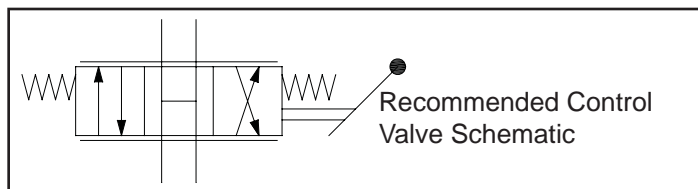
8. The hydraulic oil filter should have a 10 micron nominal rating and be a full-flow type.

9. High quality hydraulic oil is essential for satisfactory performance and long hydraulic system component life.

Oil having 150 to 330 SUS viscosity at 100°F (38°C) and viscosity index of 100 or greater will give good results under normal temperature conditions. The use of an oil having a high viscosity index will minimize cold-start trouble and reduce the length of warm-up periods. A high viscosity index will minimize changes in viscosity with corresponding changes in temperature.

Maximum cold weather start-up viscosity should not exceed 5000 SUS with a pour point at least 20°F (11°C) lower than the minimum temperature.

In general terms; for continuous operation at ambient temperatures between 50 and 110°F (10-43°C) use ISO VG 46 – 68 (SAE20); for continuous operation between 10 and 90°F (-12 and 32°C) use ISO VG 32 (SAE10W).



# WIRE ROPE INSTALLATION

## (ONE PIECE CABLE WEDGE)

### ⚠ WARNING ⚠

#### THE CABLE ANCHORS ALONE ON HOISTS ARE NOT INTENDED TO HOLD RATED LOADS.

Hoist loads applied directly to the wire rope anchor may cause the wire rope to pull free and result in the sudden loss of load control and cause property damage, personal injury or death. A minimum of 5 wraps of wire rope must be left on the drum barrel to achieve rated load.

The wedge and anchor pocket must be clean and dry. The end of the wire rope being anchored to the drum must be clean and dry and not frayed. Anything on the end of the wire rope to keep it from fraying (i.e. tape or wire) must not be in contact with the wedge when the installation is complete. Consult the wire rope manufacturer on the proper treatment of the dead end of the wire rope. Some rope manufacturers recommend when using rotation resistant wire rope, that the rope end be seized, welded or brazed before inserting the wire rope into the wedge socket to prevent core slippage or loss of rope lay.

Take the free end of the wire rope and insert it through the small opening on the cable drum. Loop the wire rope and push the free end about 3/4 of the way back through the pocket. Install the wedge as shown in figure 1, then pull the slack out of the wire rope. The "dead" end of the rope needs to extend slightly beyond the end of the wedge as shown in figure 2.

Using a hammer and brass drift, drive the wedge as deep into the pocket as possible to ensure it is fully seated and no further movement is detected. Applying a load on the wire rope will also help seat the wedge in the pocket. Check to ensure the wedge does not protrude from either end of the pocket, causing it to interfere with proper spooling of wire rope onto the drum (see figures 1 & 2).

If there is interference or the wedge does not seat firmly, contact the Braden Product Support Department at 1-918-251-8511 to determine the proper wedge size.

It is important that the wire rope have the proper tensioning when it is installed on the drum. When the wire rope is first installed, you should operate the hoist, with light to moderate loads, with reeving that let's you place these loads on the block and the drum with all the rope off the drum except for the last five wraps.

### Correct Installations

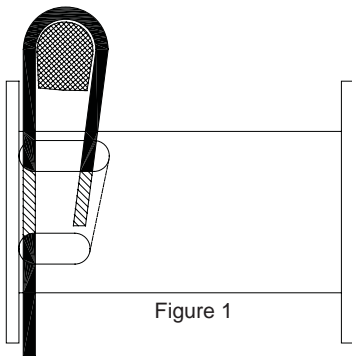


Figure 1

Drive down from  
this side

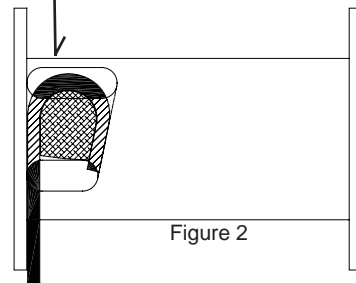
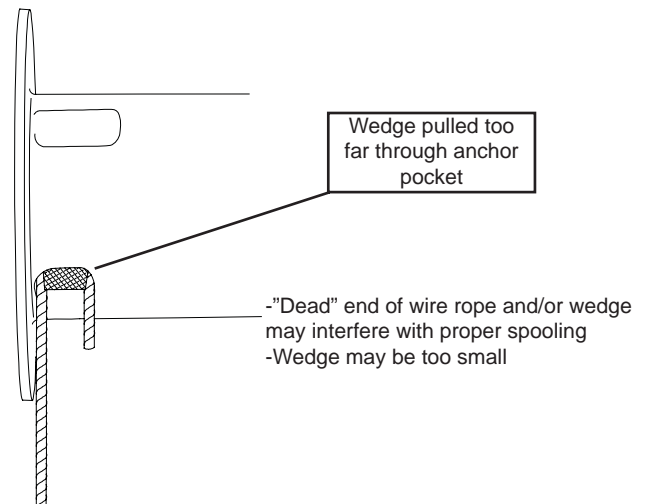
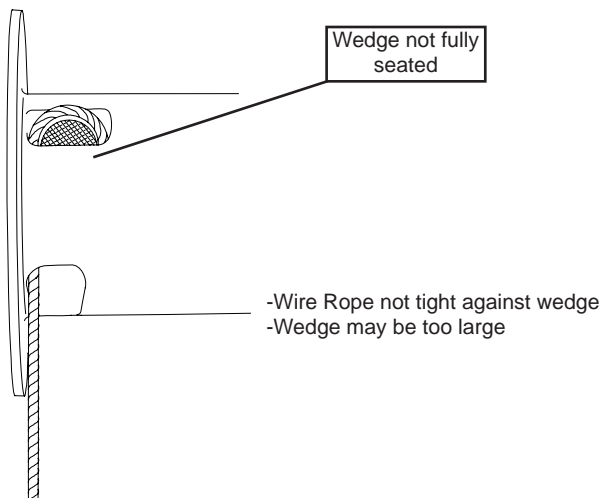


Figure 2

Wedge and wire rope fully seated in pocket

### Incorrect Installations



# HOIST OPERATION

The following warnings and instructions are basic to safe hoist operation. Please read them carefully and follow them each time your hoist is operated. These instructions are provided in addition to any information furnished by the Original Equipment Manufacturer. Equipment operators should be completely familiar with the overall operation of the piece of equipment on which the hoist is mounted (i.e. crane, truck crane, etc.). If you have any questions concerning the safe operation of this hoist or the equipment it is mounted on, contact the equipment manufacturer that installed the hoist, or the Braden Product Support Department at 1-918-251-8511, Monday through Friday, 0800 to 1630 hours CST, by fax at 1-918-259-1575, or via the internet at [www.paccarwinch.com](http://www.paccarwinch.com).

## **WARNING**

Ground personnel must stay in view of the operator and clear of the load and hoist drum at all times. Do not allow personnel near the hoist line under tension. Do not allow personnel near the hoist drum while the hoist is in operation. Do not allow personnel to be in line with the load. Do not allow personnel to stand under a suspended load. A safe distance of at least 1½ times the working length of the cable should be maintained by ground personnel. A broken cable and/or lost load may cause property damage, personal injury or death

## **WARNING**

Failure to properly warm up the hoist, particularly under low ambient temperature conditions, may result in temporary brake slippage due to high back pressures attempting to release the brake, which could result in property damage, severe personal injury or death.

## **WARNING**

Failure to use the proper type and viscosity of planetary gear oil may contribute to intermittent brake clutch slippage which could result in property damage, severe personal injury or death. Some gear lubricants contain large amounts of EP (extreme pressure) and anti-friction additives which may contribute to brake slippage and damage to brake friction discs or seals. Oil viscosity with regard to ambient temperature is also critical to reliable brake operation. Our tests indicate that excessively heavy or thick gear oil may contribute to intermittent brake slippage. Make certain that the gear oil viscosity used in your hoist is correct for your prevailing ambient temperature.

### Warm-up Procedures

A warm-up procedure is recommended at each start-up and is essential at ambient temperatures below +40°F (4°C).

The engine should be run at its lowest recommended RPM with the hydraulic hoist control valve in neutral allowing sufficient time to warm up the system. The hoist should then be operated at low speeds, raise and lower with no load on the hook, several times to prime all lines with warm hydraulic oil, and to circulate gear lubricant through the

## **CAUTION**

If the hoist is mounted on a crane that has an extendable boom, care must be taken to pay-out cable as the boom is extended. Failure to pay-out sufficient cable could result in a "two-blocking" condition that could result in damage to and/or failure of the hoist, cable, sheaves and/or boom.

planetary gear sets.

After the hoist/boom is properly positioned, we recommend the operator slowly pay-out, then haul-in a short length

of cable. The hoist should perform these operations in a smooth and controlled manner. If the hoist does not operate smoothly or makes any unusual sounds, the source of the problem should be identified and corrected before any attempt is made to lift a load.

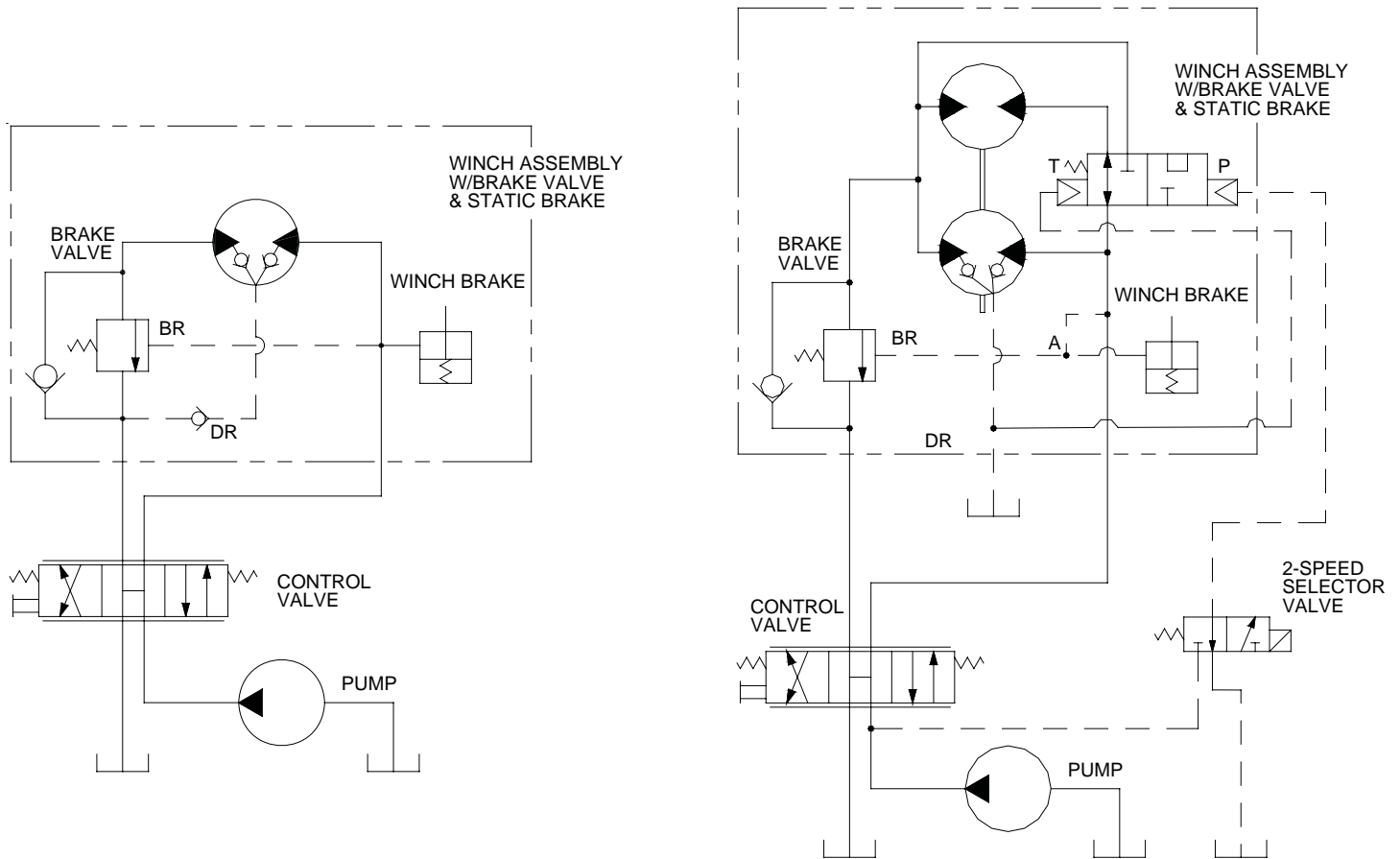
Slowly pay-out wire rope from the hoist drum until it reaches the load. Securely fasten the hoist cable to the load and be sure all ground personnel are a safe distance from the load. Slowly lift the load a short distance and stop. A small amount of "bounce" may be observed, depending on the weight of the load, size and type of wire rope, reaving and the amount of boom extension. Allow the load to stabilize and then watch for any sign of downward movement or cable drum rotation. The hoist static brake should hold the load in place without allowing any downward movement at all. If the load creeps down, it should be lowered to the ground immediately and the source of the problem identified and corrected.

If the hoist is holding the load securely, proceed with normal operations in accordance with the equipment manufacturer's operating procedures and load charts.



# TYPICAL HYDRAULIC CIRCUIT

**NOTE:** The hydraulic circuit shown below is representative of typical Braden hoists. Options and accessory equipment may result in changes to the circuit shown. If there are any questions regarding the hydraulic circuit, refer to information supplied by the original equipment manufacturer, or contact the Braden Product Support Department at the number given in the Foreword of this manual. (ALWAYS have the hoist model and serial number when contacting the factory)



## RECOMMENDED BOLT TORQUE

The general purpose torque shown in the chart applies to SAE Grade 5 & Grade 8 bolts, studs and standard steel full, thick and high nuts.

Higher or lower torques for special applications will be specified such as the use of spanner nuts, nuts on shaft ends, jam nuts and where distortion of parts or gaskets is critical.

Lubricated torque values based on use of SAE 30 engine oil applied to threads and face of bolt or nut.

### RECOMMENDED FASTENER TORQUE

Bolt Dia. Inches	Thds Per Inch	Torque (LB-FT)			
		Grade 5		Grade 8	
		Dry	Lubed	Dry	Lubed
1/4	20 28	8	6	12	9
5/16	18 24	17	13	24	18
3/8	16 24	31	23	45	35
7/16	14 20	50	35	70	50
1/2	13 20	75	55	110	80
9/16	12 18	110	80	150	110
5/8	11 18	150	115	210	160

Bolt Dia. Inches	Thds Per Inch	Torque (LB-FT)			
		Grade 5		Grade 8	
		Dry	Lubed	Dry	Lubed
3/4	10 16	265	200	380	280
7/8	9 14	420	325	600	450
1	8 14	640	485	910	680
1 1/8	7 12	790	590	1290	970
1 1/4	7 12	1120	835	1820	1360
1 3/8	6 12	1460	1095	2385	1790
1 1/2	6 12	1940	1460	3160	2370

# PREVENTATIVE MAINTENANCE

A regular program of preventive maintenance for your planetary hoist is required to minimize the need for emergency servicing and promote safe, reliable hoist operation.

The user of Braden hoist products is responsible for hoist inspection, testing, operator training and maintenance noted below with frequency dependent upon the severity of the hoist duty cycle and the thoroughness of the preventive maintenance program. Field experience, supported by engineering tests, indicate the three service procedures listed below are the most critical to safe, reliable hoist operation and **MUST** be observed.

- Regular Gear Oil Changes -

- Use of Proper Gear Oil – recommended type for prevailing ambient temperatures and additives.

- Periodic Disassembly and Inspection of All Wear Components – in compliance with ANSI specification B30.5c, 1987 and API RP 2D.

Crane inspection records as well as records of preventive maintenance, repairs and modifications must be available for a minimum of five (5) years. These records should include but not limited to, hoist model and serial number, name and employer of repair technician, date and description of work performed.

**Pre-use Inspection** (each shift the hoist is used): This inspection must be performed prior to placing the crane into service and then as necessary during the day for extended operation.

1. Check for external oil leaks and repair as necessary.

**This is extremely important due to the accelerated wear that can be caused by insufficient lubricating oil in the hoist.** Lubricant level must be visible in the lower half of the sight glass. Use only recommended lubricants. See Recommended Lubricants chart in this manual.

2. Check hydraulic plumbing for damage, such as chafed or deteriorating hoses and repair as necessary.

3. Visually inspect for loose or missing bolts, pins, keepers or cotter pins and replace or tighten as necessary.

4. The gear oil should be changed after the first 100 hours of operation or 30 days. The regular gear oil change intervals may be adopted after the first oil change.

5. Inspect the full length of wire rope, rigging and all sheaves according to the wire rope and crane manufacturer's recommendations.

6. A warm-up procedure is recommended at each start-up and is mandatory at ambient temperatures below +40°F (4°C). The engine should be run at its lowest RPM with the hydraulic hoist control in neutral allowing sufficient time to warm up the system. The hoist should then be operated at low speeds, hoisting and lowering with no load, several times to prime all hydraulic lines with warm oil and to circulate lubricant through the planetary gear sets.

## ⚠ WARNING ⚠

Failure to properly warm up the hoist, particularly under low ambient temperature conditions, may result in temporary brake slippage due to high back pressures attempting to release the brake, which could result in property damage, severe personal injury or death.

**Quarterly Inspection** (every 3 months) or monthly in Severe Duty Applications or prior to placing the machine in service if it has not been used for three months or more.

1. Perform the Pre-use Inspection.

2. Inspect all hoist fasteners for tightness and corrosion. Replace all corroded fasteners and tighten per the torque specifications on page 13.

3. The hydraulic system filters should be changed after the first 50 hours of operation then every 500 hours or quarterly or in accordance with the crane manufacturer's recommendations.

4. Take a sample of the gear oil from the hoist drum following the oil sampling procedure on page 16. The oil sample must be taken prior to changing the gear oil. Analyze the sample for wear metals, viscosity, signs of overheating, oxidation, water and other contaminants. If the oil sample contains an unusual amount of metallic particles, the hoist should be removed from service and undergo a tear-down inspection.

**Annual Inspection, Testing & Preventive Maintenance** or semi-annually in Severe Duty Applications.

1. Perform the Pre-Use and Quarterly Inspections.

2. Change the lubricating oil in the hoist drum after an oil sample is taken.

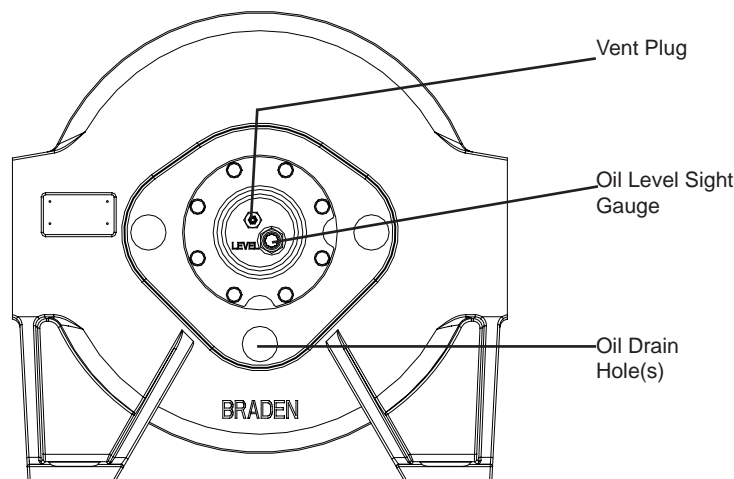
## ⚠ WARNING ⚠

The gear oil must be changed to remove wear particles that impede reliable and safe operation of the brake clutch and erode bearings and seals. Failure to change gear oil at recommended intervals may contribute to intermittent brake slippage, loss of load control, injury or death.

The gear oil should be changed whenever the ambient temperature changes significantly and an oil from a different viscosity range would be more appropriate. Oil viscosity is critical to reliable brake clutch operation. Our tests indicate that excessively heavy or thick gear oil may contribute to intermittent brake clutch slippage. Make certain the gear oil viscosity used in your hoist is correct for your prevailing ambient temperature.

## ⚠ WARNING ⚠

Failure to use the proper type and viscosity gear oil may result in loss of load control, property damage, injury or death.



**NOTE:** If the oil sampling/analysis has not been performed as required, tear-down inspections will be required. Refer to Hoist Disassembly section of this manual.

To change the gear oil, slowly rotate the drum until the oil drain plug is aligned with the lower oil port access hole. Install a short length of pipe threaded for 1 in. NPT into the threaded drain port in the cable drum. Reach through the pipe with a long hex-key and remove the drain plug. The oil will drain out the length of pipe and not between the drum and base. When the oil has drained, install the plug and remove the drain pipe. Removing the vent plug will hasten the oil drain. Rotate the drum until the drain port is aligned with the fill/level port in the end bracket. Refill the hoist with recommended lubricant. Install the plug securely.

3. The vent plug is located in the drum bearing support. It is important to keep the vent plug clean and unobstructed. Whenever the gear oil is changed, the vent plug should be removed, cleaned in solvent and reinstalled. Do not paint over the vent plug or replace with a solid plug or grease fitting.

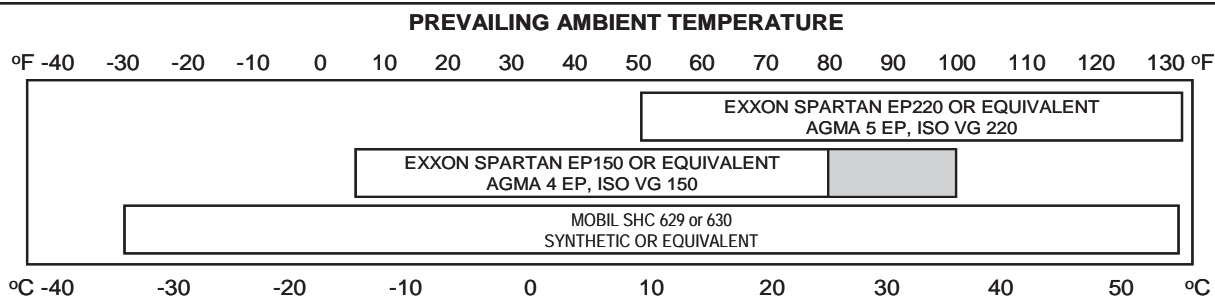
## ⚠ WARNING ⚠

DO NOT insert fingers through oil drain hole to determine drain hole alignment. Movement of the drum could result in severe injury should appendages be present in the drain hole.

## Recommended Planetary Gear Oil

## ⚠ WARNING ⚠

Failure to use the proper type and viscosity of planetary gear oil may contribute to intermittent brake clutch slippage which could result in property damage, severe personal injury or death. Some gear lubricants contain large amounts of EP (extreme pressure) and anti-friction additives which may contribute to brake slippage and damage to brake friction discs or seals. Oil viscosity with regard to ambient temperature is also critical to reliable brake operation. Our tests indicate that excessively heavy or thick gear oil may contribute to intermittent brake slippage. Make certain that the gear oil viscosity used in your hoist is correct for your prevailing ambient temperature.



**NOTE:** SHADED TEMPERATURE RANGE IN THE CHART ABOVE NOT RECOMMENDED FOR SEVERE APPLICATIONS SUCH AS: OFFSHORE CRANES, SUSTAINED FAST DUTY CYCLES OR FREQUENT LIFTING.

Texaco Meropa 150, previously used as factory fill, may no longer be widely available due to current market conditions. As of mid-year 2002, planetary hoists are factory filled with Exxon Spartan EP150, or equivalent. Consult your oil supplier for other equivalent oils if required.

Texaco	Exxon	Mobil	Shell	Chevron
Meropa 150	Spartan EP 150	Mobilgear 629	Omala 150	Gear Compund EP150
Meropa 220	Spartan EP 220	Mobilgear 630	Omala 220	Gear Compund EP220

## Tear-down Inspection

Any hoist that has not been subjected to regular oil sample analysis should undergo a tear-down inspection every 24 months. Also, if a hoist has an unknown history of repair and/or maintenance, the hoist should undergo a tear-down inspection prior to being placed into service.

A tear-down inspection of the hoist should include the complete disassembly, cleaning, inspection and replacement of all worn, cracked, corroded or distorted parts such as pins, bearings, shafts and brake components. All seals and o-rings should be replaced during a tear-down inspection. Always use new Spirol pins in the planet gear shafts.

**Any deficiency must be corrected immediately.**

Before placing the hoist back in service, the rebuilt hoist must be pull tested to the rated load of the hoist with a dynamometer or equivalent measuring device. The hoist should be dynamically tested by rotating the drum several times, in both raising and lowering directions, while under load of at least 30 % of the hoist rated lifting capacity. Check for smooth, quiet operation during this procedure.

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# OIL SAMPLING AND ANALYSIS

Proper oil sampling and analysis of the sample, is a vital part of a comprehensive preventive maintenance program. Information obtained from the oil analysis is best utilized in conjunction with a regular program of preventive maintenance. The early warning of abnormal wear provided by an analysis program allows the user to substitute preventive maintenance for a far more costly and dangerous failure that may lead to loss of load control that could result in property damage, personal injury or death. Early detection of accelerated component wear allows the scheduling of corrective maintenance and can reduce in-operation failures and costly down time.

## Taking a Valid Oil Sample

Prepare the hoist by cleaning the drain area and drain extension tube in order to obtain an uncontaminated sample. Operate the hoist in both directions for one to two minutes and then take the oil sample from the drain port as soon as possible. Do not take the sample from the first oil out of the drain port. Take a sample from the mid-stream flow of the oil to obtain an accurate representation of the oil condition. After taking an oil sample, refill hoist with recommended lubricant.

## ⚠ WARNING ⚠

Hot oil may cause personal injury and/or burns to unprotected skin. Make certain the oil has cooled to a safe temperature (less than 110°F or 43°C) before taking an oil sample, changing oil or servicing the hoist.

## Analysis

General Guide Lines

(After approximately 250 hours of operation)

**Note:** *The first oil change usually contains more “wear metals”. Following the initial break-in period, the wear metal levels should stabilize at a lower number.*

Iron Contaminates

100 to 400 ppm Normal

400 to 700 ppm      Caution – Abnormal Sample  
(monitor more frequently), tear-down inspection may be required.

701 ppm & up      Unacceptable – Abnormal Sample (tear down inspection required)

In all contaminate monitoring, equally important as the level of contamination, is the change in the amount of contamination compared to previous samples.

Moisture contamination will lead to the formation of acids that damage all internal components. Silica found in the oil typically indicates “dirt” and contaminated lubricant supply or poor maintenance practices.

# TROUBLESHOOTING

The following troubleshooting section is provided as a general guide. You may also need to contact the Original Equipment Manufacturer (OEM) for additional information.

## ⚠ WARNING ⚠

If a hoist exhibits any sign of:

- Erratic operation such as poor load control, load creeping down or chattering.
- Unusual noise.
- Gear oil leaks
- A sudden rise in wear particles from oil analysis

The hoist **MUST** be removed from service until the problem has been corrected. If a hoist has been subjected to a sudden heavy load (shock-load) or overload, the hoist must be removed from service, disassembled and all internal components thoroughly inspected for damage. Continued operation with a defect may result in loss of load control, property damage, injury or death.

TROUBLE	PROBABLE CAUSE	REMEDY
<p><b>A</b></p> <p>The hoist will not lower the load or not lower the load smoothly.</p>	<p>1. The problem could be a plugged or loose pilot orifice. The pilot orifice is a small pipe plug with a hole drilled through it, located behind the pilot port fitting on the brake valve. If it becomes plugged, it will prevent the pilot pressure, from the manifold, from opening the brake valve. If it becomes loose, it will allow an unregulated amount of oil in to operate the brake valve causing erratic brake valve operation.</p> <p><b>NOTE:</b> Some brake valves do not use a separate pilot orifice plug.</p> <p>2. The friction brake may not be releasing as a result of a defective brake cylinder seal.</p> <p><b>NOTE:</b> If the brake cylinder seal is defective you will usually find oil leaking from the hoist vent plug.</p> <p>3. Friction brake will not release as a result of damaged brake discs.</p>	<p>Remove the pilot hose and fitting from the brake valve, then use a 5/32 inch Allen wrench to remove the pilot orifice. The diameter of the orifice is approximately .020 inches (.5 mm). Clean and install the pilot orifice tightly in the brake valve.</p> <p>Check brake cylinder seal as follows:</p> <p>A. Disconnect the swivel tee from the brake release port. Connect a hand pump with accurate 0-2000 psi (13,800 kPa) gauge and shut-off valve to the fitting in the brake release port.</p> <p>B. Apply 1000 psi (6,900 kPa) to the brake. Close shut-off valve and let stand for five (5) minutes.</p> <p>C. If there is any loss of pressure in five (5) minutes, the brake cylinder should be disassembled for inspection of the sealing surfaces and replacement of the seals. Refer to "Brake Cylinder Service" section of this manual.</p> <p>Disassemble brake to inspect brake discs. Check stack-up height as described in "Brake Cylinder Service" section of this manual.</p>

TROUBLE	PROBABLE CAUSE	REMEDY
<p><b>B</b></p> <p>Oil leaks from vent plug</p>	<p>1. Same as A2.</p> <p>2. Motor seal may be defective as a result of high back pressure in the motor case drain circuit or contaminated oil. Contamination will usually cause the seal to wear a groove in the motor shaft.</p>	<p>Same as A2.</p> <p>Case drain back pressure must not exceed 100 psi (690 kPa) for gear motors and 44 psi (304 kPa) for piston motors. Inspect hydraulic system for a restriction in the return line to the reservoir.</p> <p>Oil analysis may indicate contamination has worn motor shaft and seal. Thoroughly flush entire hydraulic system and install new filters and oil. Install new motor seal.</p>
<p><b>C</b></p> <p>The brake will not hold a load with the control lever in neutral</p>	<p>1. Excessive system back pressure acting on the brake release port.</p> <p>2. Friction brake will not hold due to worn or damaged brake discs.</p> <p>3. Brake clutch is slipping.</p>	<p>The pressure at the motor lowering port is also transmitted to the brake release pilot circuit. Inspect hydraulic circuit for restrictions, plugged filters or control valves not centering.</p> <p>Same as Remedy of Trouble A3.</p> <p>Improper planetary gear oil may cause the brake clutch to slip. Drain old gear oil and flush winch with solvent. Thoroughly drain solvent and refill hoist with recommended planetary gear oil listed in "Preventive Maintenance".</p> <p>Brake clutch may be damaged or worn. Disassemble and inspect brake clutch as described in "Over-running Clutch Service".</p>
<p><b>D</b></p> <p>The hoist will not hoist the rated load</p>	<p>1. The hoist may be mounted on an uneven or flexible surface which causes distortion of the hoist base and binding of the gear train. Binding in the gear train will absorb horsepower needed to hoist the rated load and cause heat.</p> <p>2. System relief valve may be set too low. Relief valve needs adjustment or repair.</p>	<p>Reinforce mounting surface.</p> <p>If necessary, use shim stock to level hoist. Refer to "Hoist Installation". First loosen, then evenly retighten all hoist mounting bolts to recommended torque.</p> <p>Check relief pressure as follows:</p> <p>A. Install an accurate 0-5000 psi (34,500 kPa) gauge into the inlet port of the brake valve.</p>



TROUBLE	PROBABLE CAUSE	REMEDY
Trouble "D" Continued From Previous Page	<p>3. Be certain hydraulic system temperature is not more than 180°F (82°C). Excessive hydraulic oil temperatures increase motor internal leakage and reduces motor performance.</p> <p>4. Hoist line pull rating is based on 1st layer of wire rope.</p> <p>5. Rigging and sheaves not operating efficiently.</p>	<p>B. Apply a stall pull load on the hoist while monitoring pressure.</p> <p>C. Compare gauge reading to hoist specifications. Adjust relief valve as required.</p> <p><b>NOTE:</b> <i>If pressure does not increase in proportion to adjustment, relief valve may be contaminated or worn out. In either case, the relief valve may require disassembly or replacement.</i></p> <p>Same as remedies for Trouble D1 &amp; D2.</p> <p>Same as remedies for Trouble E2.</p> <p>Refer to hoist performance charts for additional information.</p> <p>Perform rigging service as recommended by crane manufacturer.</p>
<p><b>E</b></p> <p>The winch runs hot</p>	<p>1. Same as D1.</p> <p>2. Be certain that the hydraulic system temperature is not more than 180°F (82°C). Excessive hydraulic oil temperatures may be caused by:</p> <p>A. Plugged heat exchanger.</p> <p>B. Too low or too high oil level in hydraulic reservoir.</p> <p>C. Same as D2</p> <p>D. Hydraulic pump not operating efficiently.</p> <p>E. Hydraulic oil is wrong viscosity for operating conditions.</p> <p>3. Excessively worn or damaged internal winch parts.</p>	<p>Same as remedies for Trouble D1.</p> <p>Thoroughly clean exterior and flush interior.</p> <p>Fill/drain to proper level.</p> <p>Same as remedies for Trouble D2.</p> <p>Engine low on horsepower or R.P.M. Tune/adjust engine.</p> <p>Check suction line for damage.</p> <p>Pump worn. Replace pump.</p> <p>Use correct hydraulic oil.</p> <p>Disassemble hoist to inspect/ replace worn parts.</p>

TROUBLE	PROBABLE CAUSE	REMEDY
<p style="text-align: center;"><b>F</b></p> <p>Hoist “chatters” or surges while raising rated load.</p>	<p>1. Same as D2.</p> <p>2. Hydraulic oil flow to motor may be too low.</p> <p>3. Controls being operated too quickly.</p> <p>4. Hydraulic motor 2-speed control not shifting correctly.</p>	<p>Same as remedies for Trouble D2.</p> <p>Same as remedies for Trouble E2.</p> <p>Conduct operator training as required.</p> <p>Inspect and repair motor displacement control.</p>
<p style="text-align: center;"><b>G</b></p> <p>The wire rope does not spool smoothly on the drum.</p>	<p>1. The hoist may be mounted too close to the main sheave, causing the fleet angle to be more than 1½ degrees.</p> <p>2. The hoist may not be mounted perpendicular to an imaginary line between the center of the cable drum and the first sheave.</p> <p>3. Could possibly be using the wrong lay rope. There is a distinct advantage in applying rope of the proper direction of lay. When the load is slacked off, the several wraps on the drum will stay closer together and maintain an even layer. If rope of improper lay is used, the coils will spread apart each time the load is removed. Then, when hoisting is resumed, the rope has a tendency to criss-cross and overlap on the drum. The result is apt to be a flattened and crushed rope.</p> <p>4. The hoist may have been overloaded, causing permanent set in the wire rope.</p>	<p>Check mounting distance and fleet angle. Reposition hoist as required to achieve ½ to 1½ degree fleet angle.</p> <p>Refer to “Hoist Installation”.</p> <p>Consult wire rope manufacturer for recommendation of wire rope that best suits your application.</p> <p>Replace wire rope and conduct operator/rigger training as required.</p>



# DISASSEMBLY PROCEDURE

1. Remove the wire rope from the hoist drum and wind onto a cable reel as recommended by the wire rope manufacturer. Power-wash the hoist and all motor piping to remove contamination that might enter open hose and motor ports. Align the drain plug in the cable drum with the lowest access hole in the bearing support end plate before removing the hoses and piping. Drain the gear oil from the hoist as described in the Preventive Maintenance section of this manual.

## ⚠ CAUTION ⚠

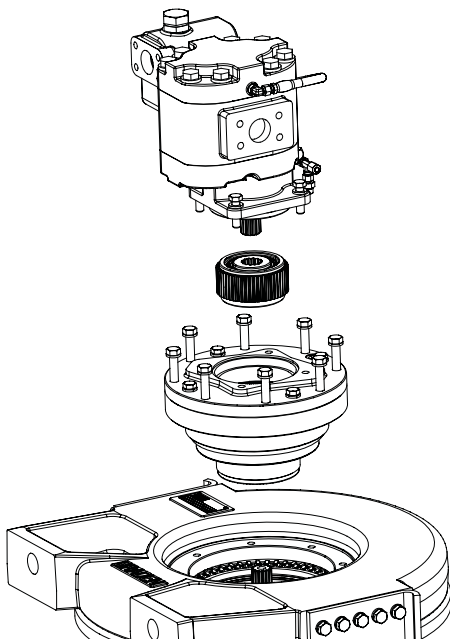
The CH165A/CH230B with the standard 01 drum weighs approximately 1100 lb (500 kg). Make certain lifting equipment has adequate capacity. Using undersized or poorly maintained lifting equipment may result in a dropped load, property damage injury or death.

## ⚠ CAUTION ⚠

**Do not** attempt to disassemble/assemble the hoist in the horizontal position as thrust washers may become dislodged and the gear train out of alignment that may cause severe gear train damage that may result in loss of load control, property damage, injury or death.

2. Stand the winch up on the drum bearing support end with the motor end up. Secure the hoist in this position so that it does not fall over and cause property damage or personal injury.

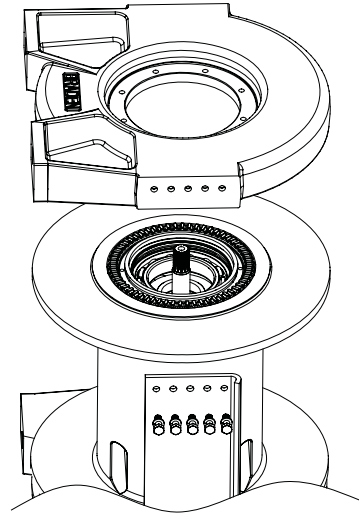
3. Tag and remove the hydraulic hoses that connect the brake valve and motor to the brake release port.



4. Remove the four capscrews and lockwashers securing the motor and lift the motor off the hoist. Cover the motor ports to prevent contamination. Remove the brake clutch assembly from the brake cylinder. Disassembly of the

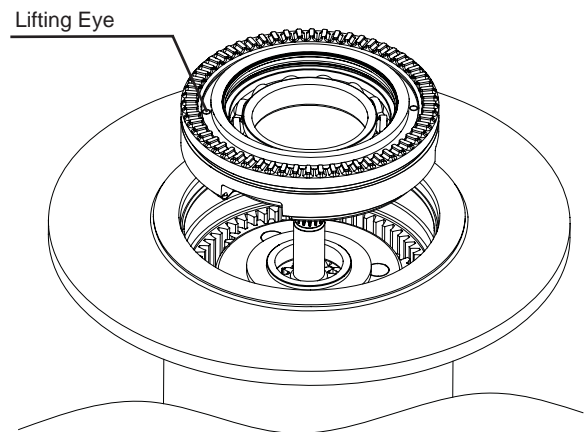
brake clutch assembly will be discussed in the "Brake Clutch Service" section of this manual.

5. Remove the eight capscrews that secure the brake cylinder to the motor side plate. Lift the brake cylinder out of the hoist and place on a clean work surface. Disassembly of the brake cylinder will be discussed in the "Brake Cylinder Service" section of this manual. Remove and discard the V-Ring seal that was under the brake cylinder. Do not remove the four (4) capscrews holding the motor adapter to the brake cylinder at this time. Refer to "Brake Cylinder Service" later in this manual.



6. Remove the twenty (20) capscrews and lockwashers from the two (2) tie plates, and remove the plates.

7. Remove the motor end plate from the drum.



8. There are two 1/2 inch NC tapped holes in the drum closure (item 33). Install two capscrews or threaded eye-bolts to aid in removing the closure from the cable drum. Remove and discard the O-Ring (item 17) from the O.D. of the drum closure.

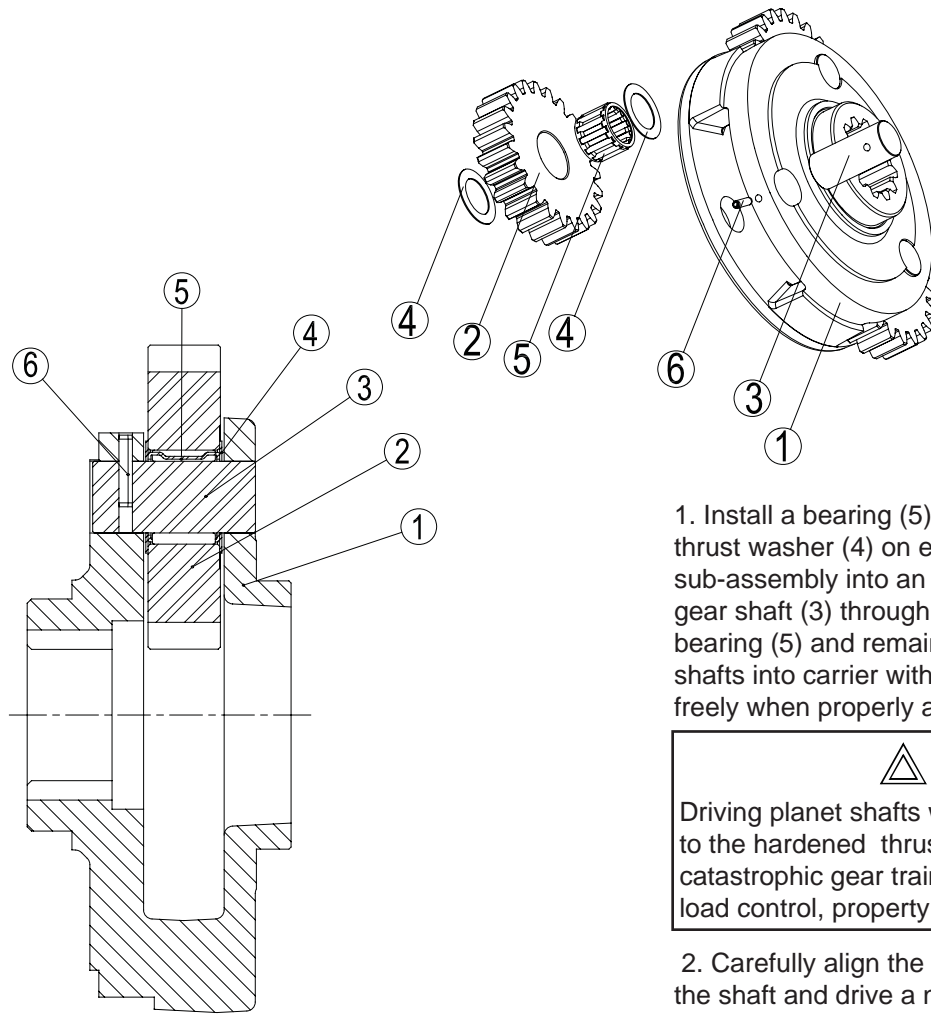
9. For -01 and -02 drums, the primary sun gear (item 22), primary planet carrier assembly (item 300), and output planet carrier assembly (item 400) can now be lifted out of the cable drum.

For -02 drums only, there are also two 1/2 inch NC tapped holes in the ring gear adapter (item 33). Install two capscrews or threaded eye-bolts into these holes and lift the ring gear adapter and ring gear out of the cable drum.

10. Lift the cable drum (item 10) off of the drum support assembly (item 3)

11. Thoroughly clean and inspect all disassembled components at this time. Inspect bearings in the drum closure and cable drum (items 9 & 16), and replace as required. Inspect sealing surfaces on the drum support and brake cylinder and repair any damaged areas if possible, or replace components as required. During a complete winch teardown, drum seals (items 18 and 70) and V-Ring seals (items 6 and 20) should always be replaced. Inspect thrust washers (items 13 and 15) for signs of excessive wear, heat damage or metal transfer and replace as necessary. Inspect the ring gear teeth for nicks, spalling or excessive wear. Replace if wear in contact areas is greater than 0.015 in. (0.4 mm) when compared to unworn area of teeth.

# PLANET CARRIER SERVICE



## PRIMARY PLANET CARRIER Disassembly

1. Remove the planet gears by first driving the roll pins (6) into the center of the planet gear shafts (3). Push the planet gear shafts far enough out of the planet carrier to expose the roll pin hole. Use a pin punch to drive the roll pins from the shafts. **DO NOT** reuse roll pins

2. Now you can remove the planet shafts, bearings, thrust washers and gears. Thoroughly clean all parts and inspect for damage and wear. The bearing rollers should not exhibit any irregularities. If the rollers show any sign of spalling, corrosion, discoloration, material displacement or abnormal wear, the bearing should be replaced. Likewise, the cage should be inspected for unusual wear or deformation, particularly the cage bars. If there is any damage that will impair the cage's ability to separate, retain and guide the rollers properly, the bearing should be replaced. The thrust washer contact areas should be free from any surface irregularities that may cause abrasions or friction. The gears and shafts should be inspected for abnormal wear or pitting. Replace if necessary

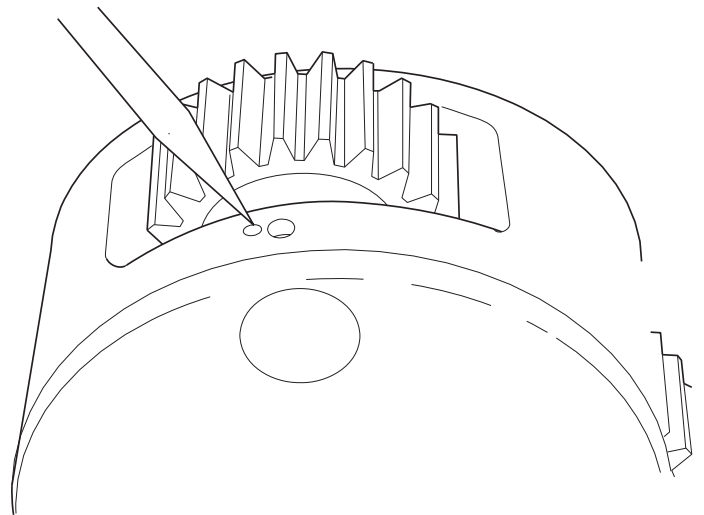
## Assembly

1. Install a bearing (5) into a planet gear (2) and place a thrust washer (4) on each side of the gear. Position this sub-assembly into an opening in the carrier. Slide a planet gear shaft (3) through the carrier (1), thrust washer (4), bearing (5) and remaining thrust washer (4). **DO NOT** drive shafts into carrier with a hammer. Shafts should move freely when properly aligned.

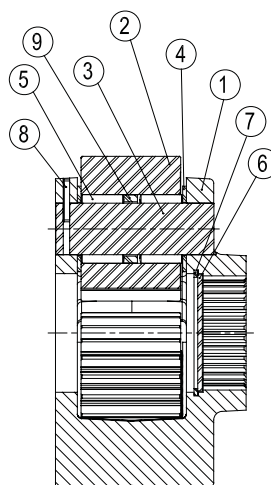
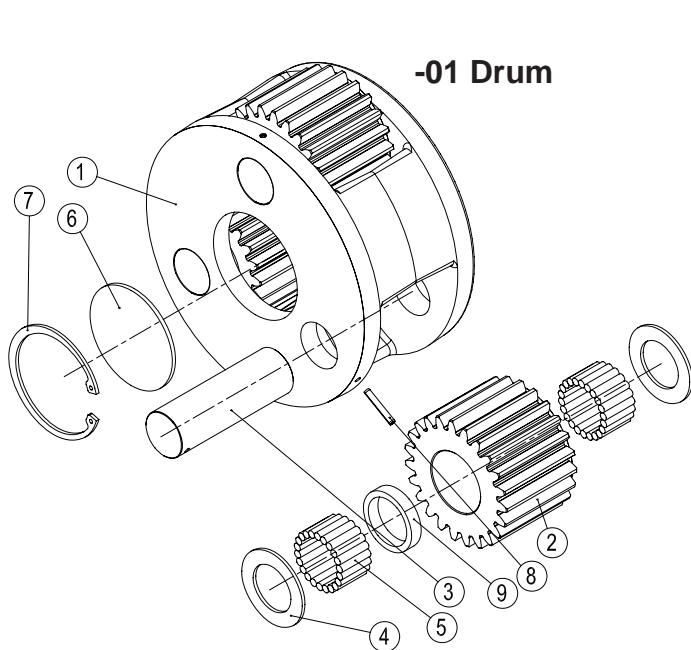
## CAUTION

Driving planet shafts with a hammer may cause damage to the hardened thrust washers which could lead to catastrophic gear train failure which could result in loss of load control, property damage, injury or death

2. Carefully align the pin hole in the carrier with the hole in the shaft and drive a new roll pin into place. **ALWAYS** use **NEW** roll pins. When properly positioned, 50% of the roll pin will engage the planet gear shaft and 50% will remain in the carrier.



3. Note that the roll pin is slightly recessed into the carrier when properly installed. With a center punch, stake the carrier next to the pin hole as shown. This will distort the hole and prevent the pin from backing out in operation. Repeat these steps for each of the three planet gears.



## Assembly

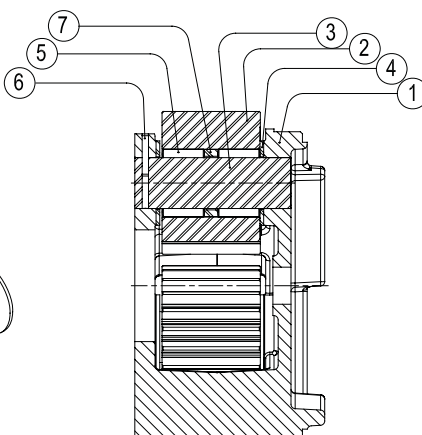
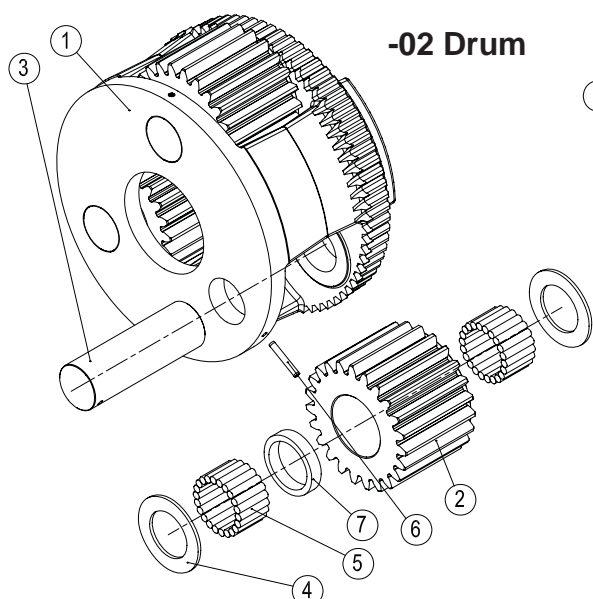
1. Place the output planet carrier on a clean work surface with the splined end of the housing down.

### 01 Drums only

Install the thrust plate (6) into the center bore of the housing and secure in place with retaining ring (7).

2. Apply oil soluble grease to a thrust washer (4) and install it on one side of a planet gear (2). Place the planet gear on a clean work surface with the thrust washer down. Apply oil soluble grease to the bore of the gear and stack a row of loose bearing rollers (5) into the planet gear using the grease to hold the rollers in position. There are 22 rollers in each row. Install a bearing spacer (9) into the gear. Install a second row of bearing rollers on top

of the bearing spacer. Place the remaining thrust washer on top of the planet gear. Carefully slide the planet gear sub-assembly into the planet carrier. Install a planet gear shaft into the planet carrier and through the planet gear bearings. **DO NOT** drive shafts into carrier with a hammer. Shafts should move freely when properly aligned.



## OUTPUT PLANET CARRIER Disassembly

1. Remove the planet gears by first driving the roll pins (8) into the center of the planet gear shafts (3). Push the planet gear shafts far enough out of the planet carrier to expose the roll pin hole. Use a pin punch to drive the roll pins from the shafts. **DO NOT** reuse roll pins.

2. Remove the planet shafts, bearing rollers, spacers, thrust washers and gears. Thoroughly clean all parts and inspect for damage and wear. The bearing rollers should not exhibit any irregularities. If the rollers show any sign of spalling, corrosion, discoloration, material displacement or abnormal wear, they should be replaced. The thrust washer contact areas should be free from any surface irregularities that may cause abrasions or friction. The gears and shafts should be inspected for abnormal wear or pitting. Replace if necessary.

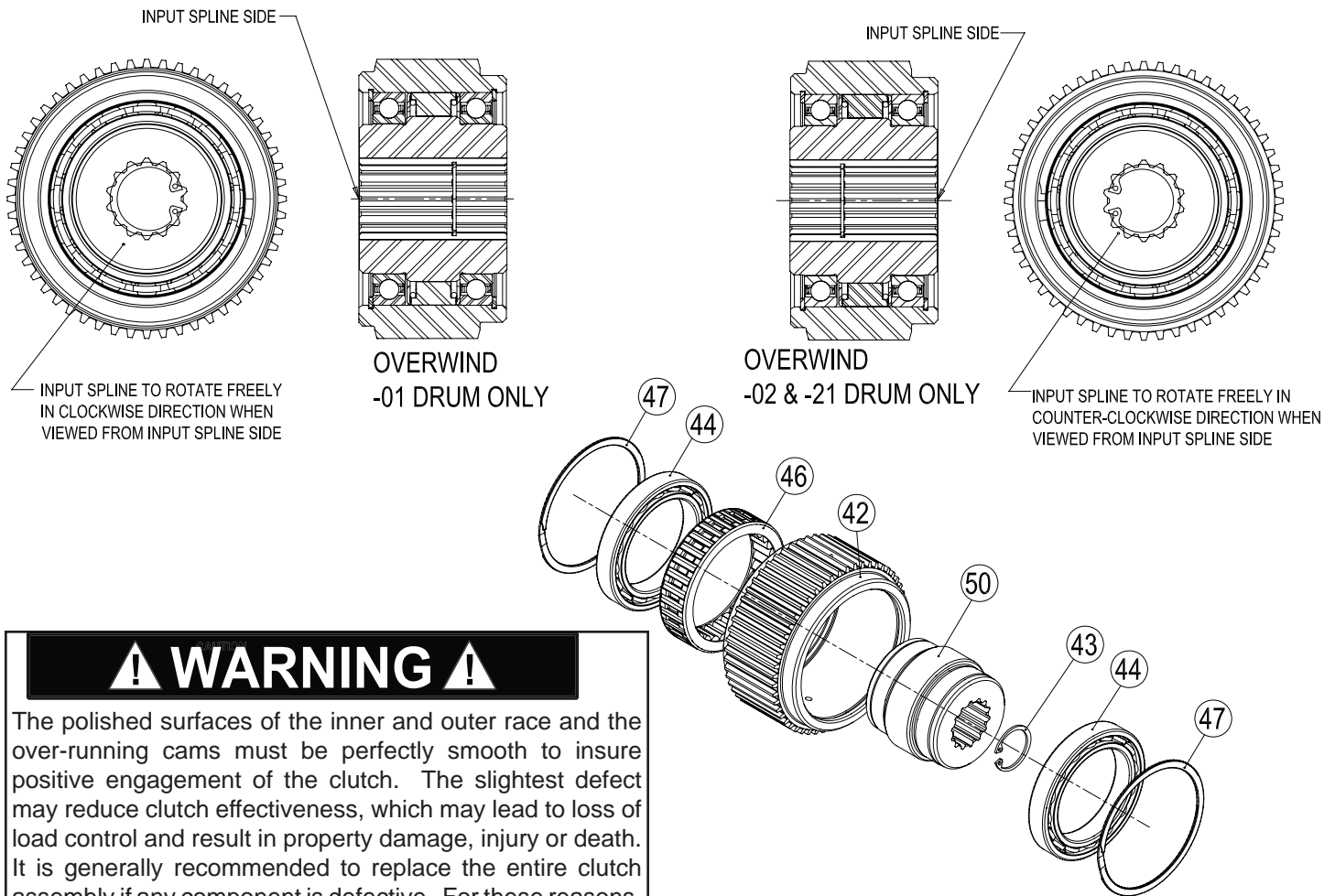
## CAUTION

Driving planet shafts with a hammer may cause damage to the hardened thrust washers which could lead to catastrophic gear train failure which could result in loss of load control, property damage, injury or death.

3. Follow steps 2 and 3 of the Primary Planet Carrier assembly procedure to install and stake a NEW roll pin in the carrier.

Repeat this procedure for each of the planet gears.

# OVER-RUNNING CLUTCH SERVICE



## ⚠ WARNING ⚠

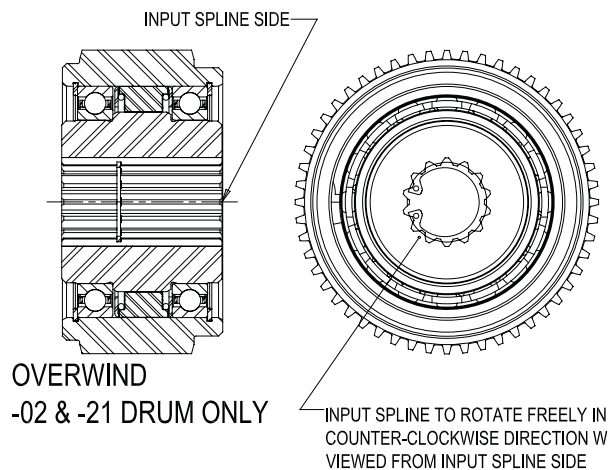
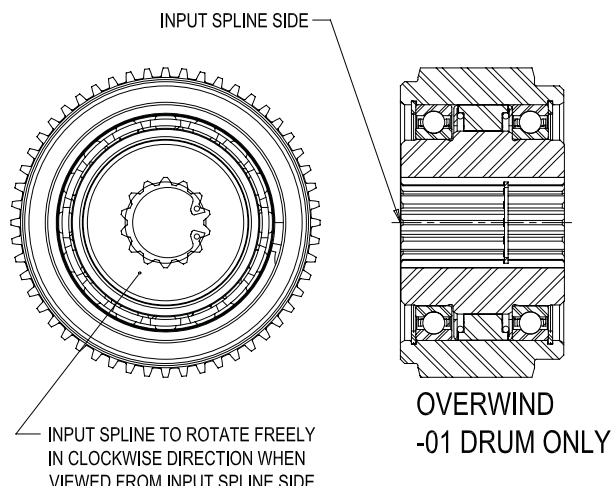
The polished surfaces of the inner and outer race and the over-running cams must be perfectly smooth to insure positive engagement of the clutch. The slightest defect may reduce clutch effectiveness, which may lead to loss of load control and result in property damage, injury or death. It is generally recommended to replace the entire clutch assembly if any component is defective. For these reasons, the over-running clutch assembly should be disassembled for inspection only if the hoist has exhibited any unusual operation that would point toward a clutch malfunction, or the over-running clutch assembly shows external signs of mechanical damage.

**NOTE:** Outer race (item 42), Inner race (item 50) and Over-running clutch (item 46) are NOT SOLD individually as replacement parts. If any of these parts require replacement, the entire over-running clutch assembly must be replaced. Carefully note the relative orientation between the inner and outer races, and the direction of free rotation of the inner race. The clutch MUST be re-assembled correctly for proper hoist operation.

## Disassembly

1. Remove one of the retaining rings (item 47) from the outer race (item 42). Push the inner race (item 50), bearings (item 44) and over-running clutch (item 46) through the outer race.
2. Use a small punch and hammer to tap one of the bearings (item 44) off of the inner race. The over-running clutch can now be removed from the inner race. Closely inspect the over-running clutch and the polished surfaces of the inner and outer race for wear, cracks, pitting, corrosion or mechanical damage. Closely inspect the bearings for any signs of damage, wear, corrosion, pitting or heat discoloration.





## Assembly

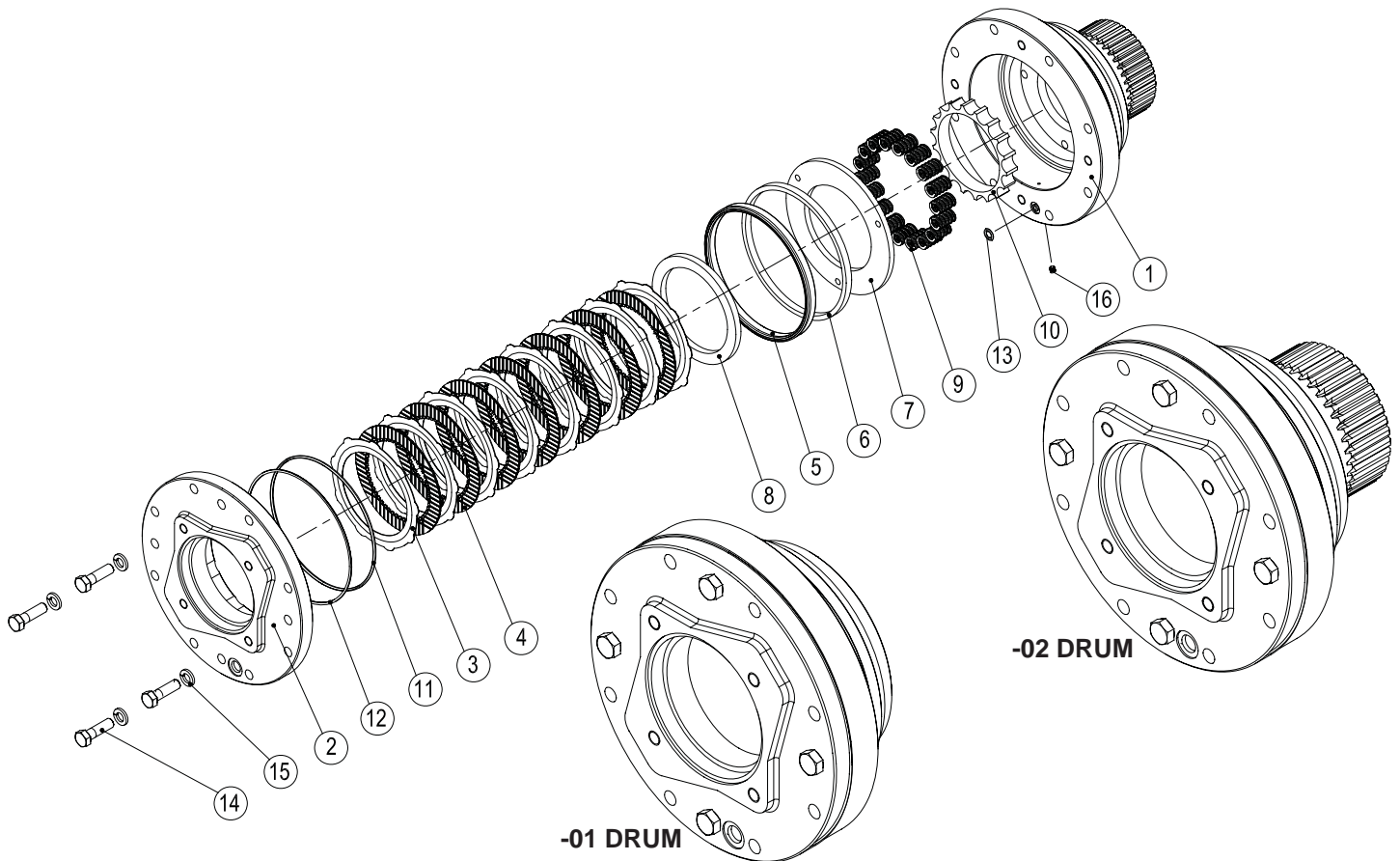
1. If both bearings (item 44) have been removed from the inner race, install one of them now.
2. Install the over-running clutch onto the inner race. Rotate the inner race slightly to get the clutch started onto the inner race.
3. Install the other bearing onto the inner race.
4. The outer race should have one retaining ring (item 47) installed in one end. Carefully slide the inner race, with bearings and clutch, into the outer race. Install the other retaining ring into the outer race.

Shown above are the two types of clutch assemblies used in CH165 and CH210 hoists. The drawings show each type properly assembled.

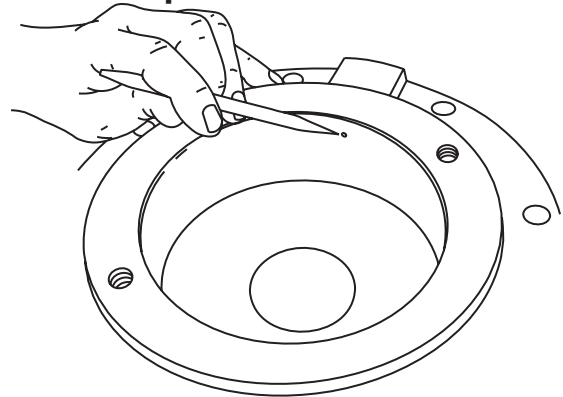
## ⚠ WARNING ⚠

Failure to assemble the over-running clutch assembly with all parts oriented correctly may result in reduced brake effectiveness, which may lead to loss of load control and result in property damage, injury or death.

# BRAKE CYLINDER SERVICE



## Clean and Inspect



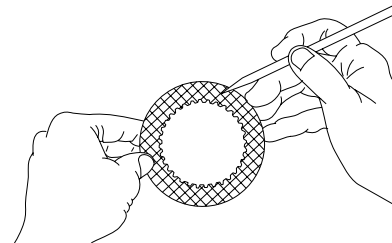
## Disassembly

### ⚠ CAUTION ⚠

The motor adapter is under spring tension from the brake springs. Loosen each of the capscrews one turn at a time until spring tension is released.

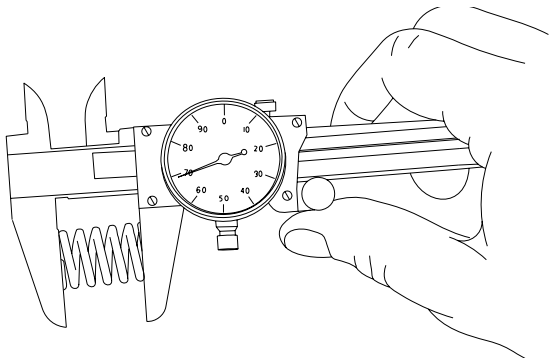
1. Stand the brake assembly on the splined end, with the motor adapter up. Remove the four capscrews (item 14) and lockwashers (item 15). Use a criss-cross pattern and loosen each capscrew one turn at a time until spring tension is released.
2. Remove the motor adapter (item 2). Lift out all the brake discs (item 3), friction discs (item 40) and the spacer (item 8).
3. Remove and discard the O-Ring and backup ring (items 11 & 12) from the motor adapter. Remove and discard the seal (item 5) from the brake cylinder. Remove the steel piston backup ring (item 6).
4. Remove the pressure plate (item 7) and the springs and separator (items 9 & 10) from the brake cylinder.

1. Thoroughly clean and inspect all parts at this time. Check sealing surfaces on both the motor adapter and brake cylinder. Be sure the brake release port is open and free of contamination.



2. Place friction brake disc on flat surface and check for distortion with a straight edge. Friction material should appear even across entire surface with groove pattern visible. Replace friction disc if splines are worn to a

point, disc is distorted, friction material is burned or worn unevenly, or groove depth is less than 0.003 in. (0.08 mm).



3. Place steel disc on flat surface and check for distortion with a straight edge. Check surface for signs of material transfer or excessive heat. Replace steel disc if distorted, heat discolored, or mechanically damaged.

4. Check brake spring free length. Minimum free length is 1-7/16 in. (36.5 mm). Check springs for any signs of cracking or failure. If a brake spring must be replaced for any reason, then ALL brake springs must be replaced.

## ⚠ CAUTION ⚠

Failure to replace brake springs as a set may result in uneven brake application pressure and repeated brake spring failure.

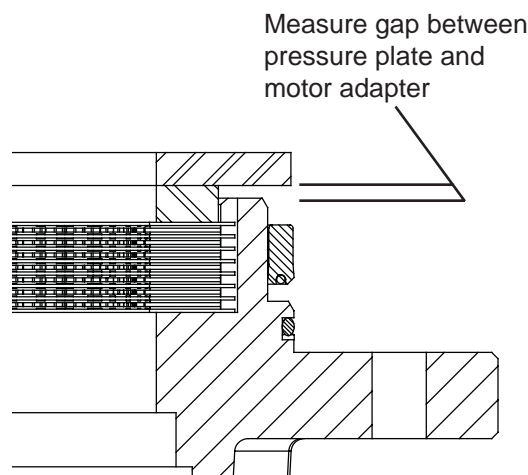
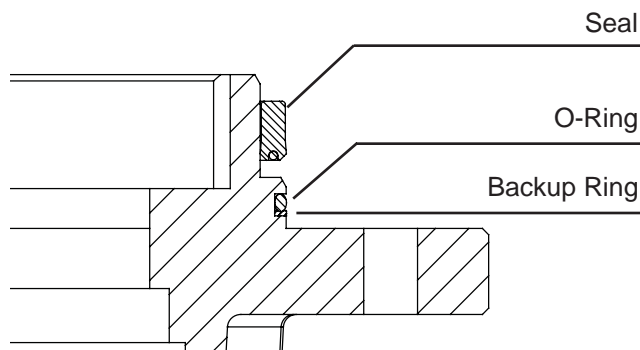
## Assembly

1. Place the motor adapter on a clean work surface with the motor mounting surface down. Apply a light coat of oil to a new backup ring (item 12) and O-Ring (item 11) and install them into the groove on the motor adapter. Backup rings are always placed on the low pressure side of the O-Ring. In this case, the backup ring is toward the motor mounting surface. Lightly oil the brake cylinder seal (item 5) and install it onto the motor adapter with the seal lip down.

2. Install a steel brake disc (item 3) into the motor adapter, followed by a friction disc (item 4). Continue to alternately install steel and friction discs until there are 8 steel and 7 friction discs. A steel disc will be on top.

3. Install the brake plate spacer (item 8) on top of the last steel disc.

4. To check brake stack height, place pressure plate (item 7) on top of brake spacer. Hold pressure plate down firmly by hand and measure gap (in three places) between motor adapter and pressure plate. Average gap must measure between 0.160 in. (4 mm) maximum and 0.080 in. (2.0 mm) minimum. If the gap exceeds the maximum limit, there may be too many discs in the stack-up or the discs are distorted. If the gap is less than the minimum, there may be too few discs or the discs are worn beyond their serviceable limit and should be replaced. When the gap is within the minimum and maximum values, remove the pressure plate and all brake discs. Lubricate all friction discs with the same oil to be used in the hoist. Install all brake discs and brake plate spacer as described in steps 2 and 3.





5. Place the brake cylinder on a clean work surface with the drum end down. Install the spring spacer (item 10), then the 18 springs (item 9.)

## **WARNING**

Always use the molded spring spacer to properly position the springs in the brake cylinder. Failure to install the spring spacer may allow the springs to contact each other and become damaged. This could result in loss of load control, property damage, injury or death.

6. Install the pressure plate (item 7) into the brake cylinder. Be careful that none of the springs fall over. Install the steel backup ring (item 6). Apply an oil soluble grease to a new O-Ring (item 13) and install it in the brake housing.

7. Apply an oil soluble grease to the sealing surface of the brake cylinder and the piston seal. Turn the brake cylinder over and lower it onto the motor adapter, being careful not to damage the piston seal or O-Ring on the adapter. Be careful the O-Ring (item 13) does not fall out of place, and the oil passages are aligned. The alternate assembly method below could also be used.

8. Turn the entire assembly over and install the four capscrews and lockwashers. After the capscrews make contact with the motor adapter, evenly tighten them one turn at a time until the motor adapter is drawn tight against the brake cylinder, then torque to the recommended value.

**NOTE:** The close fitting backup ring may be depressed slightly to one side to lodge it in the brake cylinder bore and temporarily hold the pressure plate and springs in place while the brake cylinder is inverted and lowered over the motor adapter.

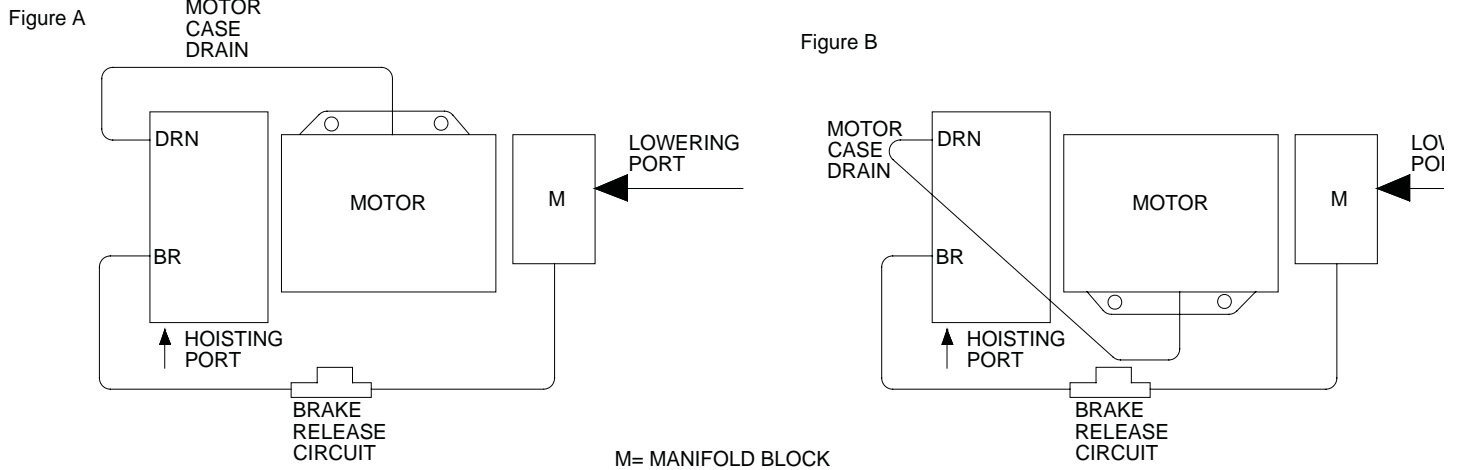
*As an alternate, the motor adapter and brake plates can be turned over and installed into the brake cylinder, holding the brake plates and spacer in place through the center opening. Be careful to not pinch your fingers between the spacer plate and the pressure plate.*

## **BRAKE CYLINDER PRESSURE TEST**

1. Install a -6 ORB fitting into the brake release port on the motor adapter. Connect a hand pump with an accurate 0-2,000 psi (0-13,800 kPa) gauge and shut-off valve to this fitting. Apply 1,000 psi (6,900 kPa) to the brake and close the shut-off valve. Let the unit stand for five minutes. If there is any loss of pressure, the brake cylinder should be disassembled for inspection of the sealing surfaces, seal and O-Ring. When the source of the pressure leak has been determined and corrected, re-assemble the brake cylinder and repeat the test.

2. WHILE PRESSURE IS APPLIED AND THE BRAKE IS RELEASED, install the over-running clutch assembly into the brake pack. Turn the clutch back and forth to align the splines on all the friction discs. Release the pressure on the brake cylinder and remove the clutch assembly. The brake cylinder is now complete and ready to be installed in the hoist.

# REVERSING DIRECTION OF DRUM ROTATION (090, 110, & 120 MOTORS ONLY)

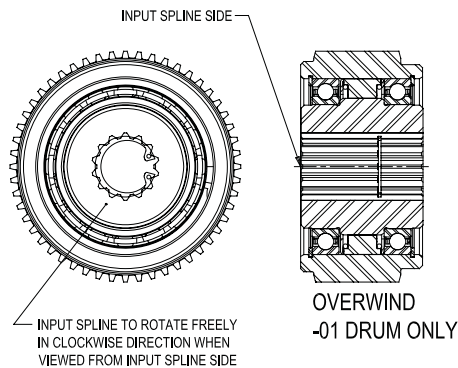


The procedure below applies to single speed gear motors. For two speed gear motors, the motor must be disassembled and the center section with the shift spool turned 180 degrees.

In order to change the direction of rotation, 2 things must be changed on the hoist. First, the motor hoist and lower directions of rotation must be changed to the opposite direction. This is done by exchanging positions of the brake valve and manifold block on the motor. Secondly, the brake clutch assembly must be made effective for the opposite direction of rotation. This is done by reversing the inner race of the brake clutch assembly.

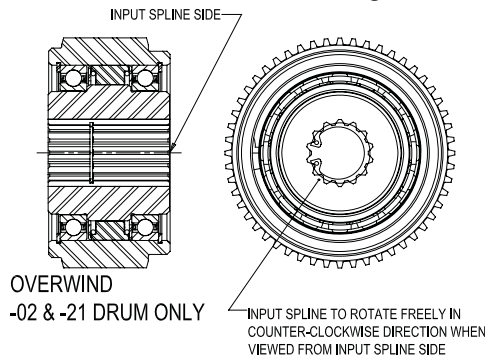
Figures "A" and "B" above show typical CH165A/230B motor installations. Note that the only difference between the two drawings is the motor is rotated 180° (the "belly" of the motor moves to the opposite side). If the motor shaft rotates clockwise in figure "A" when the hoisting port is pressurized, it will rotate counterclockwise in figure "B".

1. Remove the four capscrews if equipped securing the brake valve to the motor. Remove the four capscrews securing the manifold block to the motor. Disconnect the motor case drain hose at the motor.  
NOTE: Some installations have the brake release hose connected directly to the motor, instead of to the manifold block. In this case, disconnect the brake release hose at the motor port. Stand winch up on drum support with the motor end up and secure in this position.
2. Before removing the motor, it is a good idea to note or mark the position of the motor in relation to the winch, since it will be rotated 180° when reinstalled. Rotating the motor allows the hoist and lowering hoses to connect on the same side of the hydraulic motor as in the previous setup. Remove the capscrews securing the motor to the winch and carefully remove the motor.
3. Remove the brake clutch assembly from the brake cylinder.
4. Remove the snap ring (47) from one-end of the brake clutch assembly and push the inner race out of the assembly. Refer to Over-Running Clutch Service section of this manual for drawings.
5. Use a punch to remove the bearing on one side of the inner race so the sprag assembly can be removed. Remove the sprag assembly and flip over so that the direction of free rotation is reversed. Note: the sprag assembly is etched with arrows indicating both the free turn and lock direction.
6. Using a press or punch reinstall the bearing on the inner race.
7. Slide the inner race into the outer race while ensuring the sprag cams do not catch on the outer race. Install the snap ring and ensure it is fully seated in the groove.



#### For -01 Drums

Before installing the brake clutch, be sure the inner race turns free in the opposite direction the drum will turn to haul-in wire rope. An easy way to check the rotation is to hold the outer race in one hand and rotate the inner race. Install the brake clutch with as shown in drawing above.



#### For -02 or -21 Drums

Before installing the brake clutch, be sure the inner race turns free in the same direction the drum will turn to haul-in wire rope. An easy way to check the rotation is to hold the outer race in one hand and rotate the inner race. Install the brake clutch as shown in drawing above.

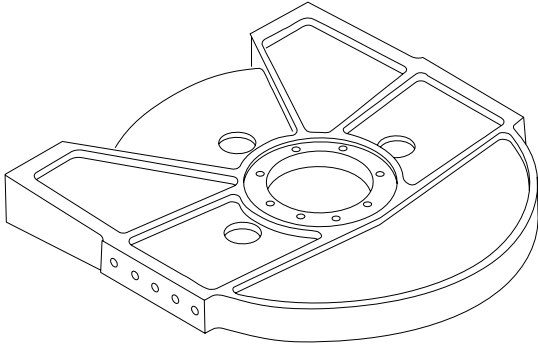
## ⚠ WARNING ⚠

Be certain the snap ring is seated in the groove in the splined bore of the inner race. This snap ring will keep the brake clutch assembly correctly positioned in the center of the friction brake pack. Binding of the brake or brake failure may occur if snap ring is omitted, which may cause winch failure resulting in property damage, injury or death.

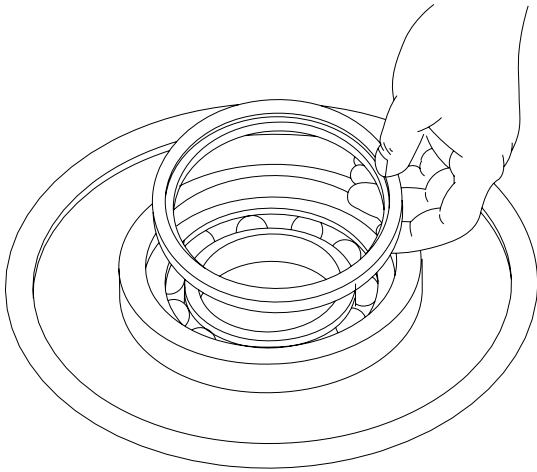
#### -02 and -21 Drum

8. Install a new O-ring on the motor pilot. Rotate the motor 180° from its original position and install it onto the brake cylinder. Install and tighten motor capscrews to recommended torque.
9. Install new O-rings in the brake valve and manifold block. Attach the brake valve and manifold block to the motor using the original capscrews and tighten to recommended torque.
10. Connect the motor case drain hose to the motor case drain port. **NOTE:** On two speed motors, the case drain and shift drain should be connected directly to tank. **DO NOT** use the drain connection on the brake valve.
11. If your winch had the brake release hose connected directly to the motor, the original motor port must be plugged and the hose connected to the motor pressure port near the manifold block (lowering port).
12. Operate the winch slowly in both directions and check for oil leaks and/or unusual sounds from the hoist. The winch should operate smoothly in both directions. Refer to "WIRE ROPE INSTALLATION" and properly install rope onto the hoist drum.
13. Before returning the hoist to full service, a light load should be lifted and held a few feet off the ground to be sure the static brake is functioning properly. The hoist should also be able to slowly lower the load in a smooth and controlled manner. If the hoist does not perform either of these functions, refer to "TROUBLESHOOTING" for additional information.

# HOIST ASSEMBLY



1. Place the drum support assembly on a clean work surface with the bearing support facing up. Lubricate the bearing and sealing surfaces on the bearing support. Install a new V-Ring seal onto the bearing support.



2. Install a new bearing in the drum if replacement is necessary, making certain to press it against the shoulder in the bottom of the bearing bore. Coat the outside diameter of a new seal with a sealant. Turn the spring side of the seal toward the bearing, and press the seal into the seal bore, leaving it EVEN with the outer surface of the drum bore.

3. Turn the drum over, and set it down on the bearing support. Be careful not to damage the seal when lowering the drum onto the bearing support.

4. -01 Drums: Install the output planet carrier (400) into the drum while meshing the planet gears with the ring gear and the planet carrier with the drum bearing support.  
-02 Drums: Lower the output planet carrier (400) into the drum, making certain the splines on the carrier mesh with the splines in the drum.

5. Install the output sun gear (12) in to the output planet carrier.

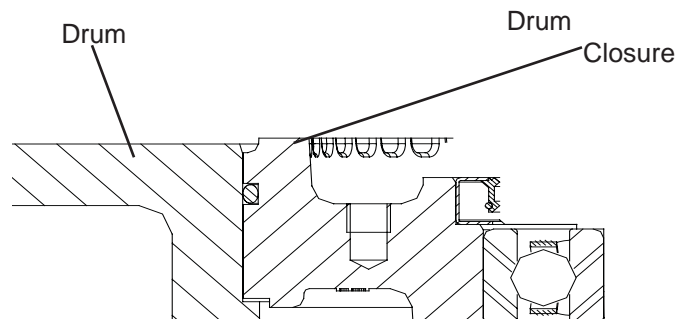
-02 Drums: Lower the ring gear into the drum while meshing

the ring gear teeth with the planet gear teeth.

6. Apply general purpose grease to thrust washer (13) and install it onto the pilot of the primary planet carrier (300). Turn the primary planet carrier over and install it into the ring gear while meshing the planet gears with the ring gear and the splines of the carrier with the output sun gear.

7. Install the primary sun gear (22) into the primary planet carrier. Apply general purpose grease to thrust washer (15) and place it on top of the primary planet carrier. Center the thrust washer on the primary planet carrier

-02 Drums: Install the ring gear adapter (33) into the ring gear.



8. Install a new bearing (16) into the drum closure (23) if replacement is necessary. Make certain to press the bearing against the shoulder in the bearing bore. Coat the outside diameter of a new seal (18) with non-hardening sealant. With the spring side toward the bearing, press the seal into the drum closure until the seal is even with the outer edge of the closure. Install a new o-ring (17) into the drum closure. Apply general purpose grease to the outside diameter of the drum closure and install it into the drum. When properly installed, the outer edge of the drum closure will extend beyond the drum by approximately .034 in. (0.9 mm). If the drum closure can not be installed as shown, one or more components may be out of position. The most common cause is the thrust washers are out of position or the output planet carrier is not seated. DO NOT proceed with assembly until the source of the problem has been identified and corrected.

9. Place the motor end plate onto the drum, aligning it approximately with the support end plate and centered on the drum. Install a new v-ring seal (20) onto the brake cylinder. Lubricate the seal and bearing surfaces of the brake cylinder, seal and bearing. Install the brake cylinder assembly into the drum and motor end plate in the same orientation as it was removed.

10. Install the eight capscrews and lockwashers (214 & 215)

through the brake cylinder into the end plate. Loosely tighten all capscrews until just snug against the brake cylinder. Continue to tighten the capscrews in a criss-cross pattern one turn at a time until the motor end plate is drawn tightly up against the brake cylinder.

11. Install the two tie plates (28) onto the end plates using all 20 capscrews and lock washers (25 & 26). Be sure the curved sides of the tie plates are toward the top of the hoist. Evenly tighten all tie plate and brake cylinder/end plate capscrews to 80 lb.-ft (109 N-m) torque.

12. Install the over-running brake clutch into the center of the brake pack. Refer to page 25 & 26 for correct orientation of the clutch. The input (motor) side of the clutch is the end facing the motor with the longest spline engagement. It may be necessary to rotate the drum and hoist gear train slightly to align the splines of the shaft with the splines of the brake clutch. If the clutch does not align with the brake discs and input sun gear, install a hand-pump onto the brake release port and apply approximately 1000 PSI (6900 kPa) to fully release the spring applied brake and permit easy alignment of the brake components. The internal retaining ring in the clutch bore should be seated against the input sun gear when correctly installed.

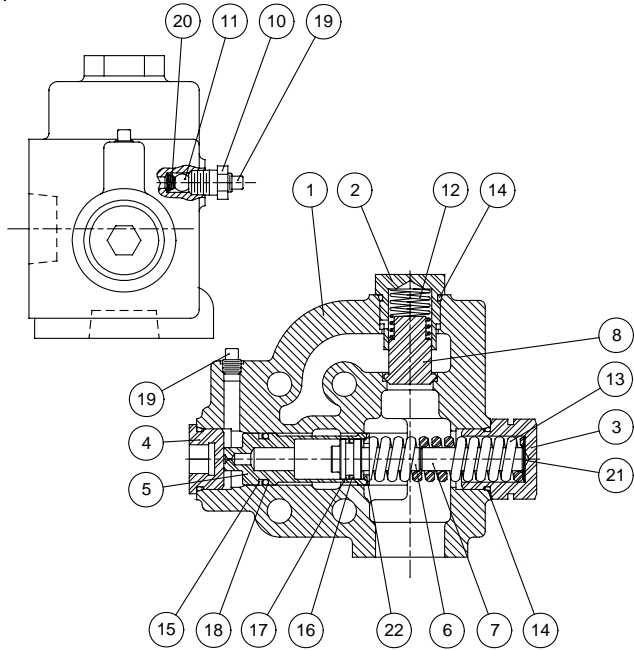
13. Lubricate and install a new O-Ring onto the hydraulic motor pilot. Engage the motor shaft with the inner race of the over-running clutch and lower the motor into place. Install motor capscrews and lockwashers and torque to correct value.

14. Install all hydraulic lines disconnected during disassembly and route hoses to avoid chafing. Be careful to clean lines and fittings if there is a chance that paint chips or other contamination has entered the ports. Tighten all connections.

15. After the hoist assembly is complete, check all capscrews and hydraulic lines to make certain they have been properly installed and tightened correctly. Fill the hoist gear cavity to the center of the sight gauge or level plug. Refer to the "Recommended Lubricant" section of this manual.

16. Before returning the hoist to service, it should be tested on a hydraulic test stand that can operate the hoist to at least 35% of the rated flow, pressure and load. A moderate load should be lifted and held 3 ft. (1m) off the ground to be sure the static brake is functioning properly. The hoist should be able to slowly lower the load in a smooth and controlled manner. If the hoist does not perform these functions correctly, refer to the "Trouble Shooting" section of this manual.

# BRAKE VALVE SERVICE



ITEM	DESCRIPTION	QTY.	PART NO.
1	Valve Housing	1	NSS
2	Check Valve Retainer	1	24424
3	Spring Retainer	1	101016
4	Plug	1	24420
5	Main Piston	1	NSS
6	Damper Piston	1	NSS
7	Damper Piston Extension	1	101017
8	Check Valve Poppet	1	24423
10	Reducer	1	24436
11	Check Ball	1	24428
12	Check Valve Spring	1	24190
13	Main Piston Spring	1	24434
14	O-Ring	1	24186
15	Back-up Ring	1	24778
16	O-Ring	1	24776
17	Back-up Ring	1	24777
18	O-Ring	1	21123
19	Pipe Plug	1	18009
20	Check Spring	1	25373
21	Shim	1	25662
22	Spring Seat	1	101015

Most CH165 & 230B Series hoists are supplied with our Braden 1-1/2" brake valve. It is a reliable hydraulic valve with internal components manufactured to close tolerances. Due to these close tolerances, several individual parts are not available as replacement parts and are noted in the following parts lists as NSS (Not Serviced Separately).

Before disassembling the brake valve, be sure you have conducted all applicable troubleshooting operations and are certain the brake valve is causing the malfunction.

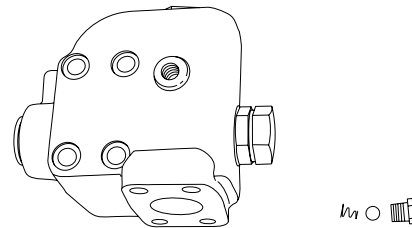
Thoroughly clean the outside surfaces of the valve and work in a clean dust-free area, as cleanliness is of utmost importance when servicing hydraulic components.

1 1/2 inch brake valves built after mid-March 1997 contain a spring seat (item 22) between the spool spring and the spool. This provides a slightly larger, more uniform area for the spring to seat against the spool. The result is increased spring service life and improved repeatability of pressure/flow modulation over the full compression range of the spring.

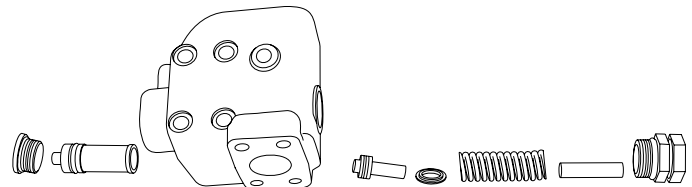
The spring retainer has been modified to allow for the additional thickness of the spring seat and a groove machined into the hex end cap serves as a visual indication that the valve contains the new spring seat. The spring seat improvement may be added to earlier brake valves by installing kit, Part Number 62805. Items 3, 7, 13, 14 and 22 are included in the kit. We recommend that this kit be installed whenever the brake valve is removed for inspection or service.

It is always a good practice to check the initial opening or "cracking" pressure of the brake valve whenever the hoist is serviced or inspected. Refer to Braden Service Bulletin 527 for complete brake valve test and adjustment procedures.

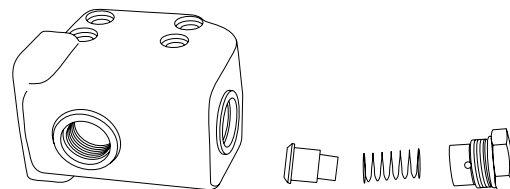
## DISASSEMBLY



1. Remove the fitting, motor drain check ball and spring.



2. Remove the spool spring retainer and spool spring. Remove the spool plug and carefully remove the spool assembly. Remove the damper piston from the spool. The piston will come out of the spool slowly, because of a partial vacuum formed between the two. Use extreme care to avoid damaging the polished surfaces of either piece.

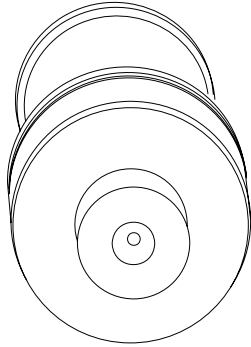


3. Remove the check valve spring retainer, spring and check valve poppet.



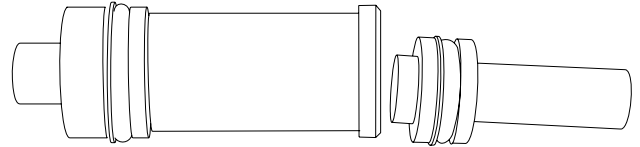
## CLEAN AND INSPECT

1. Discard all O-rings and back-up rings. Clean all parts in solvent and blow dry. Inspect polished surfaces of spool and damper piston for damage that may cause binding or leakage. Inspect spool bore in valve housing for damage or scoring. Inspect check valve seat in valve housing and check valve poppet. If the spools, bores or valves are damaged, the entire brake valve must be replaced. Check the free length of main piston spring. Replace if less than 3 7/16 in. (87.3 mm) long. Check the free length of the check valve spring. Replace if less than 1 1/2 in. (38.1 mm) long.



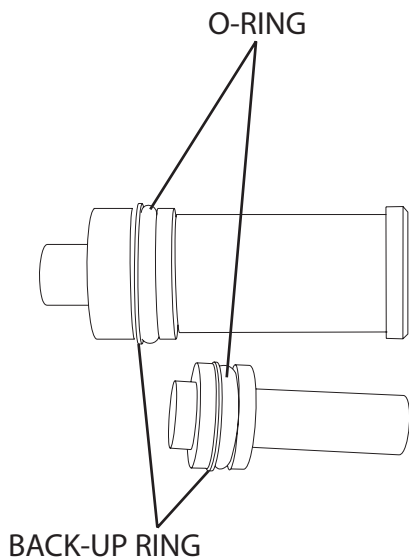
2. Inspect the 0.020 inch (0.5 mm) orifice in the end of the spool to be certain it is open.

2. Install new O-rings on the plug and spool retainers.



3. Lubricate the spool and damper piston O-rings with hydraulic oil. Carefully install the damper piston into the spool. Carefully install the spool into the valve housing. Always install the spool into the valve body from the plug end, so the O-ring enters the bore first. Install the spring seat, spool spring, damper piston extension and spring retainer.

## ASSEMBLY



4. Install the check valve poppet, spring and check valve retainer.

5. Install the motor drain check ball, spring and fitting.

6. The brake valve is now completely assembled and ready to be installed on the hoist motor.

1. Install new O-rings and back-up rings on the spool and damper pistons as shown. It is important that each back-up ring is on the correct side of its O-ring. Take care not to cut the O-rings during assembly. Let the spool and piston set for ten (10) minutes before installing them into the brake valve housing. This will allow the O-rings to return to their original size after being stretched.

## BRAKE VALVE OPENING PRESSURE TEST

Whenever brake components are replaced or a brake component malfunctions or fails, the entire brake system should be inspected and tested. Your testing must include checking the brake valve opening pressure in addition to a thorough inspection of the failed components.

### Preperation:

Begin the inspection by verifying that the brake valve and motor piping is correct for this application. If you are not certain, contact your nearest Braden distributor, the crane OEM, or the Braden factory Product Support Department before proceeding. Do not attempt repairs on equipment you are not familiar with. Fully remove the load from the hoist and block or secure any moveable parts of the crane or hoist before proceeding with brake valve test. It will be necessary to lower the hook block or ball to the ground (deck) since the brake will be completely released. Make certain the test area is clear of all unauthorized personnel as the hoist will be operated in raise and lowr functions.

### Brake Valve Pressure Test

1. Shut off the engine or motor drivning the hydraulic system and vent residual pressure as recommended by the crane OEM.
2. Install an accurate 0-2000 psi (0-13,800 kPa) pressure gauge teed into the brake release line, located at the lowering (non-brake valve) side of the hydraulic motor. This is typically a -4 JIC connection.
3. To eliminate the slight drag effect of the internal, multi-disc brake, remove the brake release line from the hoist brake port and install a plug in the line or close to the needle valve if so equipped.
4. To the internal brake port, install a hand pump with an accurate 0-2000 psi (0-13,800 kPa) gauge. Operate the hand pump and apply approximately 1000 psi (6,900 kPa) to the brake port to fully release the brake. Close the hand pump valve to hold the brake released during the remainder of the test.
5. Operate the crane power source at full throttle and VERY slowly move the winch control lever toward the lowering direction while monitoring the brake valve opening pressure. Record the pressure when the cable drum begins to turn in the lowering direction.
6. The initial lowering pressure should be no lower than 575 psi for the 1.5-inch Braden brake valve, P/N 81609 which is used on most single speed motors on CH165A & CH230B planetary hoists.

If the intial lowering pressure is less than the specification listed above, the brake valve should be adjusted.

### ADJUSTMENT OF BRAKE VALVE

1. Inspect the main spool spring to make certain it is not damaged. If the spring is in good condition, the brake valve opening pressure should be adjusted by installing shims between the spring retainer, item3, and the main piston spring. A maximum of .062 in. (1.6 mm) shims are allowed in the 1.5 in. valves. Additional shims may result in accelerated spring failure due to over-compensation.
2. If the spring requires more than the maximum number of shims listed above to achieve the recommended opening pressure, the spring should be replaced.
3. Inspect the brake valve piston and damper piston for scoring and seal ring condition. The seal rings should be replaced following disassembly and inspection. If there is any scoring of the pistons and/or the brake valve housing, the entire brake valve must be replaced.
4. Inspect the check valve poppet and seat for irregular wear or damage. If the poppet set is damaged the entire brake valve must be replaced. Tighten the spring retainers to 40 lb-ft torque. NOTE: Always recheck the brake operation following inspection or adjustment, prior to placing the hoist back in service.



# METRIC CONVERSION TABLE

English to Metric			Metric to English		
LINEAR					
inches (in.)	X 25.4	= millimeters (mm)	millimeters (mm)	X 0.3937	= inches (in.)
feet (ft.)	X 0.3048	= meters (m)	meters (m)	X 3.281	= feet (ft.)
miles (mi.)	X 1.6093	= kilometers (km)	kilometers (km)	X 0.6214	= miles (mi.)
AREA					
inches <sup>2</sup> (sq.in.)	X 645.15	= millimeters <sup>2</sup> (mm <sup>2</sup> )	millimeters <sup>2</sup> (mm <sup>2</sup> )	X 0.000155	= inches <sup>2</sup> (sq.in.)
feet <sup>2</sup> (sq.ft.)	X 0.0929	= meters <sup>2</sup> (m <sup>2</sup> )	meters <sup>2</sup> (m <sup>2</sup> )	X 10.764	= feet <sup>2</sup> (sq.ft.)
VOLUME					
inches <sup>3</sup> (cu.in.)	X 0.01639	= liters (l)	liters (l)	X 61.024	= inches <sup>3</sup> (cu.in.)
quarts (qts.)	X 0.94635	= liters (l)	liters (l)	X 1.0567	= quarts (qts.)
gallons (gal.)	X 3.7854	= liters (l)	liters (l)	X 0.2642	= gallon (gal.)
inches <sup>3</sup> (cu.in.)	X 16.39	= centimeters <sup>3</sup> (cc)	centimeters3 (cc)	X 0.06102	= inches <sup>3</sup> (cu.in.)
feet <sup>3</sup> (cu.ft.)	X 28.317	= liters (l)	liters (l)	X 0.03531	= feet <sup>3</sup> (cu.ft.)
feet <sup>3</sup> (cu.ft.)	X 0.02832	= meters <sup>3</sup> (m <sup>3</sup> )	meters3 (m3)	X 35.315	= feet <sup>3</sup> (cu.ft.)
fluid ounce (fl.oz.)	X 29.57	= millileters (ml)	milliliters (ml)	X 0.03381	= fluid ounce (fl.oz.)
MASS					
ounces (oz.)	X 28.35	= grams (g)	grams (g)	X 0.03527	= ounces (oz.)
pounds (lbs.)	X 0.4536	= kilograms (kg)	kilograms (kg)	X 2.2046	= pounds (lbs.)
tons (2000 lbs.)	X 907.18	= kilograms (kg)	kilograms (kg)	X 0.001102	= tons (2000 lbs.)
tons (2000 lbs.)	X 0.90718	= metric tons (t)	metric tons (t)	X 1.1023	= tons (2000 lbs.)
tons (long) (2240 lbs.)	X 1013.05	= kilograms (kg)	kilograms (kg)	X 0.000984	= tons (long) (2240 lbs.)
PRESSURE					
inches Hg (60°F)	X 3600	= kilopascals (kPa)	kilopascals (kPa)	X 0.2961	= inches Hg (60°F)
pounds/sq.in. (PSI)	X 6.895	= kilopascals (kPa)	kilopascals (kPa)	X 0.145	= pounds/sq.in. (PSI)
pounds/sq.in. (PSI)	X 0.0703	= kilograms/sq.cm. (kg/cm <sup>2</sup> )	kilograms/sq.cm. (kg/cm2)	X 14.22	= pounds/sq.in. (PSI)
pounds/sq.in. (PSI)	X 0.069	= bars	bars	X 14.5	= pounds/sq.in. (PSI)
inches H <sub>2</sub> O (60°F)	X 0.2488	= kilopascals (kPa)	kilopascals (kPa)	X 4.0193	= inches H <sub>2</sub> O (60°F)
bars	X 100	= kilopascals (kPa)	kilopascals (kPa)	X 0.01	= bars
POWER					
horsepower (hp)	X 0.746	= kilowatts (kW)	kilowatts (kW)	X 1.34	= horsepower (hp)
ft.-lbs./min.	X 0.0226	= watts (W)	watts (W)	X 44.25	= ft.-lbs./min.
TORQUE					
pound-inches (in.-lbs.)	X 0.11298	= newton-meters (N-m)	newton-meters (N-m)	X 8.851	= pound-inches (in.lbs.)
pound-feet (ft.-lbs.)	X 1.3558	= newton-meters (N-m)	newton-meters (N-m)	X 0.7376	= pound-feet (ft.-lbs.)
pound-feet (ft.-lbs.)	X .1383	= kilograms/meter (kg-m)	kilogram/meter (kg-m)	X 7.233	= pound-feet (ft.-lbs.)
VELOCITY					
miles/hour (m/h)	X 0.11298	= kilometers/hour (km/hr)	kilometers/hour (km/hr)	X 0.6214	= miles/hour (m/h)
feet/second (ft./sec.)	X 0.3048	= meter/second (m/s)	meters/second (m/s)	X 3.281	= feet/second (ft./sec.)
feet/minute (ft./min.)	X 0.3048	= meter/minute (m/min)	meters/minute (m/min)	X 3.281	= feet/minute (ft./min.)
TEMPERATURE					
°Celsius = 0.556 (°F - 32)			°Fahrenheit = (1.8°C) + 32		
COMMON METRIC PREFIXES					
mega	(M)	= 1,000,000 or 10 <sup>6</sup>	deci	(d)	= 0.1 or 10 <sup>-1</sup>
kilo	(k)	= 1,000 or 10 <sup>3</sup>	centi	(c)	= 0.01 or 10 <sup>-2</sup>
hecto	(h)	= 100 or 10 <sup>2</sup>	milli	(m)	= 0.001 or 10 <sup>-3</sup>
deka	(da)	= 10 or 10 <sup>1</sup>	micro	(μ)	= 0.000.001 or 10 <sup>-6</sup>





PEMEX – PP LUM A  
Project

ImXport Services Corp.

# Vendor Data Book

P.O. # 0018987

Serial # 23407C

Volume: 1

## Nautilus Crane Model 340LA-80

### Section 4.11 Manufacturer Ballring Data

#### LUBRICATION

Periodic lubrication is necessary to insure long life and proper performance. The required frequency of lubrication varies with the type of equipment and amount of usage. Some recommendations for lubricants are given below.

Typical recommendations for greasing intervals vary according to operating conditions. Generally the following lubrication intervals are recommended:

Ball bearings under light service	Every 100 operating hours
Ball bearings under heavy service or for a production type of application (e.g., excavators, grab cranes, magnet cranes, etc.) or where a high degree of reliability is required.	Every 40 operating hours
Roller bearings	Every 40 operating hours

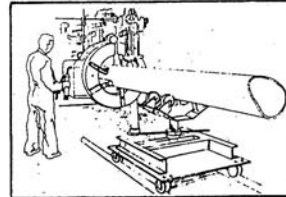
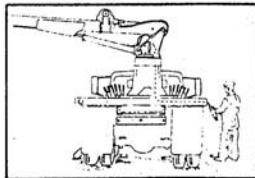
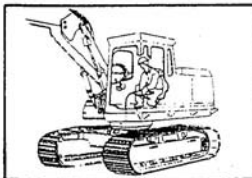
Use shorter intervals between greasings in tropical areas or where there is high humidity, dust, or wide ranges in temperature, or when there is continuous rotation.

Each RoteK bearing is equipped with one or more grease fittings. Models equipped with two or three rows of fittings should be greased in each row. To insure uniform distribution of grease throughout the bearing, the machine should be rotated at least two complete revolutions while greasing. When complete rotation is impractical, more grease fittings are required. Contact the RoteK engineering department for a recommendation. For bearings with integral gears, lubricate gear as recommended above and as necessary to prevent metal-to-metal contact.



#### CAUTION:

Extreme care must be taken when greasing and rotating any unit. Be sure that all personnel are clear of all parts of the machine during the rotating-greasing procedure. We recommend installation of an extension line from the grease fitting location to an area where the oiler will be safely clear of moving parts. Following are three examples of suggested extension arrangement.



Extension fittings and lines are widely available from local distributors of lubrication equipment such as Alemite.

ALL EQUIPMENT SHOULD BE GREASED AT LEAST TWICE YEARLY REGARDLESS OF AMOUNT OF USAGE.

The bearing should be lubricated immediately after installation. Before storing a machine, new or used, thoroughly lubricate so that clean grease can be seen venting at the seals. This procedure should be repeated periodically at least twice a year or in line with climatic conditions. Uninstalled bearings stored inside, outside or in humid environments must be properly wrapped according to RoteK specifications. They must also be stored in the horizontal position. The bearing must also be uniformly supported to prevent ring distortion. Relubrication and inspection are required at periodic intervals. Contact RoteK for instructions.

Some recommended lubricants are shown below:

	SHELL	EXXON	TEXACO	MOBIL	UNION	SUN
RACE	ALVANIA EP #2	RONEX MP	MULTIFAK EP #2	MOBILITH AW2	UNOBA EP #2	PRESTIGE 742 EP
GEAR		SURRETT Fluid 30	CRATER 2x Fluid 5x Fluid	GEAR Lube 275	GEARITE Hvy	

Under extremely dusty or dirty conditions, sufficient grease should be added to flush out contaminated grease. Under less severe conditions, add grease until it appears at the seal. The metal nameplate illustrated below, which is affixed to many styles of bearings, provides lubrication instructions suitable to most applications. Extra plates are available on request for installation on equipment.

LUBRICATION INSTRUCTIONS—Lubricate bearing through fittings every one hundred operating hours for all machine manufacturer's recommendations. Grease 10" or less No. 2 Extreme Pressure Grease such as Texaco Multifak EP 2. Grease 12" or more No. 1 grade. Rotate while greasing until clean grease extrudes at seals. Lubricate gear with Texaco Grease Fluid or equivalent as required to prevent metal-to-metal contact. Check equipment belt tightness periodically per machine manufacturer's recommendation.

SERIAL NO.

# RoteK



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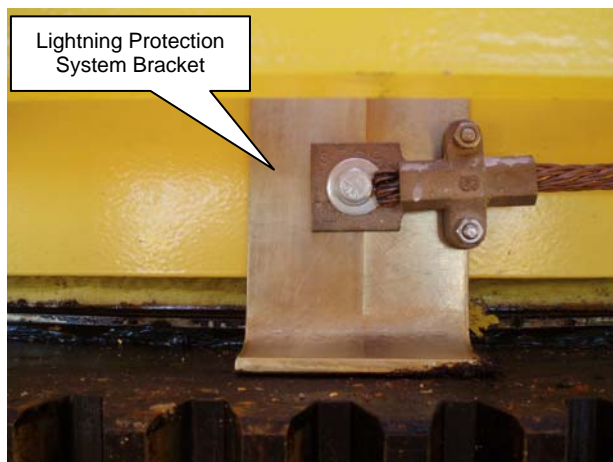
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### Section 4.12 Lightning Protection System

Due to contact with the slewing bearing, the lightning protection system bracket must be checked regularly for wear. Adjust the bracket to ensure contact with the slewing bearing.







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### Section 5.0 Repair Manual



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### Section 5.1 Hose Assembly List

ITEM	QTY.	HOSE ID	HOSE LOCATION	
			TO	FROM
1	1	1-1/2"	Boom control valve (inlet)	Pump #1 (flow divider port "B")
2	1	1/4"	Boom pressure gauge	Boom control valve (inlet)
3	1	2"	Return manifold	Boom control valve (outlet)
4	1	1-1/2"	Boom hoist motor (down)	Boom control valve (down)
5	1	1-1/2"	Boom hoist motor (up)	Boom control valve (up)
6	1	1-1/2"	Main / Aux. control valve (inlet)	Pump #2
7	1	1/4"	Main / Aux. pressure gauge	Main / Aux. control valve (inlet)
8	1	2"	Return manifold	Main / Aux. control valve (outlet)
9	1	1-1/4"	Aux. hoist motor (down)	Aux. control valve (down)
10	1	1-1/4"	Aux. hoist motor (up)	Aux. control valve (up)
11	1	1-1/4"	Main hoist motor (down tee)	Main control valve #1 (down)
12	1	1-1/4"	Main hoist motor (up tee)	Main control valve #1 (up)
13	1	1-1/4"	Two – speed dump valve (in)	Pump #3
14	1	1-1/4"	Main control valve #2 (inlet)	Two – speed dump valve (out check)
15	1	1/4"	Main pressure gauge #2	Main control valve #2 (inlet)
16	1	1-1/2"	Return manifold	Main control valve #2 (outlet)
17	1	1-1/4"	Main hoist motor (down tee)	Main control valve #2 (down)
18	1	1-1/4"	Main hoist motor (up tee)	Main control valve #2 (up)
19	1	1"	Swing control valve (inlet)	Pump #4



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ITEM	QTY.	HOSE ID	TO	HOSE LOCATION	FROM
20	1	1/4"	Swing pressure gauge		Swing control valve (inlet)
21	1	1-1/4"	Return manifold		Swing control valve (outlet)
22	2	3/4"	Swing drive motor #1		Swing control valve (working tee)
23	2	3/4"	Swing drive motor #2		Swing control valve (working tee)
24	1	1/4"	Park brake #1 (tee)		Swing control valve (inlet check tee)
25	1	1/4"	Park brake valve #2		Park brake #1 (tee)
26	1	1/4"	Park brake valve (in)		Swing control valve (inlet check tee)
27	1	1/4"	Hydraulic tank		Park brake valve (out)
28	1	1/4"	Hydraulic tank		Swing drive motor #1 case drain
29	1	1/4"	Hydraulic tank		Swing drive motor #2 case drain
30	1	1/4"	Dynamic brake actuator (in)		Hydraulic reservoir
31	1	1/4"	Dynamic brake #1 (tee)		Dynamic brake reservoir (out)
32	1	1/4"	Dynamic brake #2		Dynamic brake #1 (tee)
33	1	1/4"	Return pressure gauge		Return manifold
34	1	4"	Return filter		Return manifold
35	1	1/4"	Swing brake cooler #1 (in tee)		Return manifold (flow control)
36	1	1/4"	Swing brake cooler #2 (in)		Swing brake cooler #1 (in tee)
37	1	1/4"	Swing brake cooler #2 (out tee)		Swing brake cooler #1 (out)
38	1	1/4"	Hydraulic tank		Swing brake cooler #2 (out tee)
39	1	1/4"	Main hoist case drain (tee)		Aux. hoist case drain



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ITEM	QTY	HOSE ID	TO	HOSE LOCATION	FROM
40	1	1/4"	Hydraulic tank		Main hoist case drain (tee)
41	1	1/4"	Hydraulic tank		Boom hoist case drain
42	1	2-1/2"	Pump #1		Hydraulic tank
43	1	2-1/2"	Pump #2		Hydraulic tank
44	1	2-1/2"	Pump #3		Hydraulic tank
45	1	2"	Pump #4		Hydraulic tank
46	1	1/2"	Hydraulic tank		Pump #1 (flow divider – relief)
47	1	1/2"	Swing pilot controller (pilot pressure tee)		Pump #1 (flow divider – high pressure filter)
48	1	1/2"	Main / Boom pilot controller (pilot pressure tee)		Swing pilot controller (pilot pressure tee)
49	1	1/4"	Pilot pressure gauge		Main / Boom pilot controller (pilot pressure tee)
50	1	1/4"	Swing pilot controller (pilot return pressure tee)		Pilot return pressure gauge
51	1	1/2"	Main / Boom pilot controller (pilot return tee)		Swing pilot controller (pilot return pressure tee)
52	1	1/2"	Hydraulic tank		Main / Boom pilot controller (pilot return tee check)
53	1	1/4"	Swing control valve (pilot left)		Swing pilot controller (left)
54	1	1/4"	Swing control valve (pilot right)		Swing pilot controller (right)
55	1	1/4"	Main / Aux. selector valve (down port "2")		Main / Aux. pilot controller (down)
56	1	1/4"	Main control valve #2 (pilot down tee)		Main / Aux. selector valve (main down port "1")



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ITEM	QTY.	HOSE ID	TO	HOSE LOCATION	FROM
57	1	1/4"	Main control valve #1 (pilot down)	Main control valve #2 (pilot down tee)	
58	1	1/4"	Main / Aux. selector valve (up port "5")	Main / Aux. pilot controller (up)	
59	1	1/4"	Main anti-two block solenoid valve (port "3")	Main / Aux. selector valve (main up port "6")	
60	1	1/4"	Main control valve #2 (pilot up tee)	Main anti-two block solenoid valve (port "1")	
61	1	1/4"	Main control valve #1 (pilot up)	Main control valve #2 (pilot up tee)	
62	1	1/4"	Aux. control valve (pilot down)	Main / Aux. selector valve (aux down port "4")	
63	1	1/4"	Aux. anti-two block solenoid valve (port "3")	Main / aux. selector valve (aux up port "3")	
64	1	1/4"	Aux. control valve (pilot up)	Aux. anti-two block solenoid valve (port "1")	
65	1	1/4"	Aux. anti-two block solenoid valve (port "2" tee)	Main anti-two block solenoid valve (port "2")	
66	1	1/4"	Hydraulic tank	Aux. anti-two block solenoid valve (port "2" tee)	
67	1	1/4"	Low boom angle limit valve (port "P" tee)	Boom pilot controller (down)	
68	1	1/4"	Low angle override valve (port "A")	Low boom angle limit valve (port "P" tee)	
69	1	1/4"	Low boom angle limit valve (port "T")	Low angle override valve (port "P")	
70	1	1/4"	Boom anti-two block solenoid valve (port "3")	Low boom angle limit valve (port "B")	



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ITEM	QTY.	HOSE ID	TO	HOSE LOCATION FROM
71	1	1/4"	Boom control valve (pilot down)	Boom anti-two block solenoid valve (port "1")
72	1	1/4"	Low angle override valve (port "A")	Low boom angle limit valve (port "T")
73	1	1/4"	High boom angle limit valve (port "B")	Boom pilot controller (up)
74	1	1/4"	Boom control valve (pilot up)	High boom angle limit valve (port "P")
75	1	1/4"	High boom angle limit valve (port "A" tee)	Low angle override valve (port "B")
76	1	1/4"	Hydraulic tank	High boom angle limit valve (port "A" tee)
77	1	1/4"	Hydraulic tank	Boom anti-two block solenoid valve (port "2")
78	1	1/4"	Pressure sensing valve (port "1")	Main control valve #1 (up)
79	1	1/4"	Manual high speed reset valve (pilot port)	Pressure sensing valve (port "2")
80	1	3/8"	Manual high speed reset valve (port "A")	Two-speed dump valve (3/8" check)
81	1	3/8"	Pressure sensing valve (port "3" tee)	Manual high speed reset valve (port "B")
82	1	3/8"	Hydraulic tank	Pressure sensing valve (port "3" tee)
83	1	1/4"	Engine oil pressure gauge	Engine block (pressure)
84	1	1/4"	Throttle cylinder	Throttle actuator
85	1	3/8"	Fuel filter (in)	Fuel tank
86	1	3/8"	Sentinel valve (fuel in)	Fuel filter (out)



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ITEM	QTY	HOSE ID	HOSE LOCATION	
			TO	FROM
87	1	3/8"	Fuel pump (in)	Sentinel valve (fuel out)
88	1	3/8"	Fuel tank	Fuel rack (out)
89	1	1/4"	Sentinel valve (oil in)	Engine block (pressure)
90	1	1/4"	Water temperature probe (in)	Sentinel valve (oil out)
91	1	1/4"	Engine block (vent)	Water temperature probe (out)
92	1	1"	Air swivel (bottom)	Pedestal wall
93	1	1"	Air tank	Air swivel (top check)
94	1	1"	Air relay valve (in)	Air tank
95	1	1"	Air starter	Air relay valve (out)
96	1	1/4"	Start valve (in tee)	Air relay valve (AUX)
97	1	1/4"	Air starter (bendix in)	Start valve (out)
98	1	1/4"	Air relay valve (APP)	Air starter (bendix out)
99	1	1/4"	Air pressure gauge	Start valve (in tee)
100	1	1/4"	Air horn valve (in tee)	Air tank
101	1	1/4"	Air horn	Air horn valve (out)
102	1	1/4"	Air wiper valve #1 (in tee)	Air horn valve (in tee)
103	1	1/4"	Air wiper valve #2 (in tee)	Air wiper valve #1 (in tee)
104	1	1/4"	Air wiper valve #3	Air wiper valve #2 (in tee)
105	1	1/4"	Low angle override valve (port "A")	Low boom angle limit valve (port "T")
106	-	-	-	-
107	-	-	-	-



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### Section 5.2 Bill of Materials

#### UPPERSTRUCTURE ASSEMBLY, N80723-501

<u>ITEM</u>	<u>QTY.</u>	<u>NUMBER</u>	<u>DESCRIPTION</u>
108	1.00	N46397-002	BALLRING, 340LA
109	2.00	N47103-004	GEARBOX, SWING DRIVE
110*	1.00	N47255-021	BOLT KIT, BALLRING, 340LA
111*	1.00	N47255-022	BOLT KIT, 340L, PEDESTAL
112	2.00	N61503-001	PINION, 340LA
113	1.00	N61584-001	UPPERSTRUCTURE WELDMENT
114	1.00	N61585-001	UPPERSTRUCTURE MACHINING
115	2.00	N61196-004	PINION GUARD
116	1.00	N61644-002	SWING LOCK
117	-	-	-
118	-	-	-
119	-	-	-
120	-	-	-
121	-	-	-
122	-	-	-
123	-	-	-
124	-	-	-

**\*Warning:** These are special bolts meeting SAE Grade 8 requirements and must be purchased from Oil States Industries. Standard off-the-shelf Grade 8 bolts **MUST NOT BE USED** as they do not meet the requirements of API Spec 2C.



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### BOOM SUSPENSION ASSEMBLY, N80723-502

125	840.00'	N00034-012	WIRE ROPE, 3/4"
126	2.00	N15969-001	SPRING, BOOM STOP
127	1.00	N30602-007	SOCKET, OPEN WEDGE, 3/4"
128	1.00	N30606-012	CLAMP, CABLE, 3/4"
129	1.00	N45002-502	RATCHET & PAWL KIT, CH150/230
130	12.00	N45422-007	BEARING, SHEAVE
131	12.00	N45931-012	SHEAVE, NYLON, 20", 3/4" GROOVE
132	1.00	N46057-001	MIRROR, CONVEX, 18"
133	1.00	N45937-001	BOLT KIT, HOIST, CH 230
134	1.00	N46430-009	HOIST, CH230B-36120-21-1
135	1.00	N46500-001	BOLT KIT, GANTRY, 340L
136	2.00	N46501-035	LINE, PENDANT, 1-3/4" DIA., 35'
137	1.00	N46579-004	GATE, SAFETY, INTREPID
138	1.00	N61583-003	GANTRY
139	1.00	N61591-001	BRIDLE
140	2.00	N60265-004	PINION KEEPER
141	2.00	N61597-001	PENDANT LINK
142	2.00	N61594-001	PENDANT KEEPER
143	1.00	N99SK1-093	BRIDLE REST
144	1.00	N47140-002	RATCHET & PAWL
145	1.00	N61608-001	GANTRY LADDER
146	1.00	N61606-001	GANTRY PLATFORM



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### BOOM SUSPENSION ASSEMBLY, N80723-502 (continued)

147	1.00	N61607-001	GANTRY LADDER SUPPORTS
148	-	-	-
149	-	-	-
150	-	-	-

### BOOM ASSEMBLY, N80723-503

151	1.00	N45916-001	INDICATOR, BOOM ANGLE, RIGHT HAND
152	1.00	N60255-005	NEEDLE, INDICATOR, BOOM ANGLE
153	1.00	N61586-001	BOOM BASE
154	2.00	N60986-005	BOOM LIFTING PIN
155	2.00	N47008-001	BOOM BUMPER
156	4.00	N60980-004	BOOM ROLLER (MID)
157	1.00	N60980-011	BOOM ROLLER (TIP)
158	1.00	N60980-012	BOOM ROLLER (TIP)
159	1.00	N60980-007	BOOM ROLLER (BASE)
160	1.00	N60980-008	BOOM ROLLER (BASE)
161	-	-	-
162	-	-	-

### BOOM INSERT ASSEMBLY, N80723-504

163	1.00	N61587-020	BOOM MID #1
164	1.00	N61587-020	BOOM MID #2
165	2.00	N60982-001	BOOM STOPS
166	-	-	-



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### BOOM POINT ASSEMBLY, N80723-505

167	1.00	N61588-001	BOOM POINT
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### POWER UNIT ASSEMBLY, N80723-506

168	1.00	N00174-001	COATING, EPOXY, RAD.
169	4.00	N13581-004	PAD, FABREEKA
170	1.00	N45031-014	PUMP, DRIVE, ASSY
171	1.00	N45101-024	DECAL, DIESEL FUEL, SPANISH
172	1.00	N45101-025	DECAL, HYD OIL, SPANISH
173	2.00	N45125-001	FILLER, BREATHER, RESERVOIR
174	1.00	N45272-004	SILENCER, MUFFLER
175	2.00	N45690-030	GAUGE, LEVEL, 0-25PSI, TOP MOUNT
176	1.00	N45998-001	VALVE, SHUT OFF, BRASS, 3/4"
177	2.00	N46018-360	CABLE, KILL, 30'
178	1.00	N46101-015	RAIN CAP
179	1.00	N46133-003	PICKUP, MAGNETIC, TACHOMETER
180	2.00	N46748-030	GAUGE, TEMPERATURE, 130-250 DEG.
181	1.00	N47232-036	VALVE, CHALMATIC, 4"
182	1.00	N47233-002	SHUTDOWN, CAT. ENGINE, SENTINEL
183	1.00	N47243-001	INSULATION, EXHAUST, BLANKET
184	1.00	N47787-017	ENGINE, CAT, 3126 DITA
185	1.00	N61590-026	POWER UNIT WELDMENT
186	-	-	-
187	-	-	-



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### CONTROL STATION ASSEMBLY, N80723-507

188	1.00	N45358-001	THROTTLE KIT, HYDRAULIC FOOT
189	1.00	N45813-003	SWING, BRAKE, CYLINDER
190	2.00	N45880-013	FIRE EXTINGUISHER, 20#, ABC DRY CHEMICAL
191	2.00	N45880-513	BRACKET, FIRE EXTINGUISHER
192	1.00	N46017-003	TACHOMETER, DIGITAL
193	1.00	N46638-001	SEAT, TRIMLINE
194	1.00	N46638-501	PEDESTAL, SEAT SWIVEL
195	2.00	N47445-016	GAUGE, PRESSURE, 0-100PSI, BACK MOUNT
196	1.00	N47445-018	GAUGE, PRESSURE, 0-200PSI
197	1.00	N47445-019	GAUGE, PRESSURE, 0-300PSI, BACK MOUNT
198	1.00	N47445-020	GAUGE, PRESSURE, 0-600PSI, BACK MOUNT
199	1.00	N47445-024	GAUGE, PRESSURE, 0-3000PSI, BACK MOUNT
200	3.00	N47445-026	GAUGE, PRESSURE, 0-5000PSI, BACK MOUNT
201	1.00	N80278-059-TINTED	GLASS, GREEN TINT, CAB N80278-059
202	35.00'	N80278-220	GASKET, DOOR END SEAL
203	1.00	N80520-001	PLACARDS KIT, (SPANISH), 340L
204	1.00	N80278-059	CAB WELDMENT
205	1.00	N61117-039	CAB TRAY
206	-	-	-
207	-	-	-
208	-	-	-
209	-	-	-



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### PIN KIT, N80723-508

210	2.00	N61595-001	BOOM FOOT PIN
211	2.00	N61596-001	GANTRY / UPPERSTRUCTURE PIN
212	2.00	N61604-001	MAIN IDLER PIN
213	1.00	N61605-001	LOWER AUXILIARY EXTENSION PIN
214	8.00	N60986-004	BOOM CONNECTION PIN
215	4.00	N60986-005	BOOM LIFTING PADEYE PIN
216	2.00	N61603-001	BRIDLE / GANTRY PIN
217	1.00	N60645-001	MAIN EXTENDED WEDGE SOCKET PIN
218	2.00	N60646-004	LOAD CELL PIN

### WALKWAY ASSEMBLY, N80723-509

219	2.00	N46579-004	GATE, SAFETY, INTREPID
220	1.00	N62583-039	GRATING, FIBERGLASS
221	1.00	N61589-027	WALKWAYS & SUPPORTS

### PEDESTAL ASSEMBLY, N80723-510

222	1.00	N2007SK1-132	PEDESTAL WELDMENT
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### BRACKETS, N80723-511

223	2.00	N60989-010	ANTI-TWO BLOCK HANGERS
224	1.00	N95SK1-104	FLEET ANGLE IDLER
225	2.00	N99SK1-110	BOOM LIFTING BRACKET
226	1.00	N61627-015	RETURN MANIFOLD
227	1.00	N86SK1-403	DYNAMIC SWING BRAKE
228	1.00	N61322-026	GAUGE CONSOLE



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### BRACKETS, N80723-511, (continued)

229	1.00	N60756-007	HI / LO BOOM KICKOUT
230	1.00	N60863-001	FILTER BRACKET
231	1.00	N80402-006	BOOM TIP BEACON BRACKET
232	1.00	N80402-007	GANTRY BEACON MOUNTING
233	4.00	N61109-040	FLOODLIGHT BRACKETS
234	1.00	N61638-001	ELECTRIC SWIVEL BRACKET
235	1.00	N62223-001	SPEAKER BRACKET
236	1.00	N61322-027	GAUGE CONSOLE
237	1.00	N61980-004	BRACKET, LOAD PIN INDICATOR, 340L
238	1.00	N96SK1-441	ASSY, INDICATOR AUX. LOAD PIN
239	1.00	N2006SK1-123	RETURN 90
240	4.00	N2004SK1-063	GANTRY FLOODLIGHT BRACKET
241	1.00	N2006SK1-137	CAB STEP
242	1.00	N2007SK1-225	ACCESS LADDER
243	1.00	N2006SK1-126	LADDER BRACKET
244	1.00	N62147-004	PILOT CONTROLLER VALVE BRACKET
245	1.00	N2007SK1-271	GROUNDING SYSTEM, 340LA
246	1.00	N62214-006	CHALMATIC BRACKET
247	1.00	N80375	RESET VALVE
248	1.00	N2006SK1-180	BOLT HOLE PLUG
249	4.00	N2003SK1-296	JACK PAD PLUG
250	1.00	N2007SK1-320	BRACKET AIR TANK MOUNTING



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### BRACKETS, N80723-511, (continued)

251	1.00	N60924-008	SPACER, SHEAVE
252	1.00	N80541-013	CLEVIS
253	-	-	-
254	-	-	-
255	-	-	-

### RIGGING ASSEMBLY, N80723-512

256	362.00'	N00031-010	WIRE ROPE, DYFORM, 18HSLR, 5/8"
257	1608.00'	N00031-014	WIRE ROPE, DYFORM, 18HSLR, 7/8"
258	8.00	N30601-006	SHACKLE, ANCHOR, 3/8"
259	1.00	N30602-005	SOCKET, OPEN WEDGE, 5/8"
260	1.00	N30602-008	SOCKET, OPEN WEDGE, 7/8"
261	1.00	N30606-010	CLAMP, CABLE, 5/8"
262	1.00	N30606-014	CLAMP, CABLE, 7/8"
263	4.00	N45315-048	CABLES, ANTI-TWO BLOCK
264	1.00	N45421-004	SHEAVE, NYLON, 16", 5/8" GROOVE
265	1.00	N45421-017	SHEAVE, NYLON, 14", 5/8" GROOVE
266	1.00	N45421-026	SHEAVE, NYLON, 16", 5/8" GROOVE
267	1.00	N45421-039	SHEAVE, NYLON, 14", 7/8" GROOVE
268	2.00	N45422-006	BEARING, SHEAVE, 2-1/2"
269	6.00	N45422-007	BEARING, SHEAVE
270	1.00	N45422-012	BEARING, SHEAVE, 1-1/2"
271	2.00	N45931-010	SHEAVE, NYLON, 20", 5/8" GROOVE



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### RIGGING ASSEMBLY, N80723-512, (continued)

272	4.00	N45931-014	SHEAVE, NYLON, 20", 7/8" GROOVE
273	1.00	N46059-003	HOIST, PD15B-41064-04-1
274	1.00	N46419-003	BOLT KIT, HOIST, PD15
275	1.00	N46419-006	BOLT KIT, HOIST, CH240
276	1.00	N46831-243	LOAD BLOCK, 45 TON
277	1.00	N46832-001	OVERHAUL BALL, 7 TON,
278	1.00	N47022-002	HOIST, CH240A-53120-02-1
279	1.00	N80196-004	KIT, EMERGENCY LOAD LOWERING
280	1.00	N2004SK1-245	MODIFICATION, SHEAVE GREASE PORT
281	1.00	N45421-026	SHEAVE MODIFICATION
282	-	-	-
283	-	-	-
284	-	-	-
285	-	-	-

### HYDRAULIC ASSEMBLY, N80723-513

286	2.00	N45025-001	VALVE, DIRECTIONAL, HYD, 3/4"
287	2.00	N45025-501	SPRING KIT, DIRECTIONAL VALVE
288	2.00	N45025-502	KIT, HANDLE, DIRECTIONAL VALVE
289	2.00	N45375-001	MOTOR, HOIST, 090
290	2.00	N45401-001	VALVE, HYD, 3/8"
291	1.00	N45408-509	VALVE, CONTROL, HYD, VA35, INLET
292	1.00	N45408-512	VALVE, CONTROL, HYD, VA35, OUTLET



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### HYDRAULIC ASSEMBLY, N80723-513, (continued)

293	1.00	N45408-528	VALVE, CONTROL, HYD, VA35, WORKING
294	1.00	N45410-004	VALVE, RELIEF, HYD, ASSY
295	1.00	N45419-004	VALVE, FLOW CONTROL, HYD, 1/4"
296	1.00	N45460-001	FILTER, RETURN, HYDRAULIC
297	2.00	N45460-501	FILTER, ELEMENT, HYDRAULIC
298	2.00	N45674-009	VALVE, CHECK, HYD, INLINE, 1/4", 6000PSI
299	1.00	N45674-011	VALVE, CHECK, HYD, INLINE, 1/2", 6000PSI
300	1.00	N45813-003	SWING, BRAKE, CYLINDER
301	1.00	N45813-008	RESERVOIR, SWING BRAKE
302	1.00	N45854-002	CARTRIDGE, HYD DUMP VALVE
303	1.00	N45855-002	COVER, HYD DUMP VALVE, W / BOLTS
304	3.00	N45921-032	STRAINER, SUCTION, 3"
305	1.00	N46074-001	VALVE, SENSING, PRESSURE
306	1.00	N46096-001	VALVE, RESET
307	1.00	N46488-001	VALVE, FLOW DIVIDER
308	1.00	N46632-012	CONTROLLER, HYD, 2 SECTION
309	1.00	N46632-013	CONTROLLER, HYD, 1 SECTION
310	1.00	N46739-002	VALVE, HYD, 2 POS.
311	1.00	N46785-479	PUMP, HYD, GEAR
312	2.00	N47010-002	VALVE, CONTROL, HYD, V90
313	1.00	N47010-007	VALVE, CONTROL, ASSY, V90
314	2.00	N47199-002	BRAKE, SWING DRIVE



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### HYDRAULIC ASSEMBLY, N80723-513, (continued)

315	1.00	N47965-001	VALVE, DIRECTIONAL SPOOL, 6 WAY, 2 POS.
316	1.00	N47965-501	CARTRIDGE, VALVE, DIRECTIONAL, SPOOL
317	1.00	N60780-001	BODY, DUMP VALVE
318	1.00	N80375	VALVE, RESET
319	1.00	N80519-007	ADAPTER, KIT, PEMEX, 340LA-80
320	1.00	N83SK1-043	FILTER, HIGH PRESSURE
321	-	-	-
322	-	-	-
323	-	-	-
324	-	-	-

### ELECTRICAL ASSEMBLY, N80723-514

325	155.00'	N45044-013	CABLE, ELEC., 12-4
326	520.00'	N45044-017	CABLE, ELEC., 12-3
327	60.00'	N45044-033	CABLE, ELEC., 10-4
328	35.00'	N45044-108	CABLE, ELEC.
329	1.00	N45425-001	SWITCH, PRESSURE, DIAPHRAM
330	4.00	N46046-002	LIGHT, FLOOD, 120VAC, 400W
331	4.00	N46046-502	BULB, FLOODLIGHT, 400W
332	2.00	N46184-006	SWITCH, TEMP, NEODYNE
333	2.00	N46238-005	LIGHT, BEACON, RED, 120VAC
334	1.00	N46405-004	BOX, JUNCTION, STAHLIN, 10 x 8
335	1.00	N46405-006	BOX, JUNCTION, STAHLIN, 12 x 10



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### ELECTRICAL ASSEMBLY, N80723-514, (continued)

336	2.00	N46405-014	BACKPLATE, FOR N46405-004
337	1.00	N46405-015	BOX, JUNCTION, RAISED COVER, STAHLIN
338	1.00	N46405-616	BACKPLATE, ALUMINUM, FOR N46405-006
339	1.00	N46525-005	POWER SUPPLY
340	4.00	N46534-002	ENCLOSURE, ONE 3/4" HUB, 4 DEVICE
341	1.00	N46535-001	PLUG, CLOSURE
342	11.00	N46537-001	SWITCH, SELECTOR, 2 POSITION, TWO CIRCUIT
343	3.00	N46540-001	LIGHT, PILOT, (RED)
344	1.00	N46540-002	LIGHT, PILOT, GREEN
345	12.00	N46547-003	BOX, OUTLET, GEC SERIES
346	1.00	N46782-006	AIR CONDITIONER
347	1.00	N46868-010	LIGHT, CAB
348	4.00	N46868-024	LIGHT, CAB
349	4.00	N46868-522	BULB, LIGHT, FOR N46868-024
350	1.00	N46868-523	BULB, LIGHT, FOR N46868-010
351	1.00	N46878-001	PAGING SYSTEM ASSY, HANDSET W / JACK
352	1.00	N46878-504	HEADSET, W / MIC ASSY, GAITRONICS
353	1.00	N46878-505	CABLE, 30FT, EXT.
354	1.00	N46878-506	HORN / SPEAKER, 130 DEGREE, GAITRONICS
355	1.00	N46878-507	SPEAKER DRIVER
356	1.00	N46999-011	SYSTEM, LOAD INDICATOR, MARKLOAD
357	1.00	N47021-086	SWIVEL, ELECTRIC



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### ELECTRICAL ASSEMBLY, N80723-514, (continued)

358	35.00	N47481-002	GLAND, CABLE
359	6.00	N47481-011	GLAND, CABLE
360	3.00	N47518-505	VALVE, SOLENOID
361	80.00'	N47759-501	CABLE, COPPER MAIN CLASS II
362	1.00	N47759-502	POINT, BARE, COPPER
363	1.00	N47759-503	BASE, MOUNT POINT
364	50.00	N47759-504	CABLE, LOOP, WIDE, 1/2" COPPER
365	1.00	N47759-505	LUG, TERMINAL BONDING
366	58.00	N47759-506	SCREW, SELF DRILL
367	1.00	N47759-507	BRACE, GALV STL TRIPOD, 18" LONG
368	1.00	N47911-002	RELAY, 24VDC, SEALED
369	1.00	N47911-501	SOCKET, RELAY (REFERENCE N47911-001)
370	1.00	N47961-001	TRANCEIVER, MARINE, VHF
371	1.00	N47966-002	CIRCUIT BREAKER, 220V, 60Hz, 1 PHASE, 3 POLE
372	-	-	-
373	-	-	-
374	-	-	-

### PNEUMATIC ASSEMBLY, N80723-515

375	1.00	N45357-005	LUBRICATOR, AIR, 3/8"
376	1.00	N45386-001	VALVE, PUSH BUTTON, MANUAL START
377	1.00	N45445-001	VALVE, POPOFF, AIR, 150PSI
378	1.00	N45674-004	VALVE, CHECK, HYD, INLINE, 5000PSI



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### PNEUMATIC ASSEMBLY, N80723-515, (continued)

379	1.00	N45678-003	HORN, AIR, NYLON, 10", BUELL
380	1.00	N46003-001	VALVE, PUSH BUTTON, AIR, 7/8"
381	3.00	N46051-001	WIPER, ASSEMBLY
382	1.00	N46178-008	VALVE, BALL, 316SS, 1/2"
383	1.00	N47164-004	RECEIVER, AIR, 200GAL
384	1.00	N47370-002	MOTOR, START, AIR
385	1.00	N47552-501	VALVE, STARTER RELAY, AIR
386	-	-	-
387	-	-	-

### MAINTENANCE JIB ASSEMBLY, N80723-517

388	9.00	N30606-004	CLAMP, CABLE, 1/4"
389	9.00	N45180-004	TURNBUCKLE, 316SS
390	200.00'	N46291-004	CABLE, 1/4" SS
391	1.00	N46871-004	TROLLEY, 3 TON
392	1.00	N46871-010	TROLLEY, 2 TON
393	1.00	N61648-003	MAINTENANCE JIB
394	1.00	N61840-003	MAINTENANCE JIB
395	-	-	-
396	-	-	-

### BOOM MAINTENANCE WALKWAY ASSEMBLY, N80723-518

397	1.00	N61589-032	BOOM MAINTENANCE WALKWAY
398	-	-	-



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### SPARE PARTS, N80723-521

399	1.00	N00028	LUBE, WIRE ROPE, ESGARD, 5 GAL PAIL
400	20.00	N12669-001	GREASE, TUBE, GENERAL PURPOSE
401	2.00	N45025-001	VALVE, DIRECTIONAL, HYD, 3/4"
402	2.00	N45025-501	SPRING KIT, DIRECTIONAL VALVE
403	2.00	N45025-502	KIT, HANDLE, DIRECTIONAL VALVE
404	1.00	N45408-502	SEAL KIT, VA35 CONTROL VALVE
405	2.00	N45674-009	VALVE, CHECK, HYD, INLINE, 1/4", 6000PSI
406	1.00	N45674-011	VALVE, CHECK, HYD, INLINE, 1/2", 6000PSI
407	1.00	N45921-028	STRAINER, SUCTION, 2"
408	3.00	N45921-032	STRAINER, SUCTION, 3"
409	2.00	N46018-360	CABLE, KILL, 30'
410	2.00	N46046-502	BULB, FLOODLIGHT, 400W
411	2.00	N46238-005	LIGHT, BEACON, RED, 120VAC
412	1.00	N46785-479-SK	KIT, SEAL, PUMP, HYD, GEAR
413	2.00	N46868-522	BULB, LIGHT, 26W, FOR N46868-024
414	1.00	N46999-011-1	SWITCH, A2B
415	2.00	N47010-002-SK	KIT, CONTROL VALVE SEAL, GRESSEN, V90
416	1.00	N47010-007-SK	SEAL KIT, CONTROL VALVE
417	2.00	N47204-501	FILTER, HYDRAULIC RETURN ELEMENT
418	12.00	N47204-501	FILTER, HYDRAULIC RETURN ELEMENT
419	2.00	N47445-016	GAUGE, PRESSURE, 0-100PSI, BACK MOUNT
420	1.00	N47445-018	GAUGE, PRESSURE, 0-200PSI



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### SPARE PARTS, N80723-521, (continued)

421	1.00	N47445-019	GAUGE, PRESSURE, 0-300PSI, BACK MOUNT
422	1.00	N47445-020	GAUGE, PRESSURE, 0-600PSI, BACK MOUNT
423	1.00	N47445-024	GAUGE, PRESSURE, 0-3000PSI, BACK MOUNT
424	3.00	N47445-026	GAUGE, PRESSURE, 0-5000, BACK MOUNT
425	10.00	N47787-510	SECONDARY FUEL FILTER
426	10.00	N47787-513	AIR CLEANER ELEMENT (PRIMARY)
427	4.00	N47787-515	ENGINE FAN BELTS
428	10.00	N47787-540	FILTER, OIL
429	-	-	-
430	-	-	-
431	-	-	-

### LOAD CHART & API TAG, N80723-522

432	1.00	23407 INFO	INFORMATION CHART
433	1.00	23407 API	API PLACARD
434	1.00	N2007SK3-061	CHART, LOAD, 23407 (ENGLISH)
435	1.00	N2007SK3-086	CHART, LOAD, 23407 (METRIC)

### MANUFACTURER ENGINE SPARE PARTS

436	1.00	N47787-503	RADIATOR GROUP
437	1.00	N47787-504	RADIATOR CAP
438	1.00	N47787-505, -506	RADIATOR FAN GUARD
439	1.00	N47787-507	RADIATOR SHROUD
440	1.00	N47787-508	FUEL TRANSFER PUMP



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### MANUFACTURER ENGINE SPARE PARTS, (continued)

441	1.00	N47787-509	FUEL PRIMING PUMP
442	1.00	N47787-510	SECONDARY FUEL FILTER
443	1.00	N47787-540	OIL FILTER
444	1.00	N47787-529	AIR CLEANER ASSEMBLY
445	1.00	N47787-513 / -514	AIR CLEANER ELEMENT – PRIMARY / SECONDARY
446	2.00	N47787-515	ENGINE FAN BELTS
447	1.00	N47787-516	FAN PULLEY SYSTEM
448	1.00	N47787-517	BELT TENSIONER
449	1.00	N47787-518	FLYWHEEL
450	1.00	N47787-519	WATER PUMP
451	1.00	N47787-520	FAN SPIDER ASSEMBLY
452	1.00	N47787-521	UPPER RADIATOR HOSE
453	1.00	N47787-522	LOWER RADIATOR HOSE
454	1.00	CUSTOM MADE	ENGINE HOOD
455	1.00	CUSTOM MADE	ENGINE SIDE PANELS
456	1.00	CUSTOM MADE	FLEX PIPING
457	1.00	N47787-532	WATER GAUGE
458	1.00	N47787-533	OIL GAUGE
459	1.00	N47445-029	FUEL GAUGE
460	1.00	CUSTOM MADE	FUEL SOLENOID
461	3.00	N47787-531	EXHAUST MANIFOLD GASKETS
462	-	-	-



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### Section 5.3 Identified Parts – Pictures



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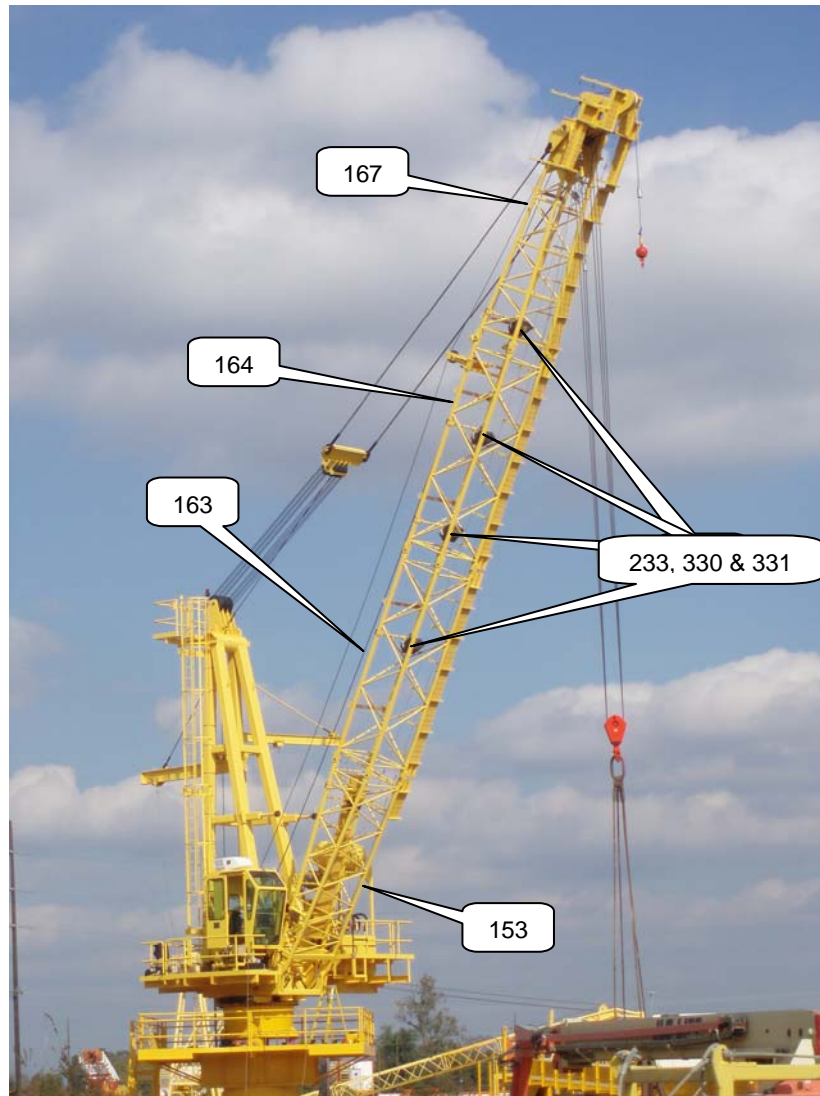
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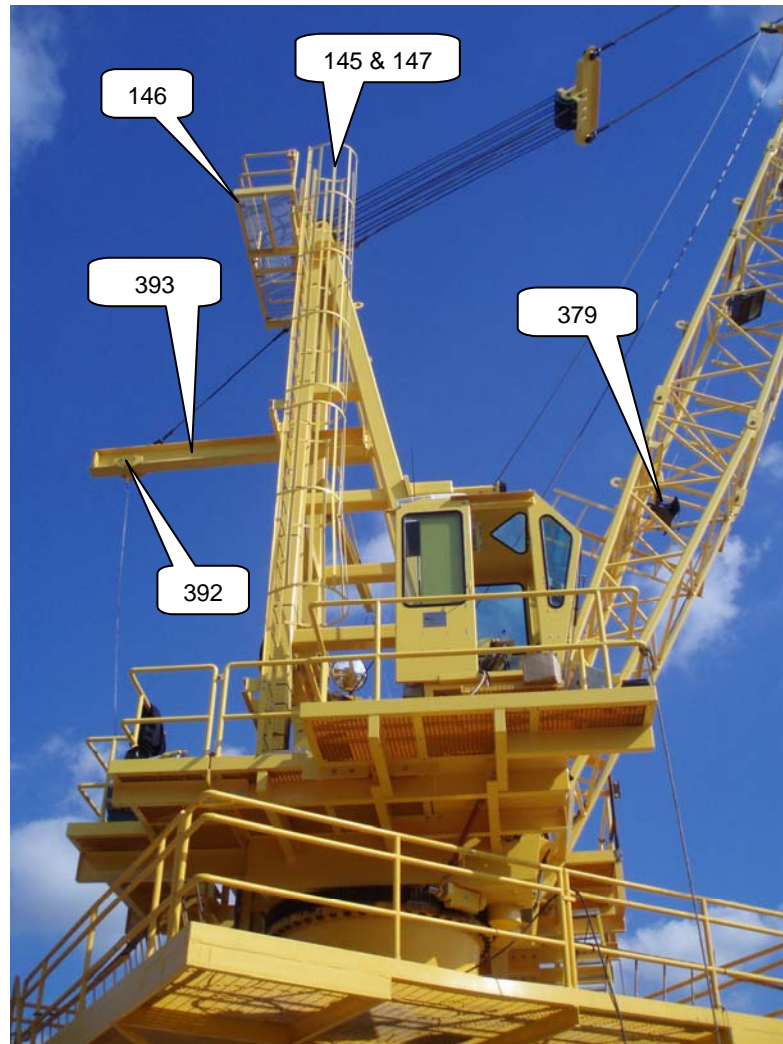
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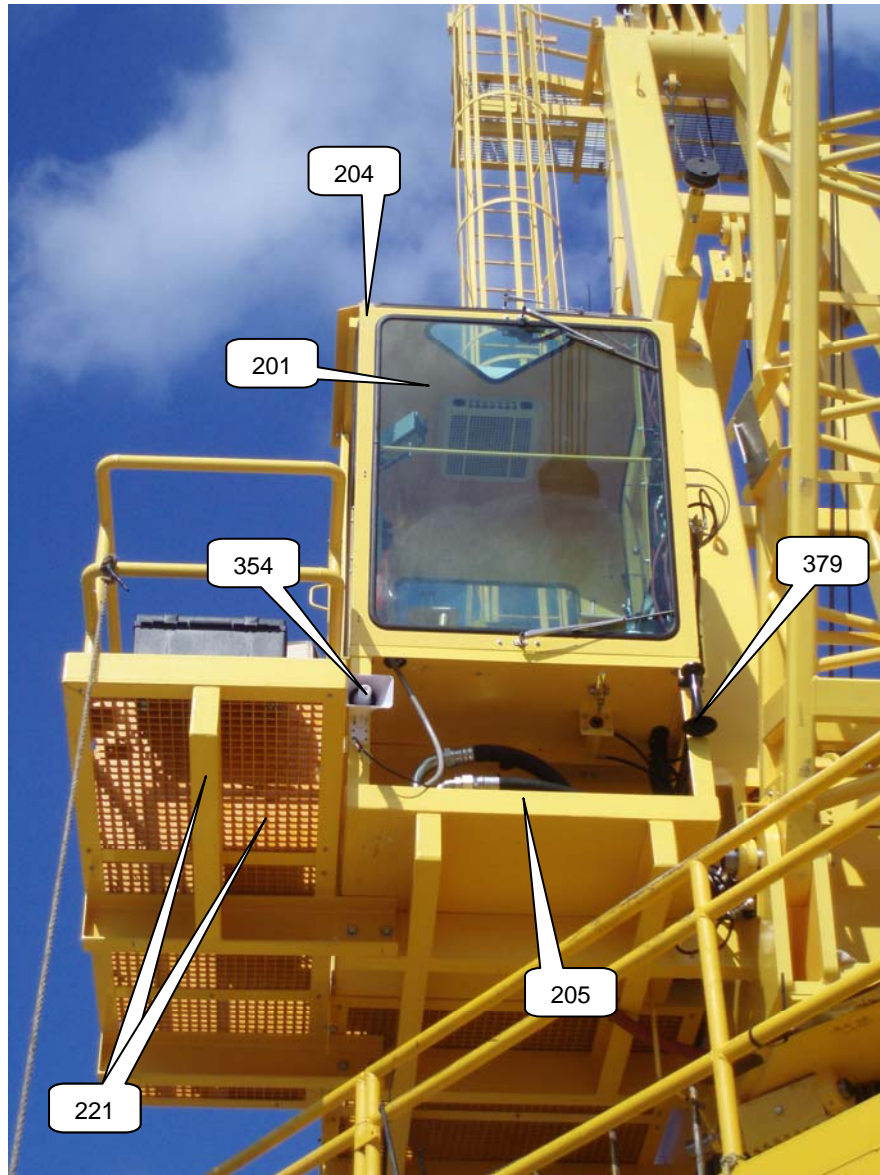
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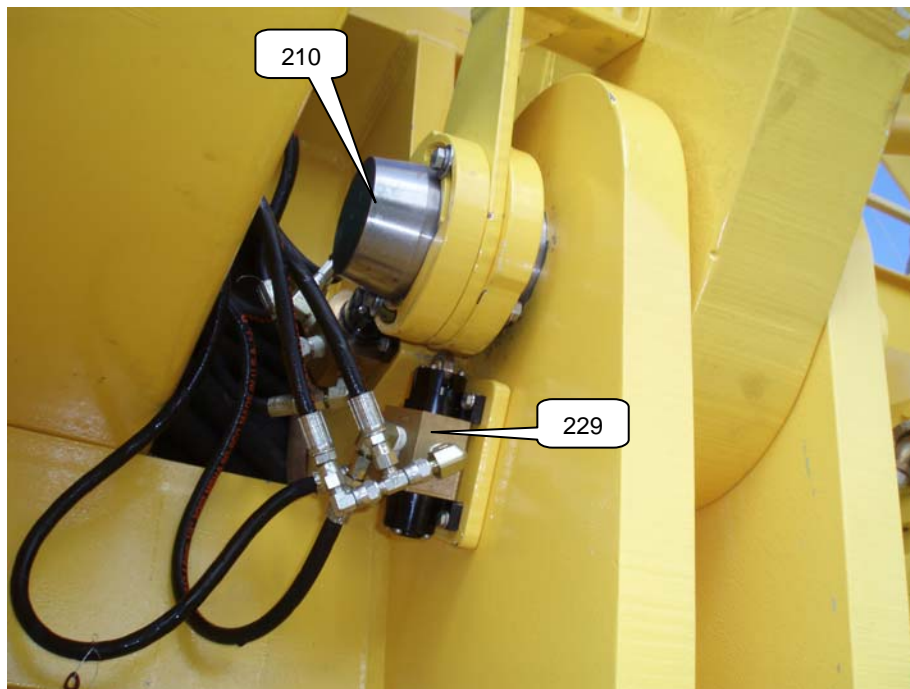
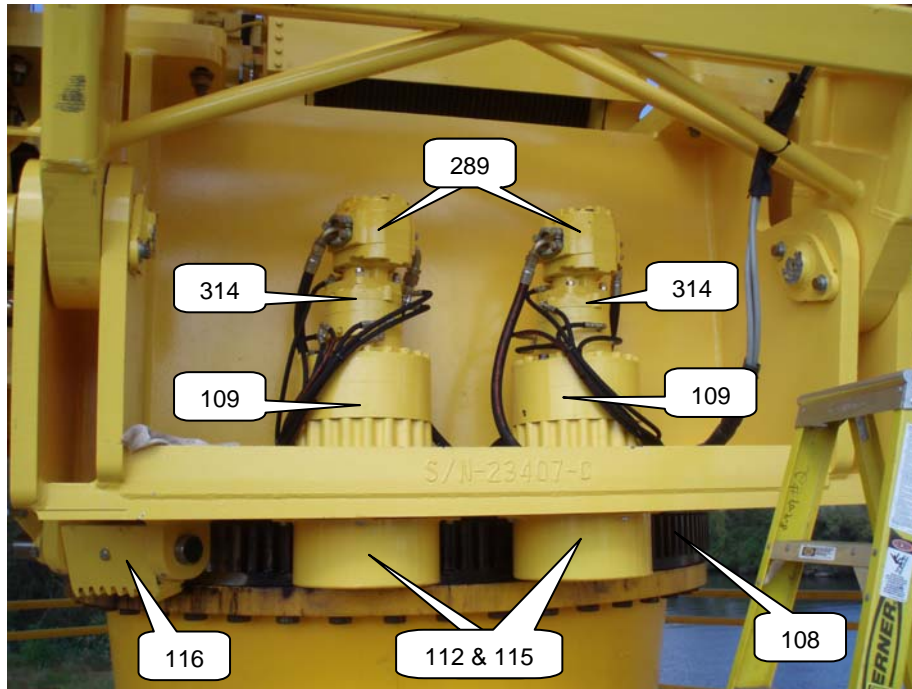
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USA







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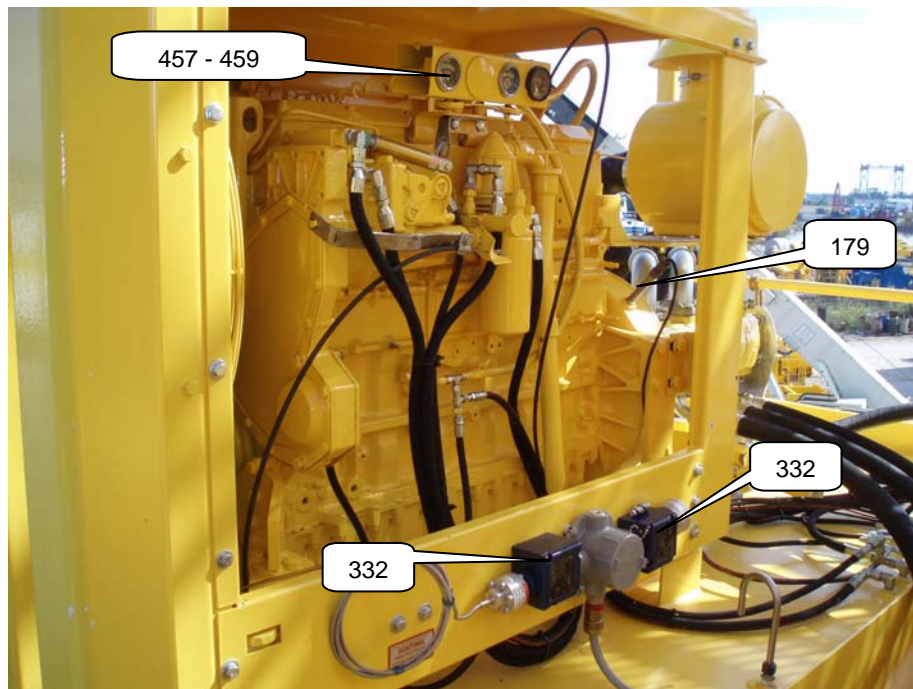
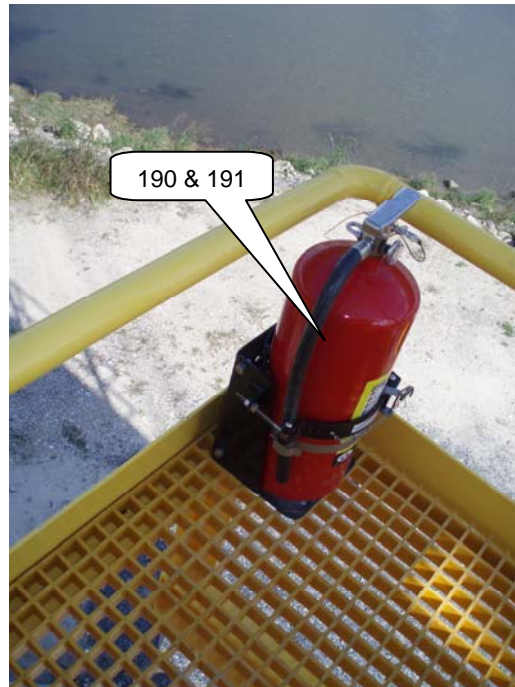
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Volume: 1

## Nautilus Crane Model 340LA-80



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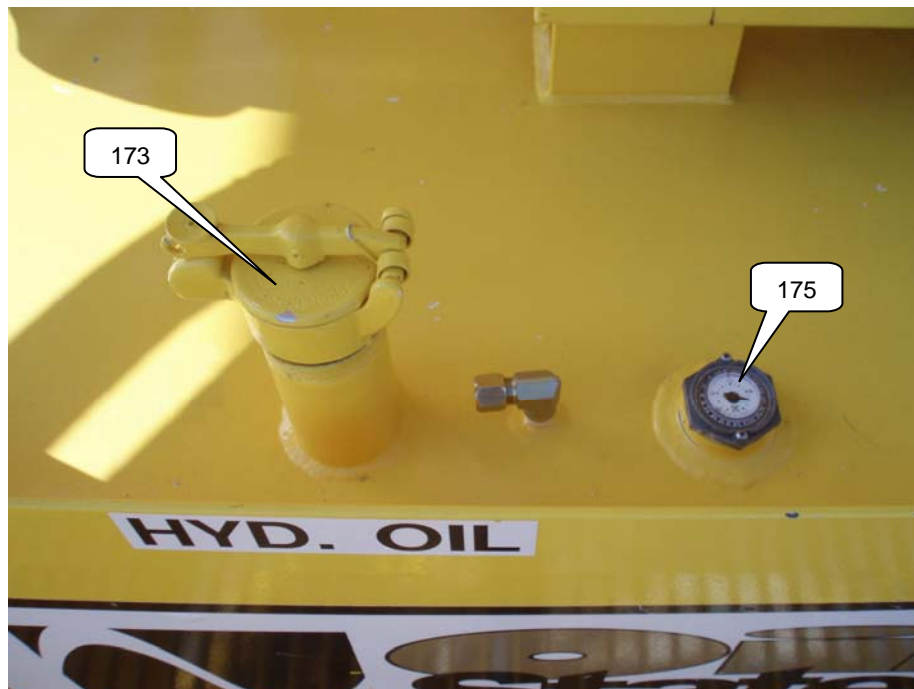
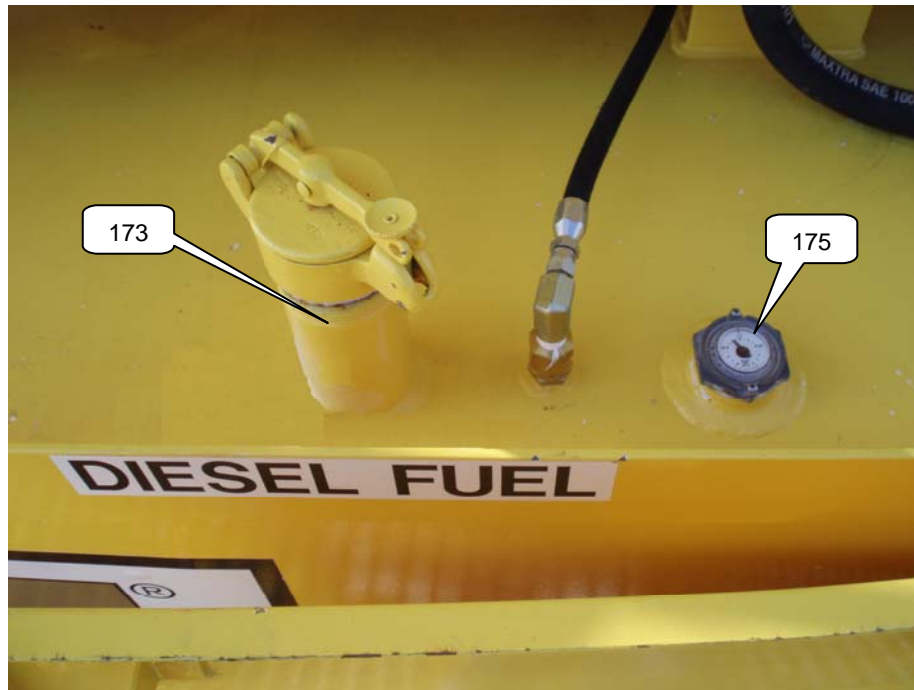
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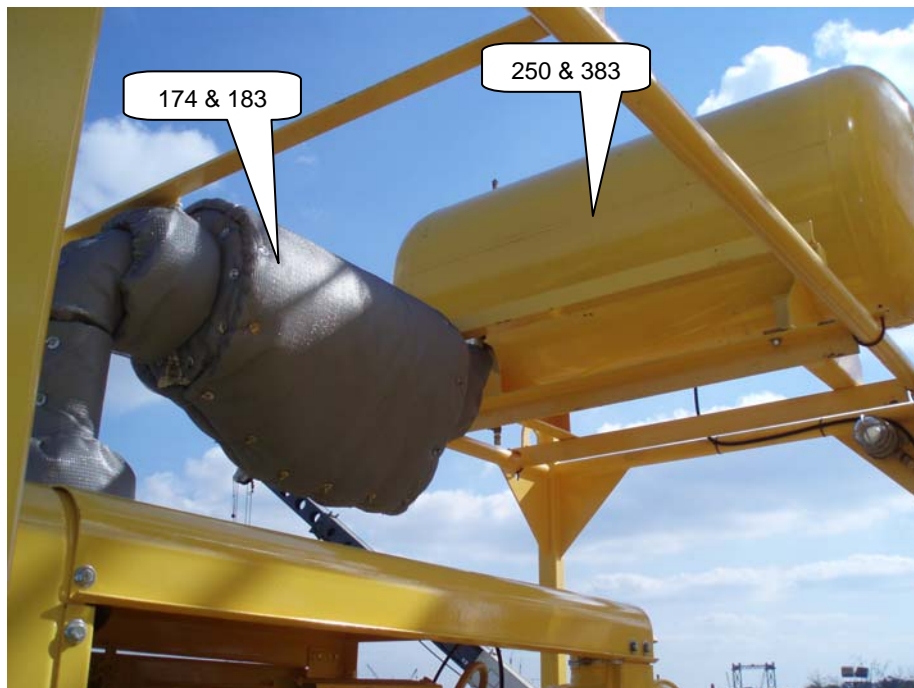
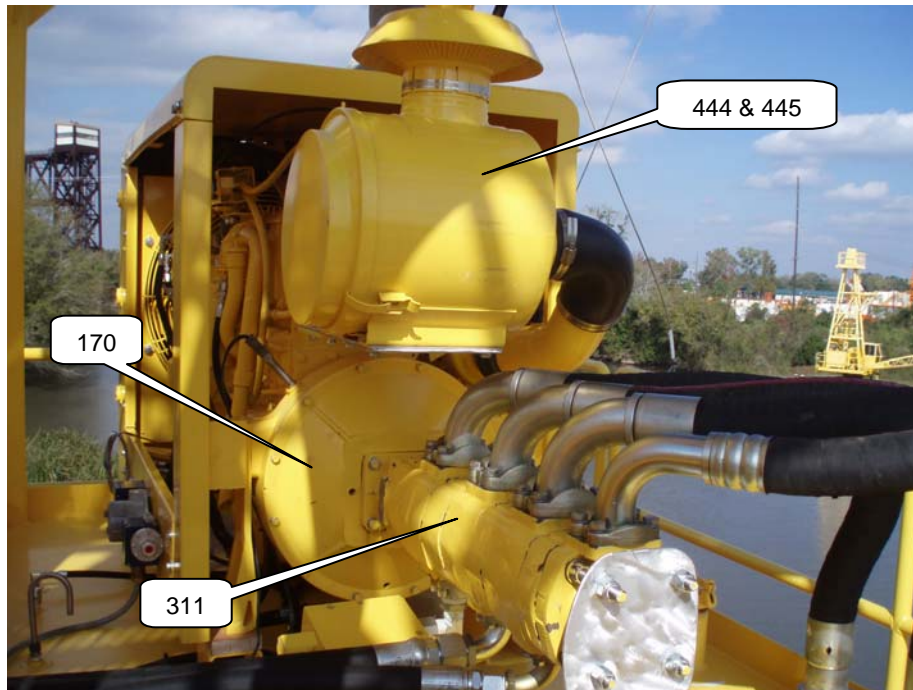
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## Nautilus Crane Model 340LA-80



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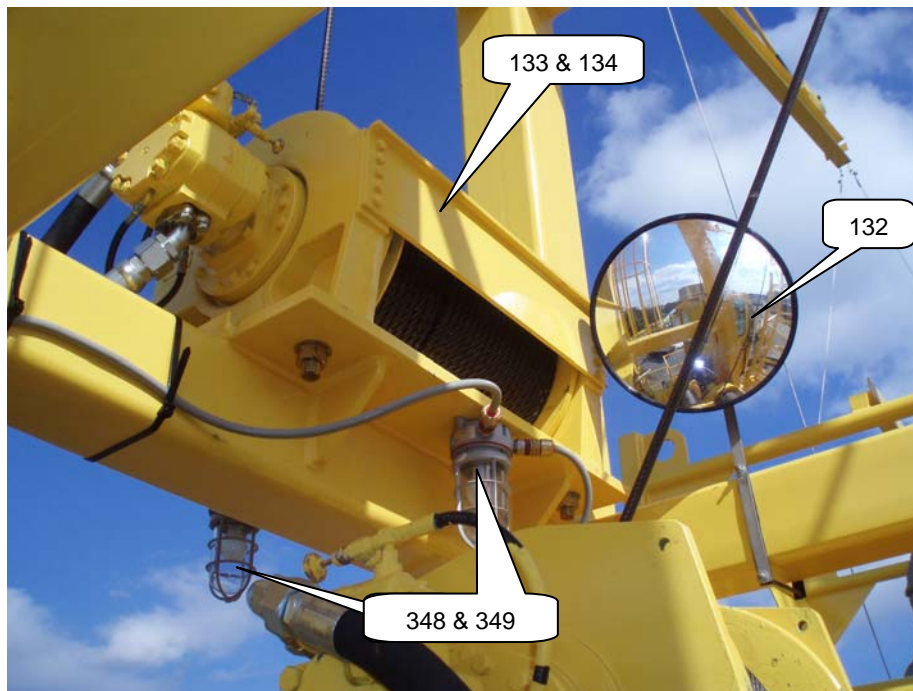
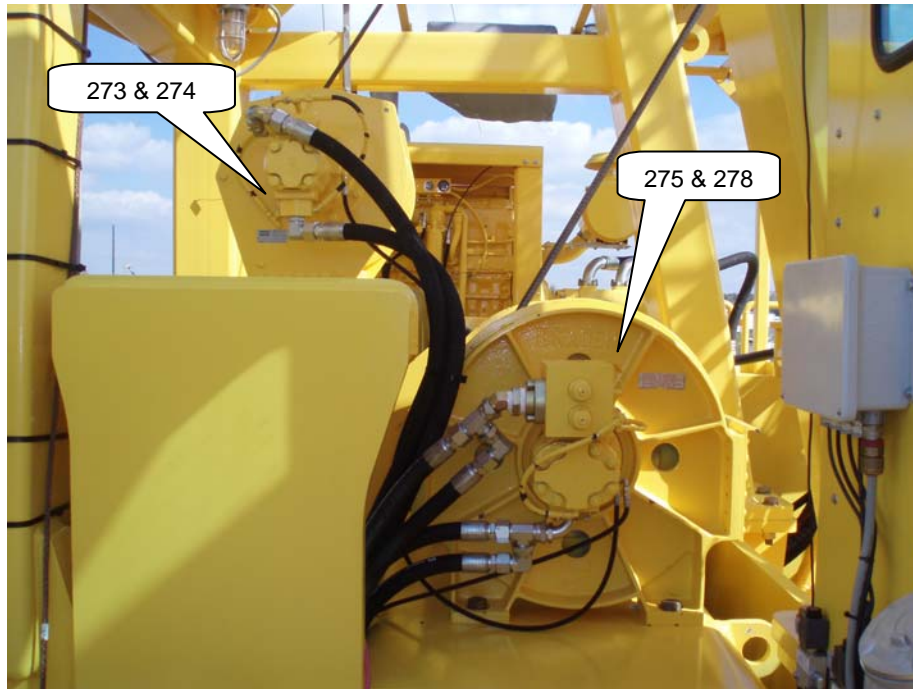
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## Nautilus Crane Model 340LA-80



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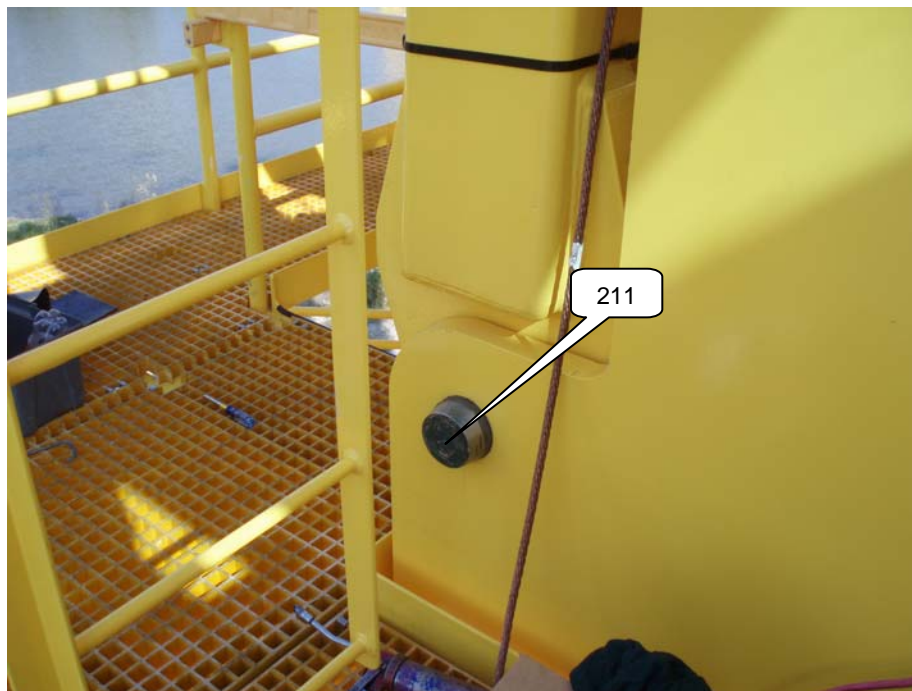
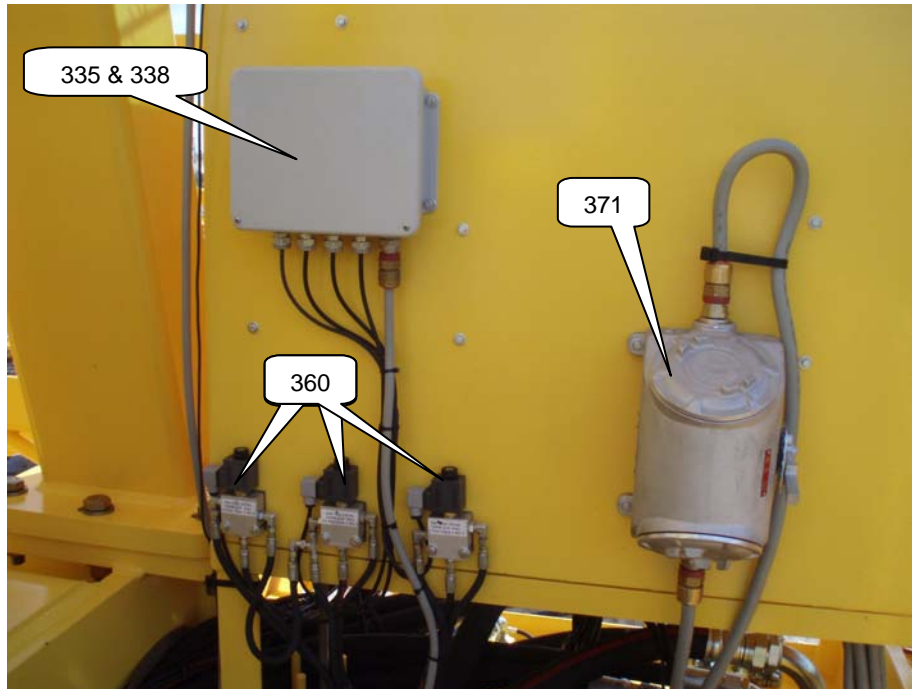
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## Nautilus Crane Model 340LA-80



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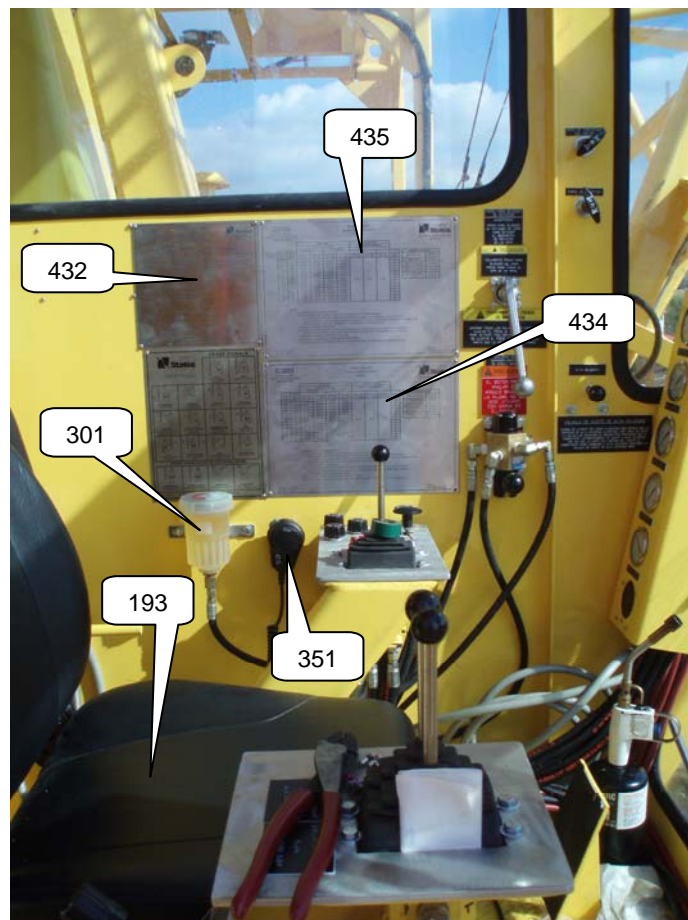
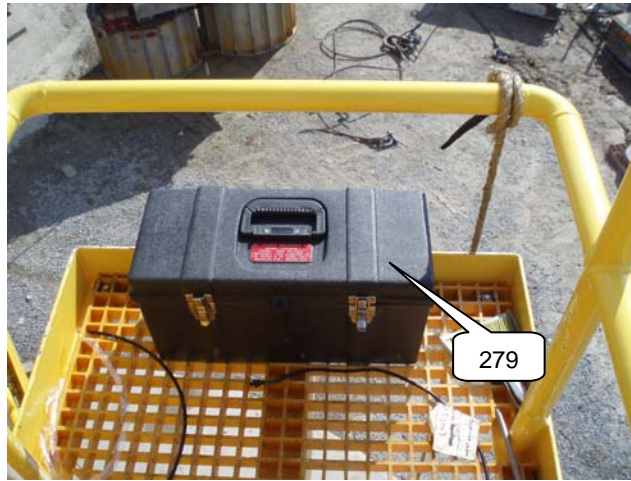
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## Nautilus Crane Model 340LA-80



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## Nautilus Crane Model 340LA-80



Push to Lower  
Main / Aux Hoist  
Pull to Raise

Push to Lower  
Boom  
Pull to Raise



Selector Valve  
Main Hoist  
Auxiliary Hoist

Caution: Do not switch  
hoist selector valve  
while hoist is in motion



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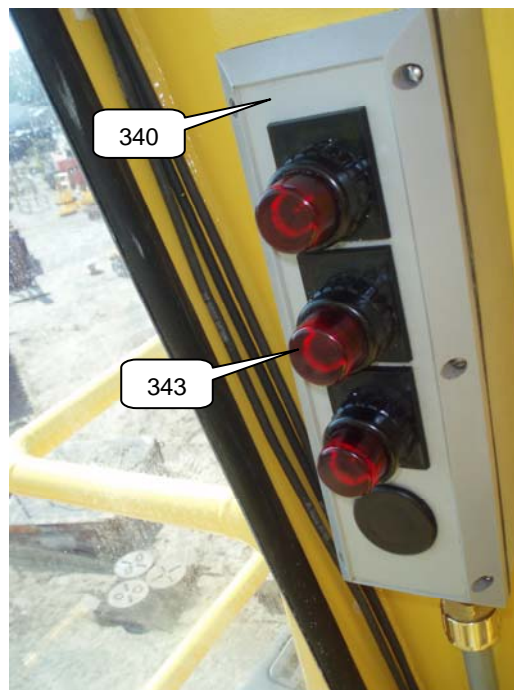
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## Nautilus Crane Model 340LA-80



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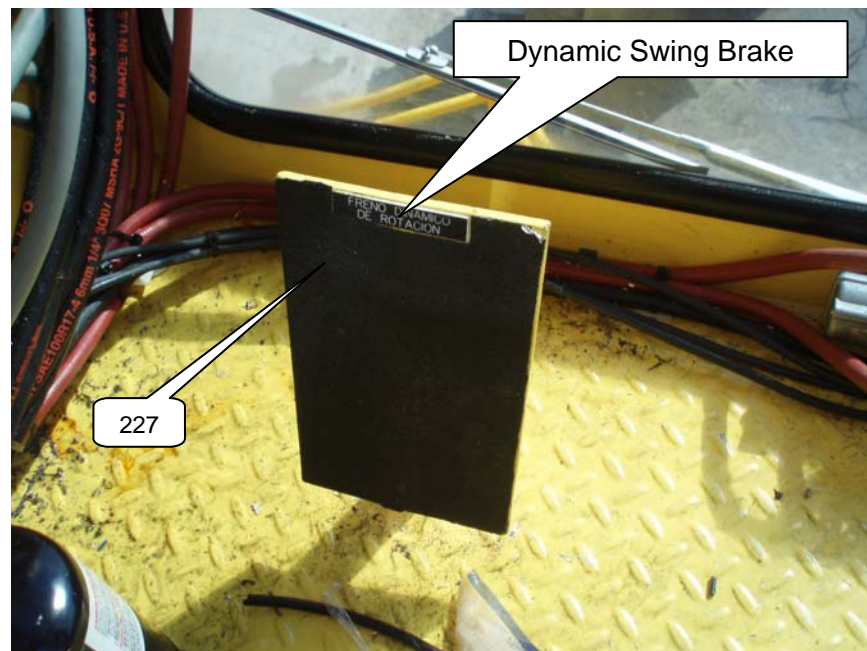
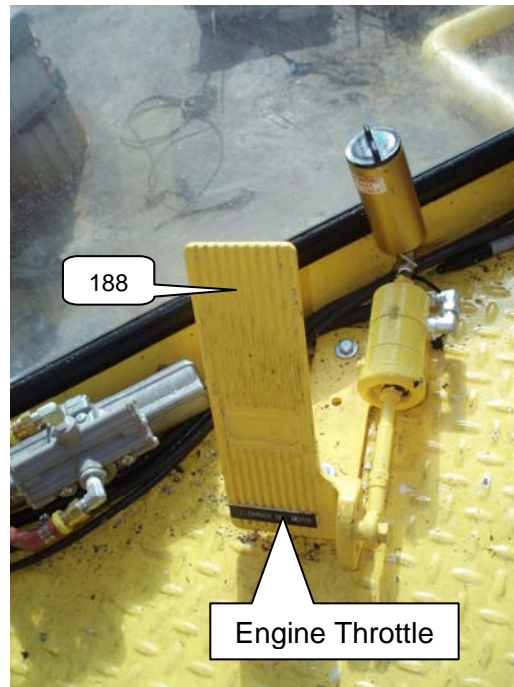
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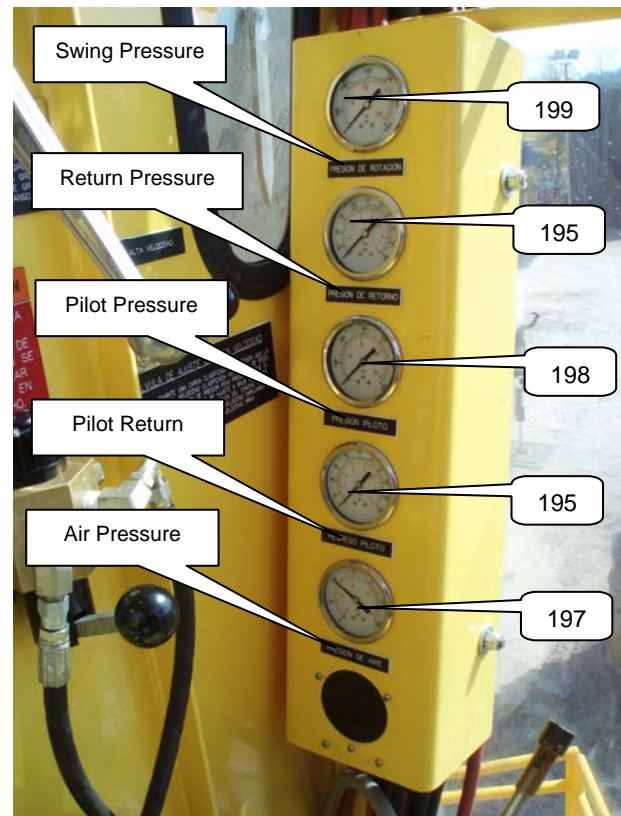
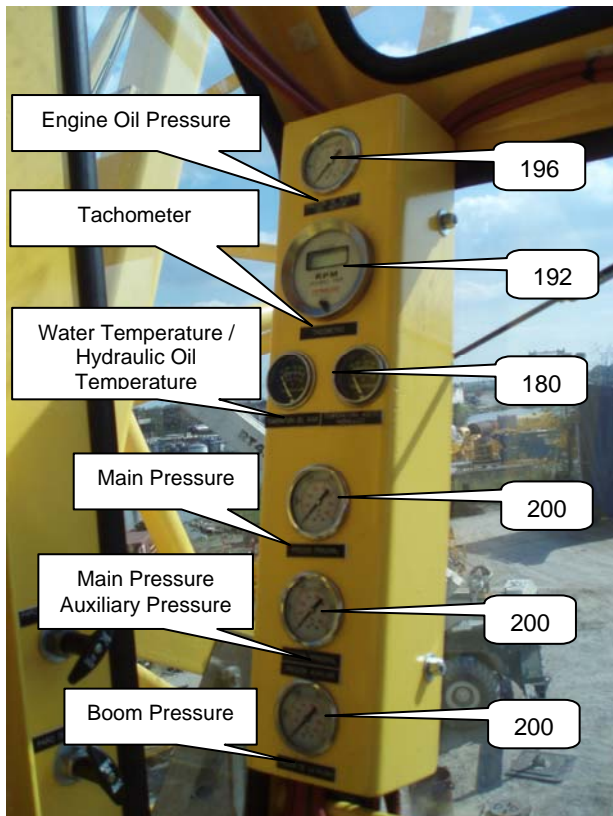
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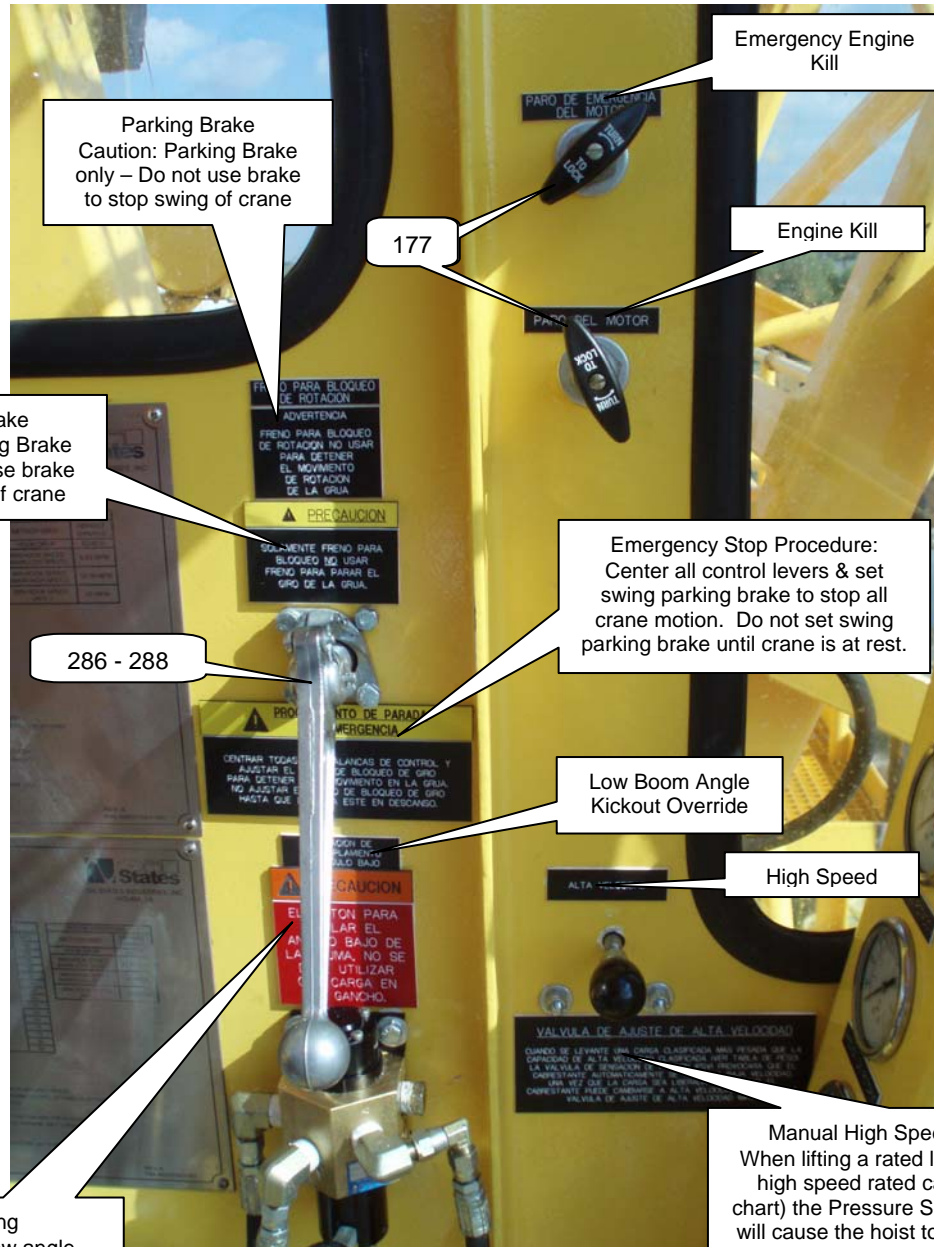
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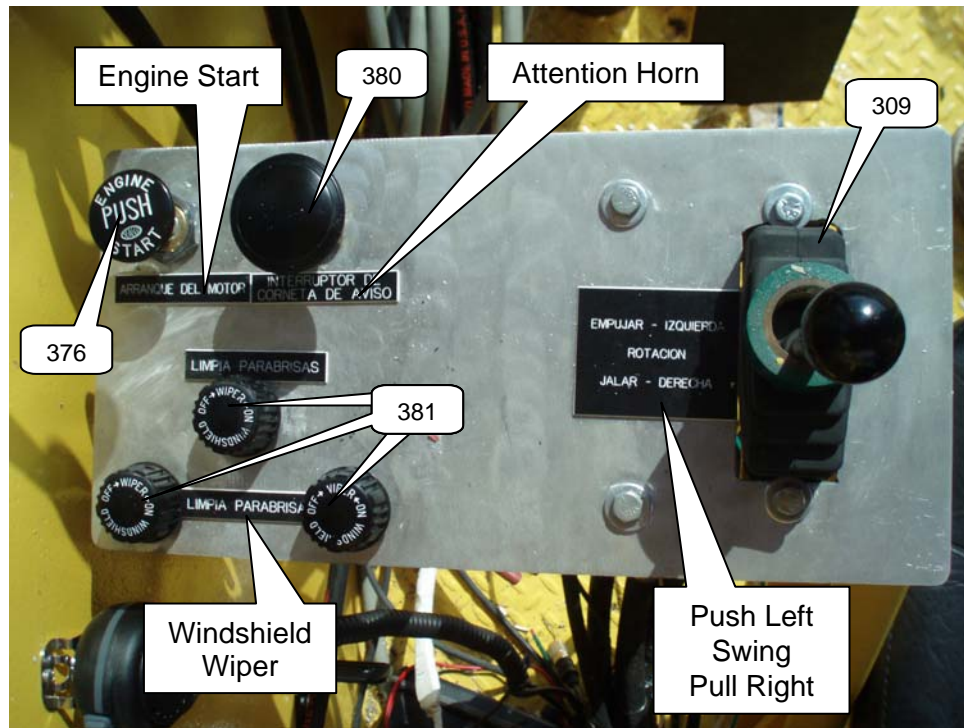
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## Nautilus Crane Model 340LA-80



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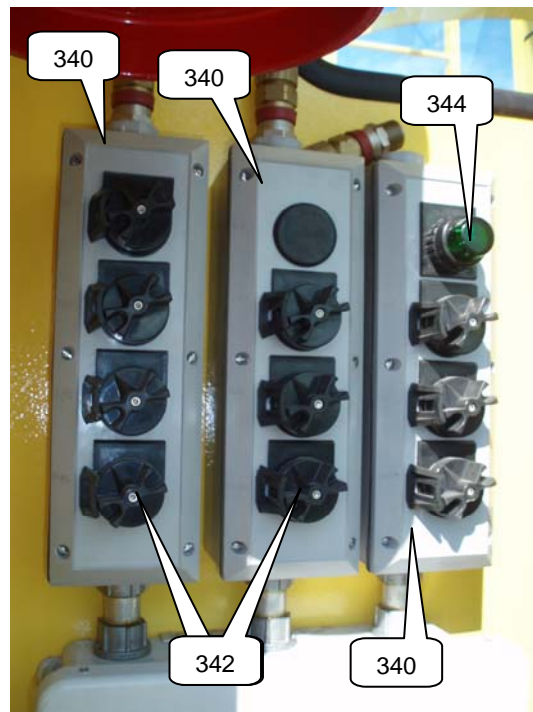
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## Nautilus Crane Model 340LA-80



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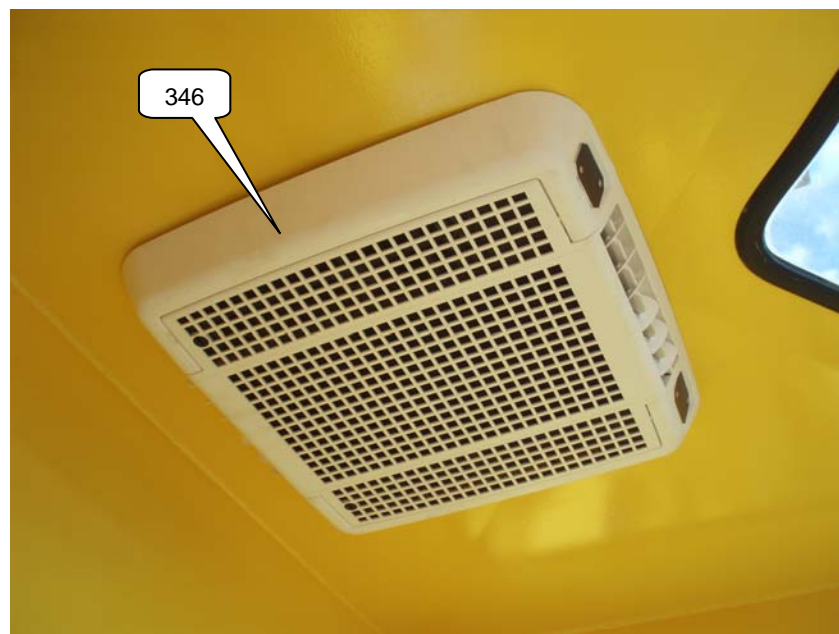
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## Nautilus Crane Model 340LA-80



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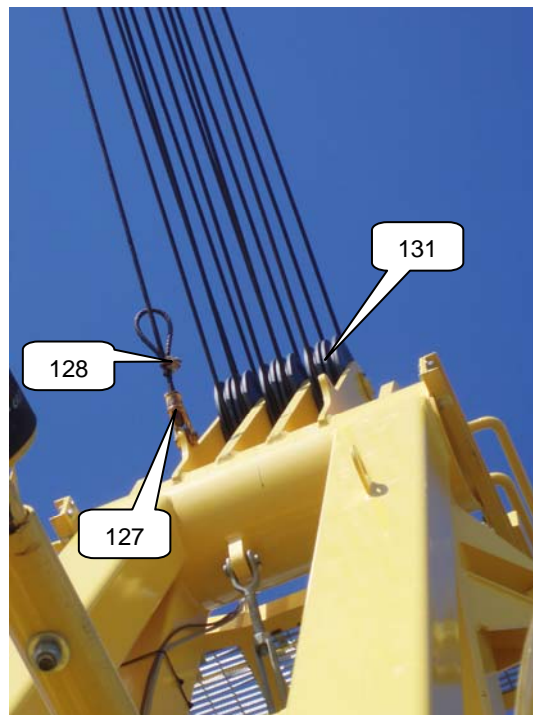
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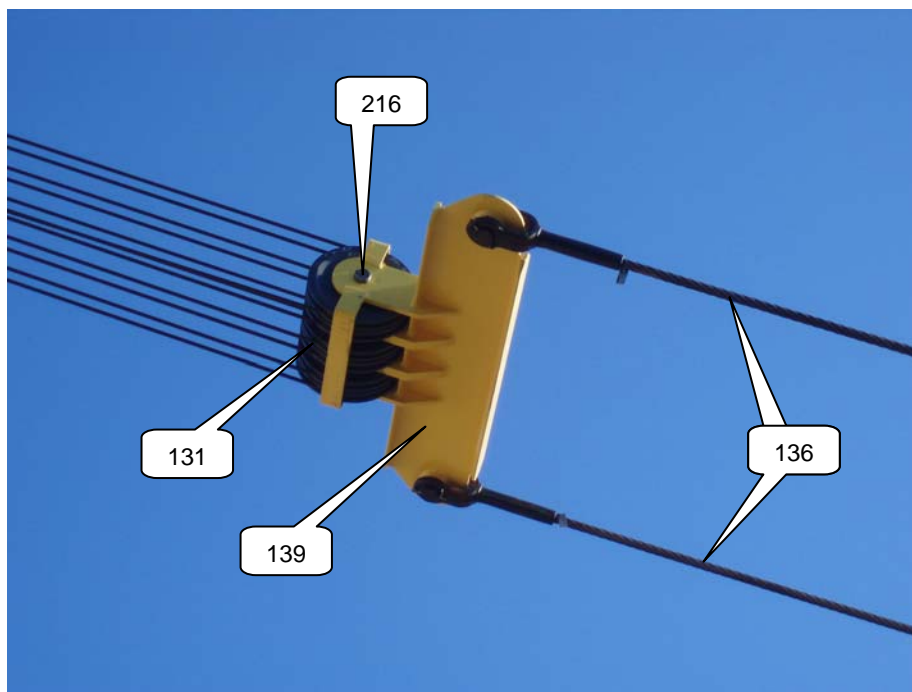
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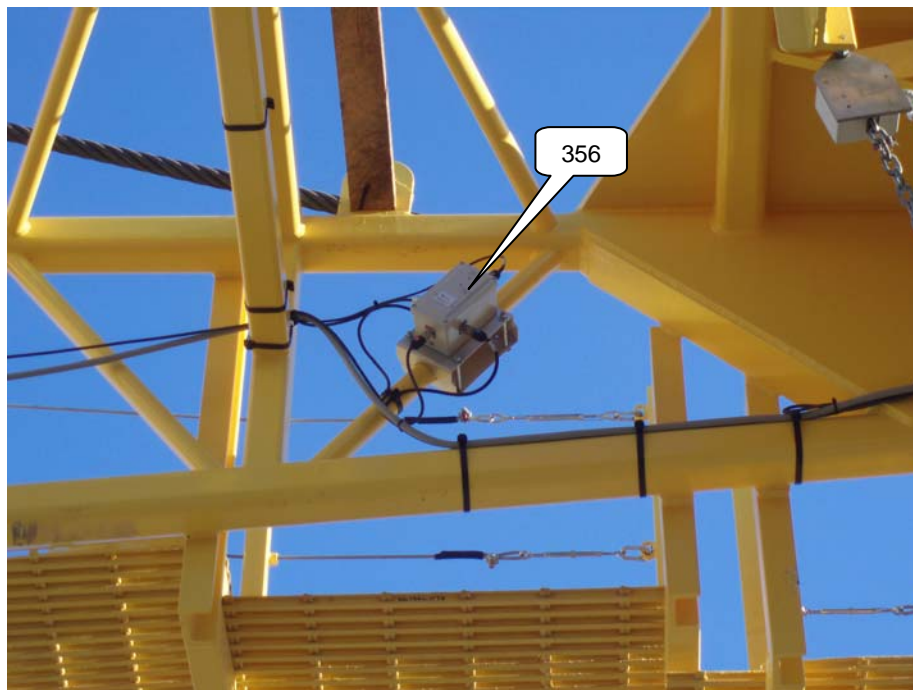
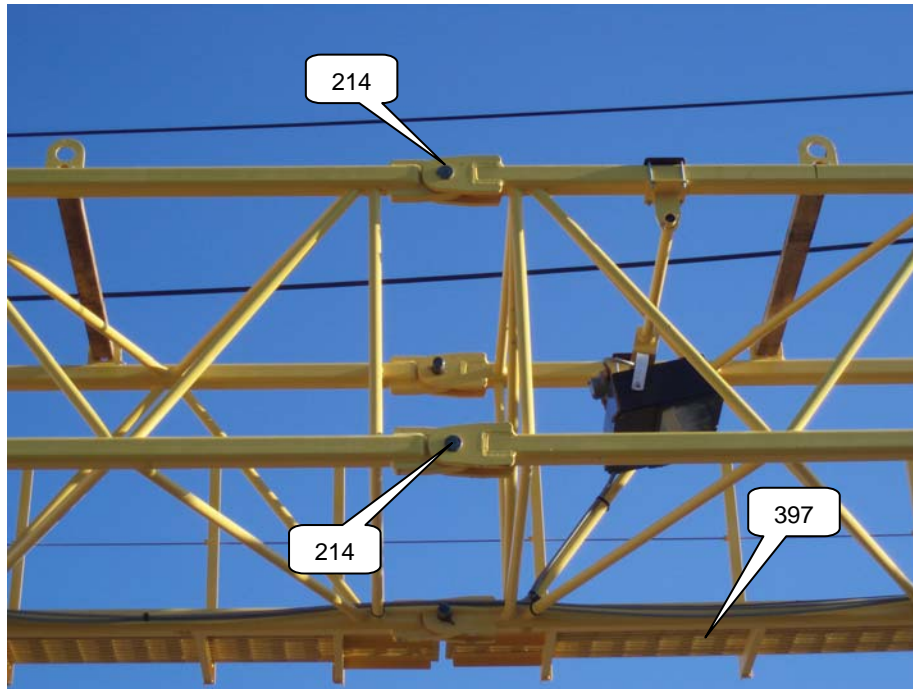
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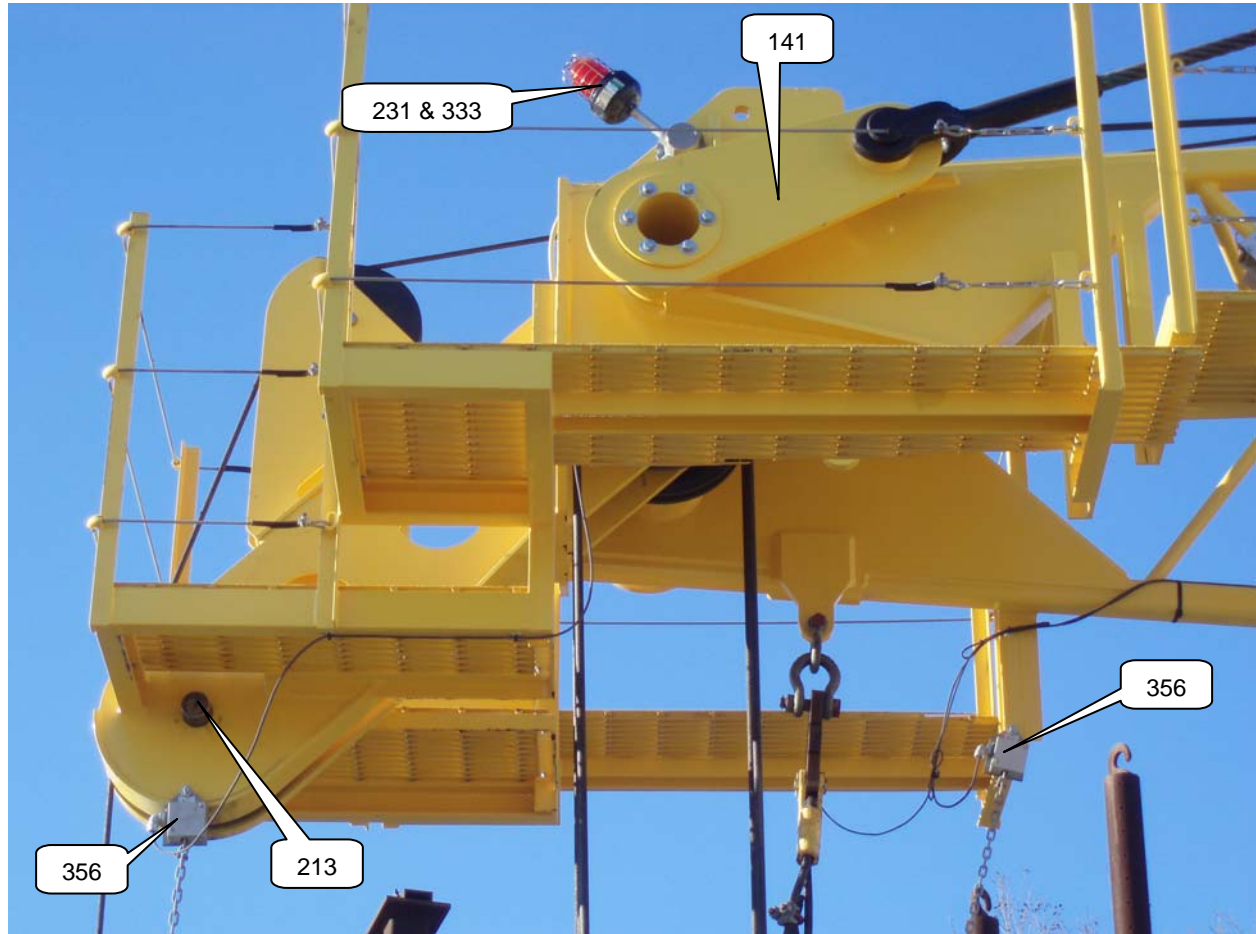
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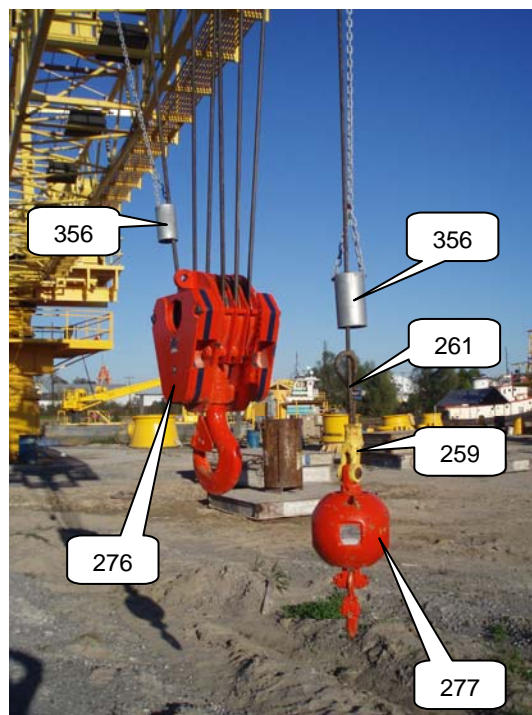
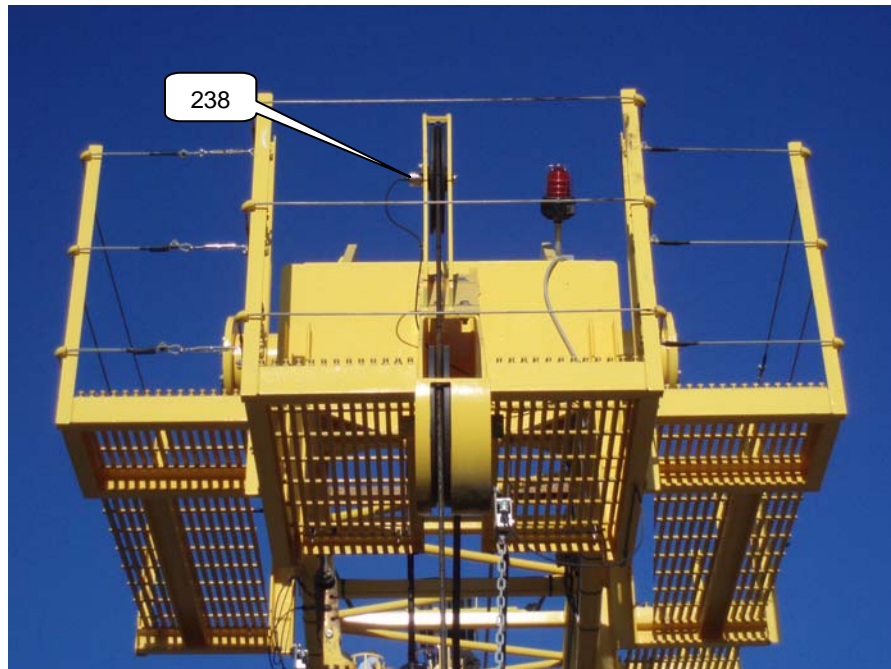
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## Nautilus Crane Model 340LA-80



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## Nautilus Crane Model 340LA-80

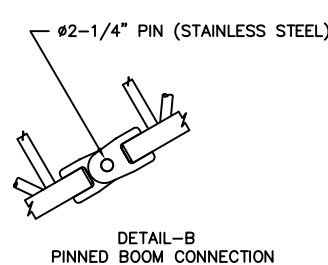
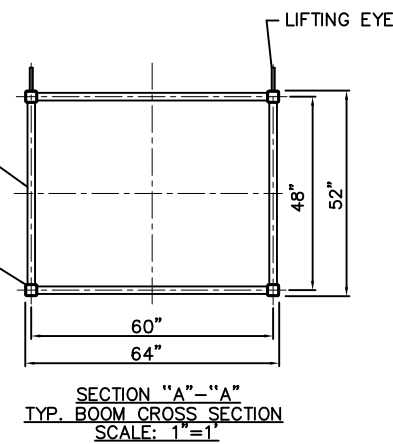
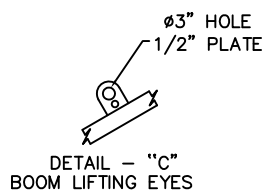
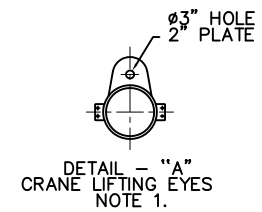
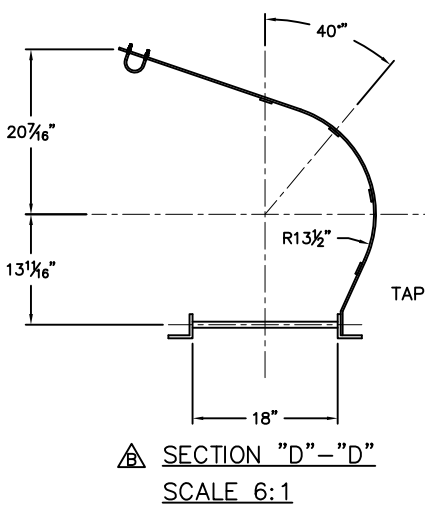
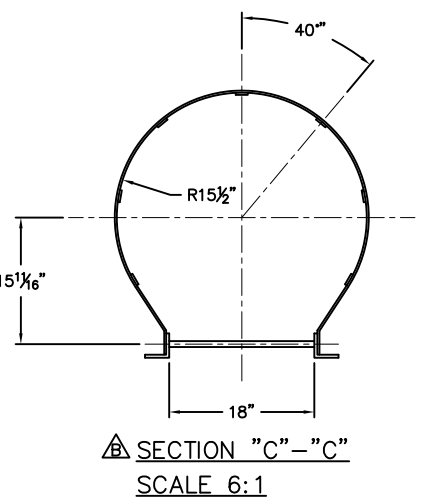
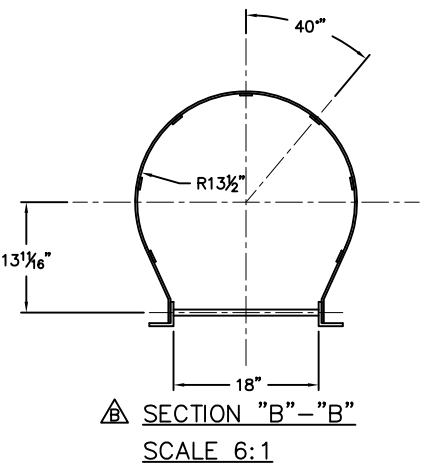
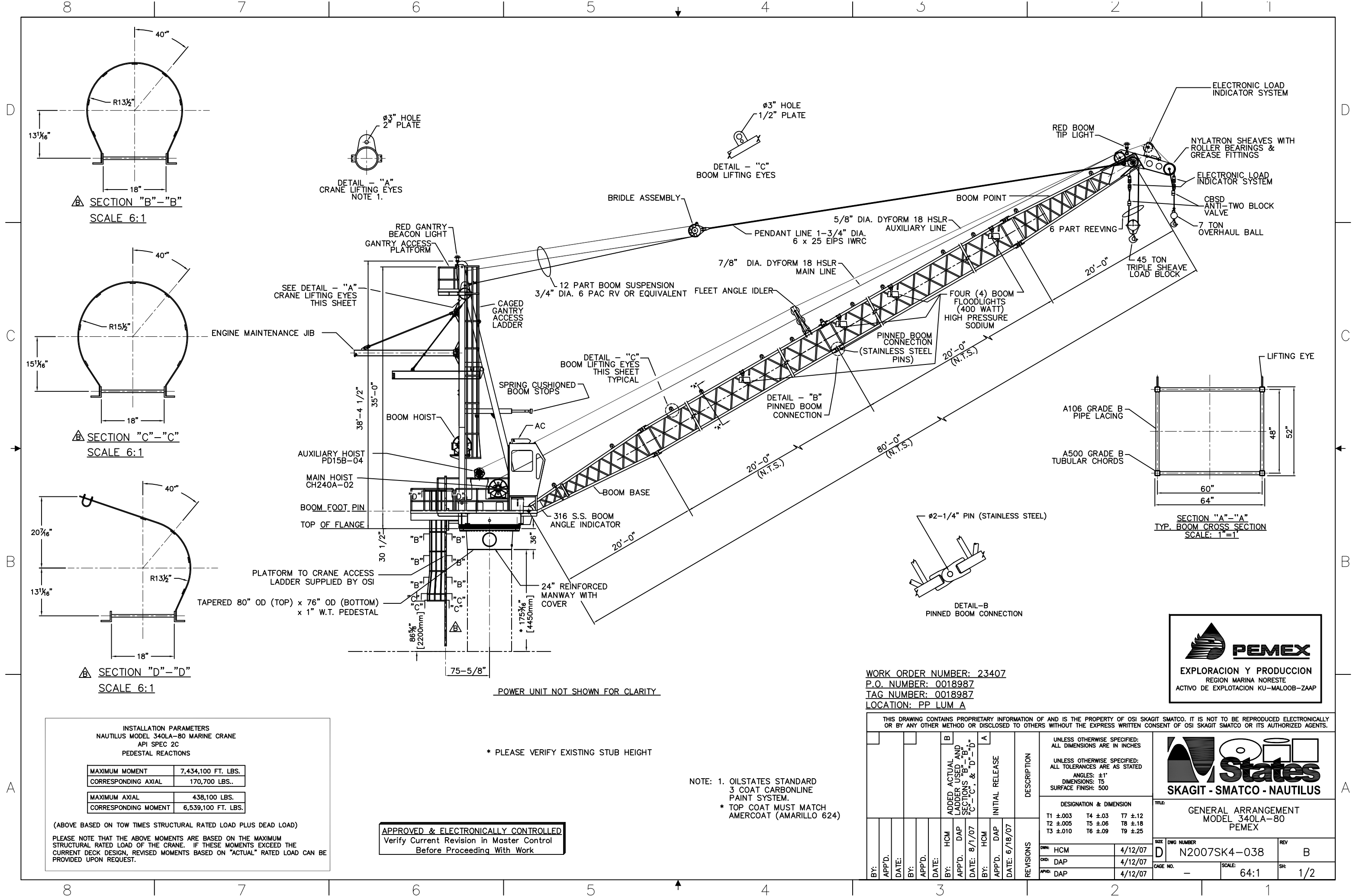
### Section 5.4 Crane General Arrangement N2007SK4-038



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INSTALLATION PARAMETERS  
NAUTILUS MODEL 340LA-80 MARINE CRANE  
API SPEC 2C  
PEDESTAL REACTIONS

MAXIMUM MOMENT	7,434,100 FT. LBS.
CORRESPONDING AXIAL	170,700 LBS.
MAXIMUM AXIAL	438,100 LBS.
CORRESPONDING MOMENT	6,539,100 FT. LBS.

(ABOVE BASED ON TOW TIMES STRUCTURAL RATED LOAD PLUS DEAD LOAD)

PLEASE NOTE THAT THE ABOVE MOMENTS ARE BASED ON THE MAXIMUM STRUCTURAL RATED LOAD OF THE CRANE. IF THESE MOMENTS EXCEED THE CURRENT DECK DESIGN, REVISED MOMENTS BASED ON "ACTUAL" RATED LOAD CAN BE PROVIDED UPON REQUEST.

APPROVED & ELECTRONICALLY CONTROLLED  
Verify Current Revision in Master Control  
Before Proceeding With Work

NOTE: 1. OILSTATES STANDARD  
3 COAT CARBONLINE  
PAINT SYSTEM.  
\* TOP COAT MUST MATCH  
AMERCOAT (AMARILLO 624)

WORK ORDER NUMBER: 23407  
P.O. NUMBER: 0018987  
TAG NUMBER: 0018987  
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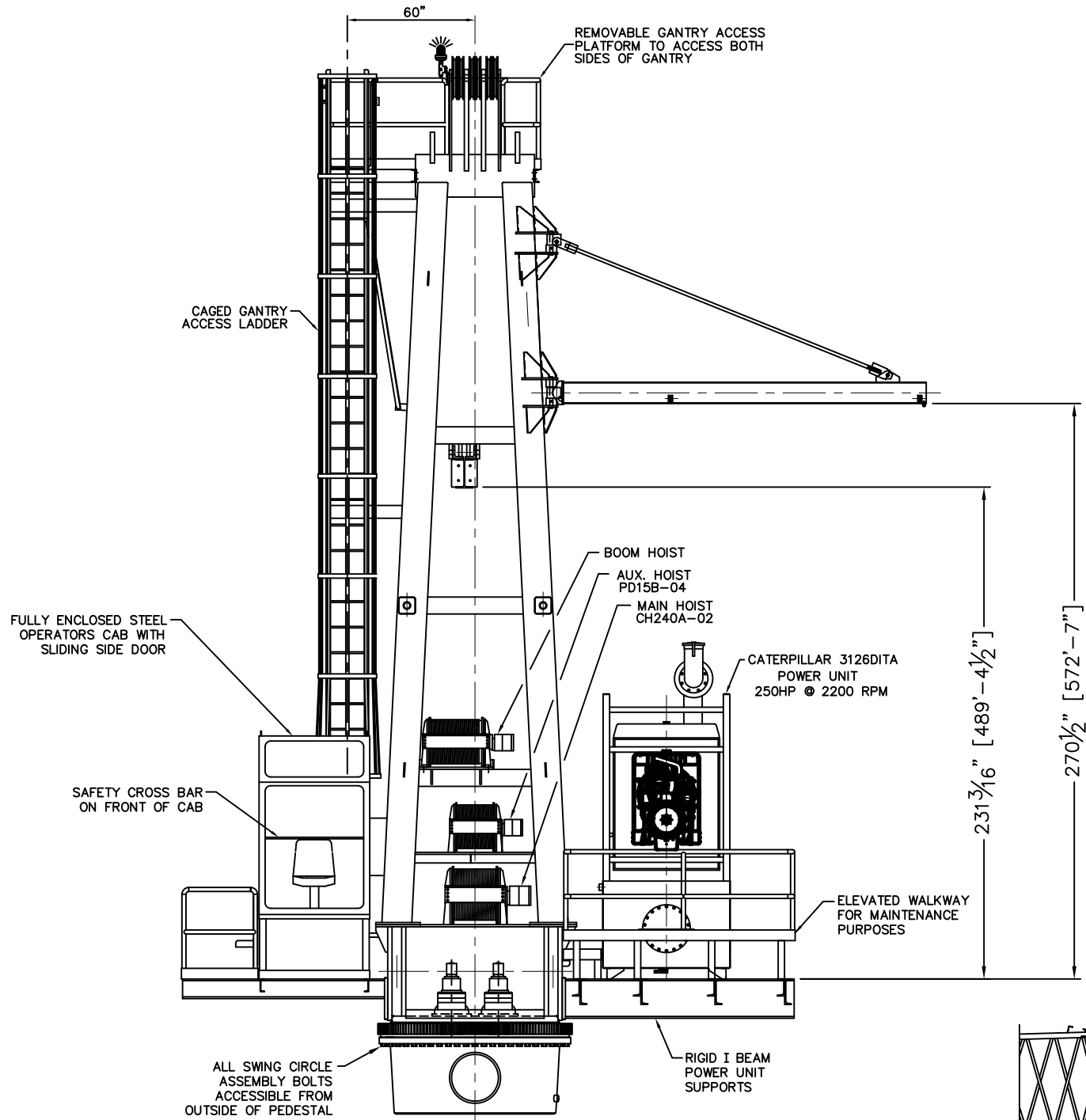
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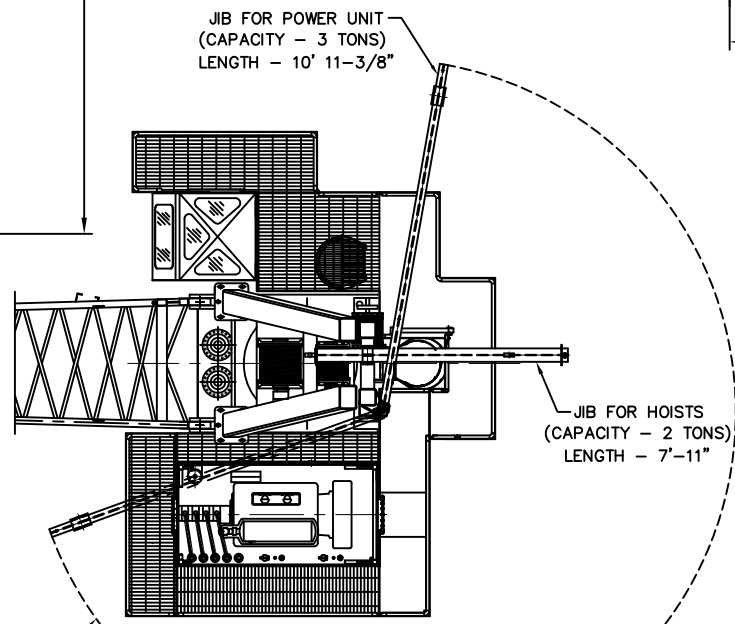
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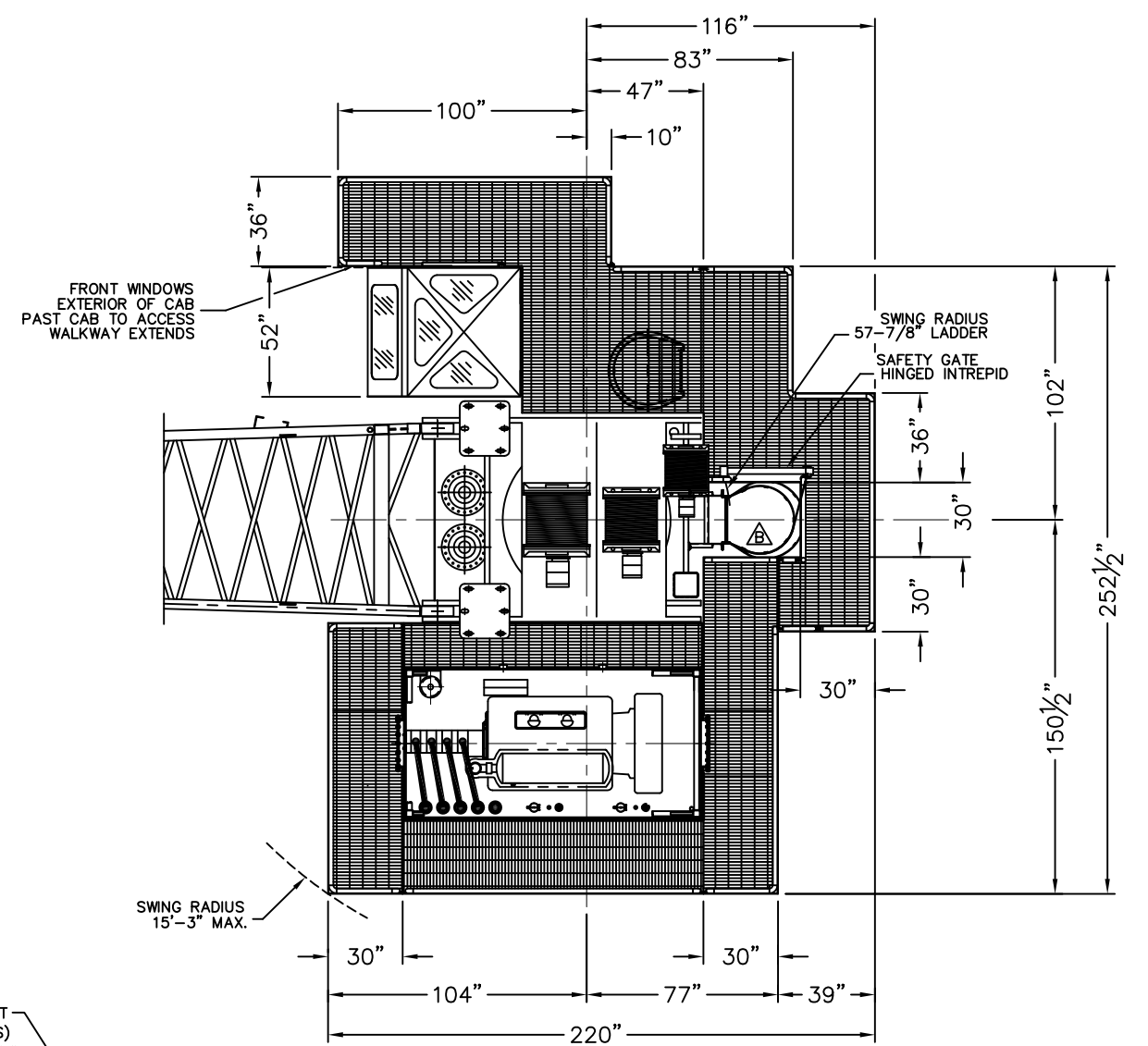


FRONT ELEVATION  
(BOOM NOT SHOWN)

APPROVED & ELECTRONICALLY CONTROLLED  
Verify Current Revision in Master Control  
Before Proceeding With Work



PLAN VIEW  
JIB #1 SWING



PLAN VIEW  
(GANTRY NOT SHOWN FOR CLARITY)

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TAG NUMBER: 0018987  
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UNLESS OTHERWISE SPECIFIED:  
ALL DIMENSIONS ARE IN INCHES  
  
UNLESS OTHERWISE SPECIFIED:  
ALL TOLERANCES ARE AS STATED  
ANGLES:  
DIMENSIONS:  
SURFACE FINISH:



DESIGNATION & DIMENSION  
T1 ±.003 T4 ±.03 T7 ±.12  
T2 ±.005 T5 ±.06 T8 ±.18  
T3 ±.010 T6 ±.09 T9 ±.25

TITLE:  
GENERAL ARRANGEMENT  
MODEL 340LA-80  
PEMEX

DWG: HCM 4/12/07  
CHK: DAP 4/12/07  
APP: DAP 4/12/07

SIZE DWG NUMBER REV  
D N2007SK4-038 B  
CAGE NO. 32:1 SCALE: 32:1 SH: 2/2





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## Nautilus Crane Model 340LA-80

### Section 5.5 Power Unit General Arrangement N2007SK4-037



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1. HYDRAULIC RESERVOIR CAPACITY: 550 gal.
2. FUEL RESERVOIR CAPACITY: 275 gal.
3. ENGINE GAUGE AND CONTROL PANEL IS LOCATED IN OPERATORS CAB.
4. SPILL CONTAINMENT DRAINS INTO PEDESTAL INTERIOR.
5. ENGINE EQUIPPED WITH AUTOMATIC SHUTDOWN SYSTEM FOR HIGH WATER TEMPERATURE, LOW OIL PRESSURE, AND OVERSPEED.
6. HOOD AND SIDE PANELS PROVIDED, BUT NOT SHOWN.

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## Nautilus Crane Model 340LA-80

### Section 5.6 Hydraulic Schematic N2007SK1-137

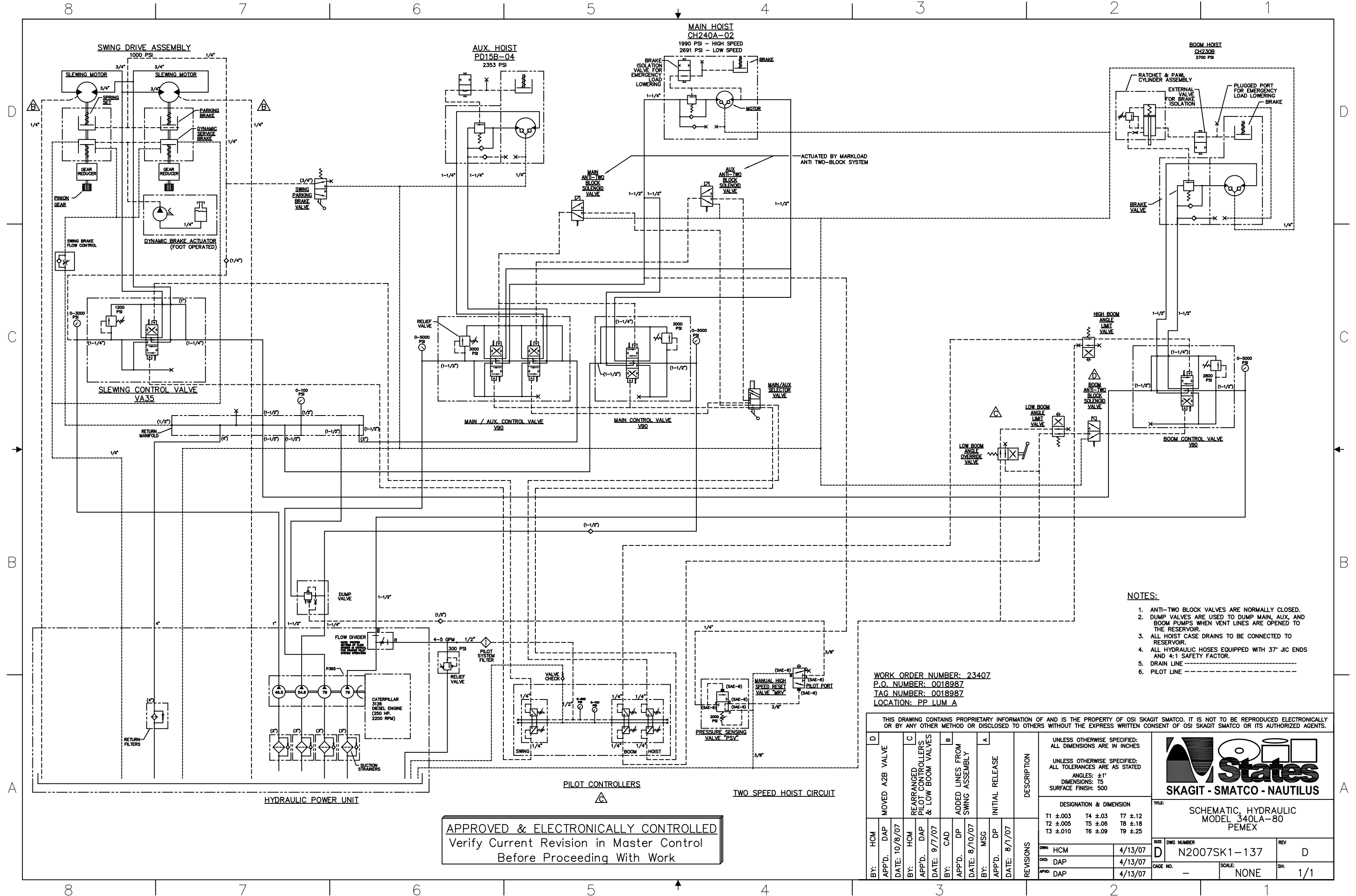


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- NOTES:
- 1. ANTI-TWO BLOCK VALVES ARE NORMALLY CLOSED.
  - 2. DUMP VALVES ARE USED TO DUMP MAIN, AUX, AND BOOM PUMPS WHEN VENT LINES ARE OPENED TO THE RESERVOIR.
  - 3. ALL HOIST CASE DRAINS TO BE CONNECTED TO RESERVOIR.
  - 4. ALL HYDRAULIC HOSES EQUIPPED WITH 37" JIC ENDS AND 4:1 SAFETY FACTOR.
  - 5. DRAIN LINE
  - 6. PILOT LINE

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D	MOVED A2B VALVE		C	REARRANGED PILOT CONTROLLERS & LOW BOOM VALVES		B	ADDED LINES FROM SWING ASSEMBLY		A	INITIAL RELEASE		DESCRIPTION	UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS ARE IN INCHES  UNLESS OTHERWISE SPECIFIED: ALL TOLERANCES ARE AS STATED  ANGLES: ±1° DIMENSIONS: T5 SURFACE FINISH: 500			 SKAGIT - SMATCO - NAUTILUS		
DESIGNATION & DIMENSION																		
T1 ±.003    T4 ±.03    T7 ±.12 T2 ±.005    T5 ±.06    T8 ±.18 T3 ±.010    T6 ±.09    T9 ±.25																		
BY: HCM	APP'D: DAP	DATE: 10/8/07	BY: HCM	APP'D: DAP	DATE: 9/7/07	BY: CAD	APP'D: DP	DATE: 8/10/07	BY: MSG	APP'D: DP	DATE: 8/1/07	REVISIONS	TITLE: SCHEMATIC, HYDRAULIC MODEL 340LA-80 PEMEX					
DWG: HCM    4/13/07													SIZE: D	DWG NUMBER: N2007SK1-137	REV: D			
CDD: DAP    4/13/07													CAGE NO.: -	SCALE: NONE	SH: 1/1			
APP'D: DAP    4/13/07																		





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## Nautilus Crane Model 340LA-80

### Section 5.7 AC Electrical Schematic N2007SK1-135



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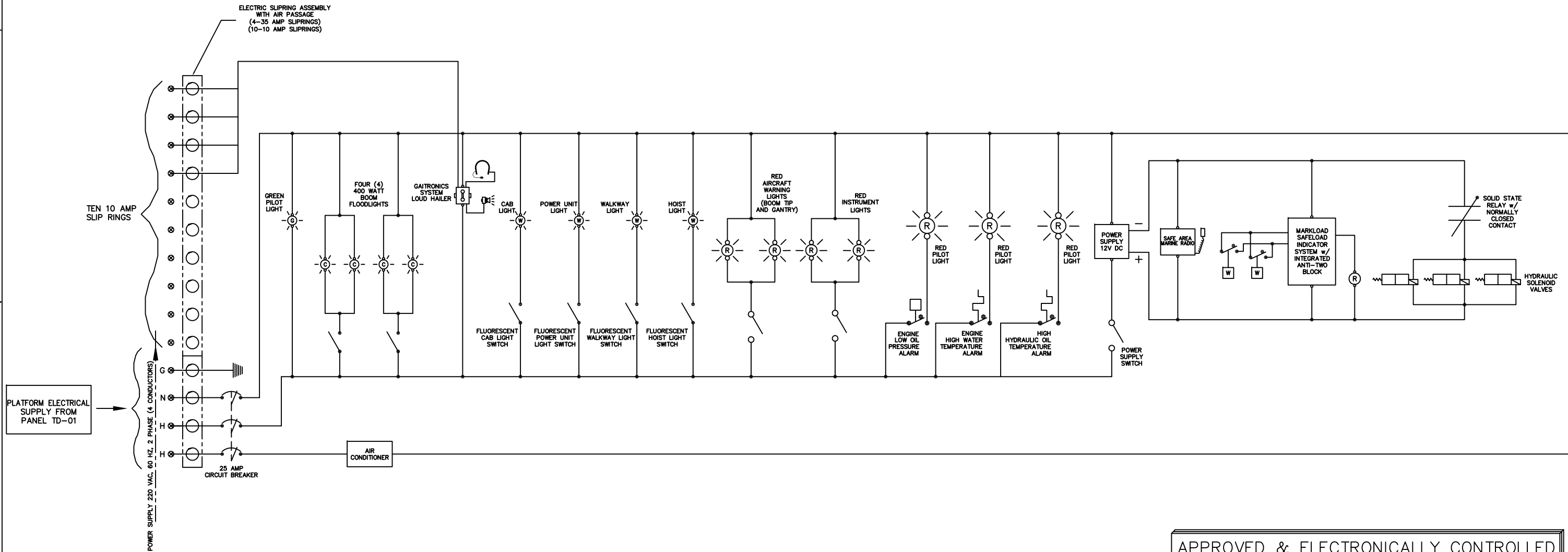
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- NOTES:
1. POWER SUPPLY 220 VAC, 60 HZ, 2 PHASE (4 CONDUCTORS).
  2. THE ELECTRICAL SYSTEM IS DESIGNED FOR A MARINE DUTY CLASS 1, DIVISION 2, GROUP D AREA, EXCEPT THE MARINE RADIO WHICH IS A SAFE AREA DEVICE.
  3. ARMORED MARINE SHIPBOARD CABLE UTILIZED.

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P.O. NUMBER: 0018987  
TAG NO: 0018987  
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Verify Current Revision in Master Control  
Before Proceeding With Work

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BY:	APP'D.	DATE:	BY:	APP'D.	DATE:	BY:	APP'D.	DATE:	BY:	CAD	INITIAL RELEASE		DESCRIPTION	UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS ARE IN INCHES			 SKAGIT - SMATCO - NAUTILUS																				
										DAP					UNLESS OTHERWISE SPECIFIED: ALL TOLERANCES ARE AS STATED  ANGLES: ±1° DIMENSIONS: T5 SURFACE FINISH: 500																						
															DESIGNATION & DIMENSION T1 ±.003    T4 ±.03    T7 ±.12 T2 ±.005    T5 ±.06    T8 ±.18 T3 ±.010    T6 ±.09    T9 ±.25																						
DATE: 10/29/07													REVISIONS	TITLE:  SCHEMATIC, AC ELECTRICAL, MODEL 340LA-80 PEMEX																							
														DWG:	HCM				4/13/07				SIZE	DWG NUMBER D    N2007SK1-135				REV	A								
														COD:	DAP				4/13/07				CAGE NO.	-				SCALE:	NONE				SH:	1/1			
														APP'D:	DAP				4/13/07																		





PEMEX – PP LUM A  
Project

ImXport Services Corp.

# Vendor Data Book

P.O. # 0018987

Serial # 23407C

Volume: 1

## Nautilus Crane Model 340LA-80

### Section 5.8 AC Electrical Diagram N2007SK1-213

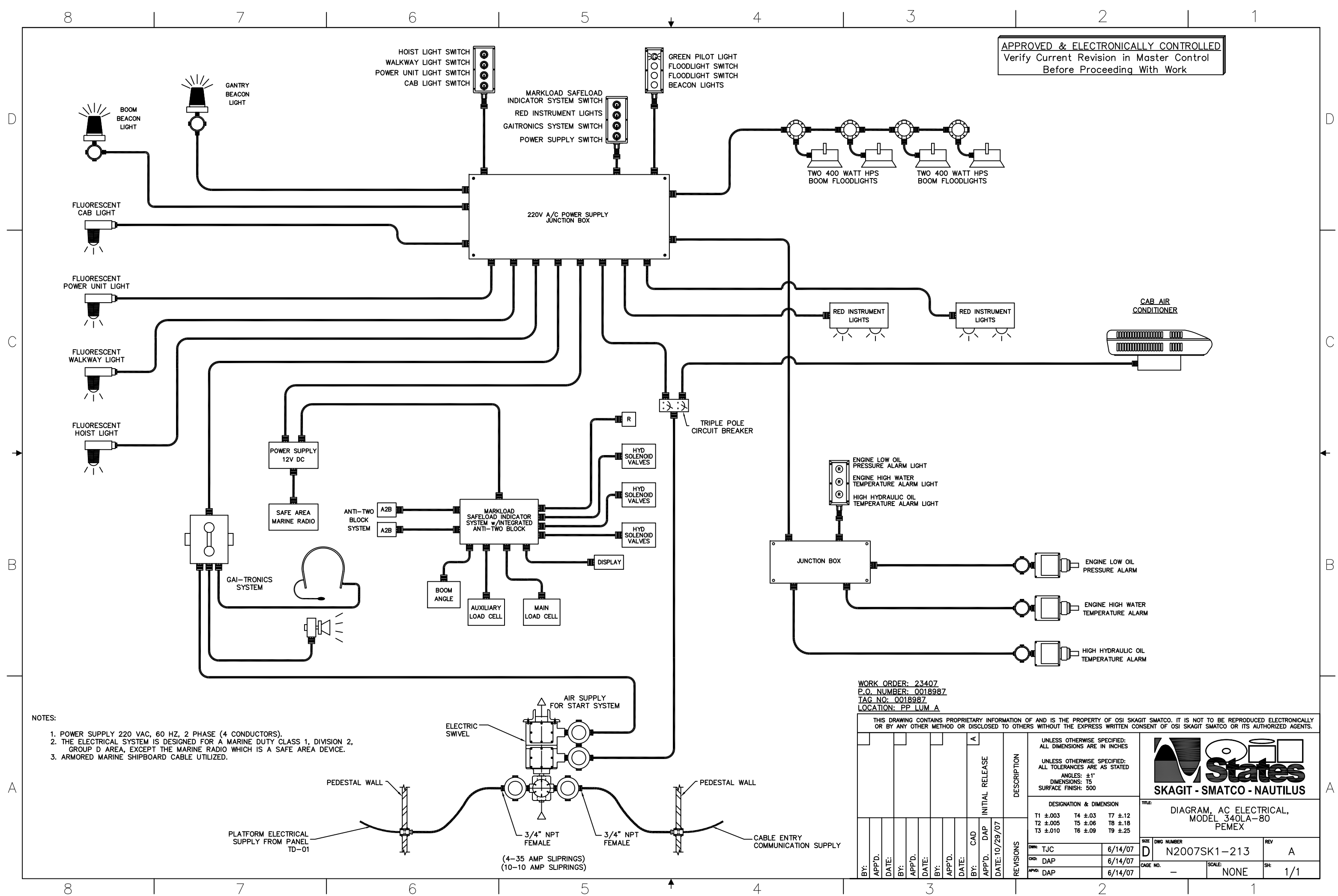


SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA













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# Vendor Data Book

P.O. # 0018987  
Serial # 23407C  
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## Nautilus Crane Model 340LA-80

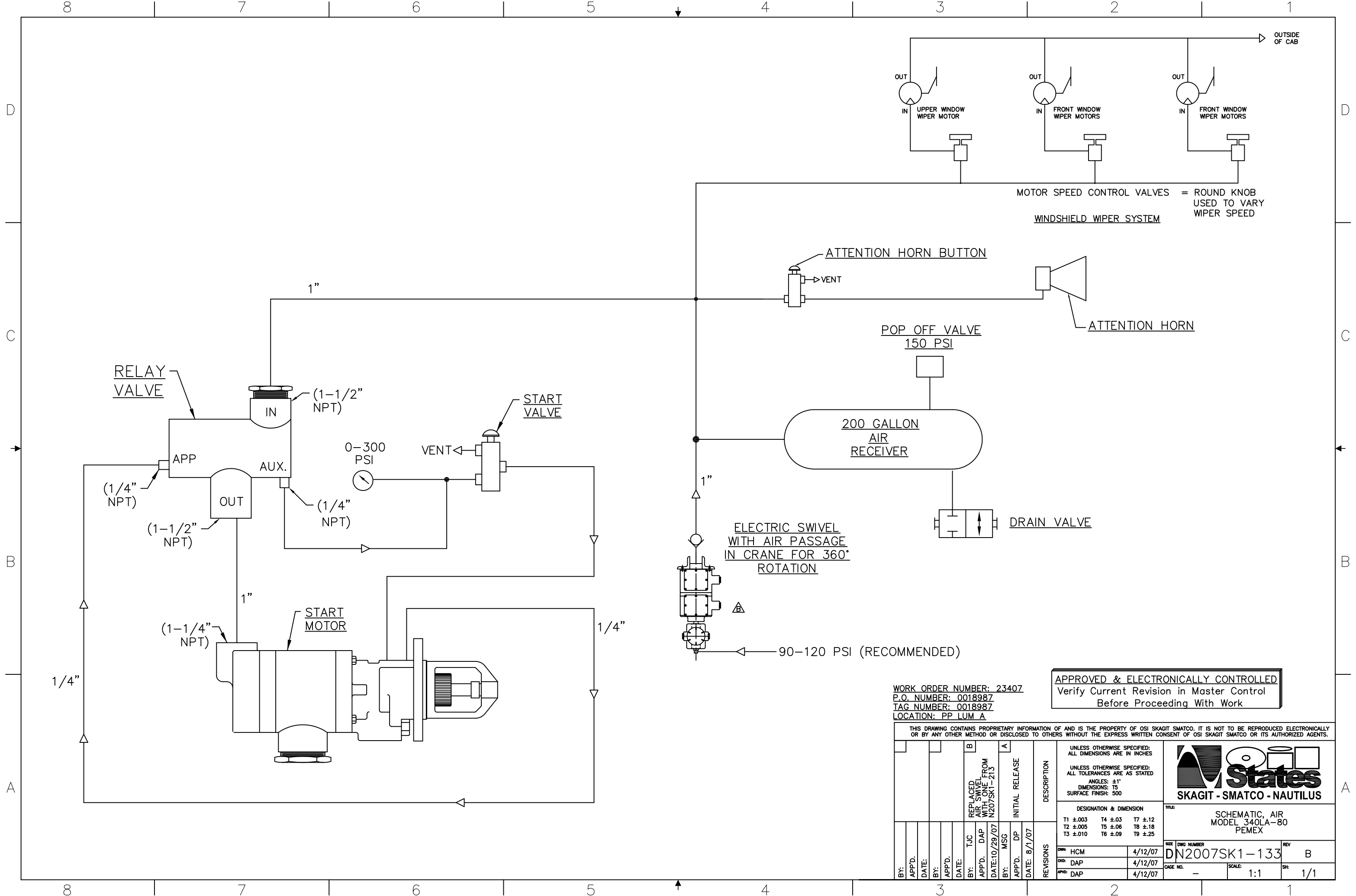
### Section 5.9 Air Schematic N2007SK1-133



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USA







WORK ORDER NUMBER: 23407  
P.O. NUMBER: 0018987  
TAG NUMBER: 0018987  
LOCATION: PP LUM A

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Verify Current Revision in Master Control  
Before Proceeding With Work

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BY:			DATE:			BY:			DATE:		
APP'D:			DATE:			BY:			DATE:		
TJC			DAP			MSG			DP		
DATE: 10/29/07			DATE: 8/1/07			DATE: 8/1/07			DATE: 8/1/07		
REPLACED AIR SWIVEL WITH ONE FROM N207SK1-213			INITIAL RELEASE			DESCRIPTION			UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED: ALL TOLERANCES ARE AS STATED ANGLES: ±1° DIMENSIONS: T5 SURFACE FINISH: 500		
DESIGNATION & DIMENSION			T1 ±.003			T4 ±.03			T7 ±.12		
T2 ±.005			T5 ±.06			T8 ±.18			T9 ±.25		
T3 ±.010			T6 ±.09			T8 ±.18			T9 ±.25		
DWR: HCM			4/12/07			DAP			4/12/07		
APVD: DAP			4/12/07			CAGE NO.			SCALE: 1:1		
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APP'D:			DATE:			BY:			DATE:		
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DATE: 10/29/07			DATE: 8/1/07			DATE: 8/1/07			DATE: 8/1/07		
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APVD: DAP			4/12/07			CAGE NO.			SCALE: 1:1		
APVD: DAP			4/12/07			REV			SH: 1/1		



SCHEMATIC, AIR  
MODEL 340LA-80  
PEMEX

SIZE: 1/2" x 1/2" DWG NUMBER: DN2007SK1-133 REV: B  
CAGE NO.: - SCALE: 1:1 SH: 1/1





PEMEX – PP LUM A  
Project

ImXport Services Corp.

# Vendor Data Book

P.O. # 0018987

Serial # 23407C

Volume: 1

## Nautilus Crane Model 340LA-80

### Section 5.10 Engine Operations & Maintenance Manual



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA







# Operation and Maintenance Manual

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## **3114, 3116 and 3126 Industrial and Generator Set Engines**

---

5EF1-Up (Engine)  
6AF1-Up (Engine)  
1ZG1-Up (Engine)  
2SG1-Up (Engine)  
2WG1-Up (Engine)  
4PG1-Up (Engine)  
5JG1-Up (Engine)  
1NJ1-Up (Engine)  
CKK1-Up (Engine)  
5EN1-Up (Engine)  
2MR1-Up (Engine)  
4KR1-Up (Engine)  
9ZR1-Up (Engine)  
6MS1-Up (Engine)

## Important Safety Information

Most accidents that involve product operation, maintenance and repair are caused by failure to observe basic safety rules or precautions. An accident can often be avoided by recognizing potentially hazardous situations before an accident occurs. A person must be alert to potential hazards. This person should also have the necessary training, skills and tools to perform these functions properly.

**Improper operation, lubrication, maintenance or repair of this product can be dangerous and could result in injury or death.**

**Do not operate or perform any lubrication, maintenance or repair on this product, until you have read and understood the operation, lubrication, maintenance and repair information.**

Safety precautions and warnings are provided in this manual and on the product. If these hazard warnings are not heeded, bodily injury or death could occur to you or to other persons.

The hazards are identified by the "Safety Alert Symbol" and followed by a "Signal Word" such as "DANGER", "WARNING" or "CAUTION". The Safety Alert "WARNING" label is shown below.



The meaning of this safety alert symbol is as follows:

**Attention! Become Alert! Your Safety is Involved.**

The message that appears under the warning explains the hazard and can be either written or pictorially presented.

Operations that may cause product damage are identified by "NOTICE" labels on the product and in this publication.

**Caterpillar cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this publication and on the product are, therefore, not all inclusive. If a tool, procedure, work method or operating technique that is not specifically recommended by Caterpillar is used, you must satisfy yourself that it is safe for you and for others. You should also ensure that the product will not be damaged or be made unsafe by the operation, lubrication, maintenance or repair procedures that you choose.**

The information, specifications, and illustrations in this publication are on the basis of information that was available at the time that the publication was written. The specifications, torques, pressures, measurements, adjustments, illustrations, and other items can change at any time. These changes can affect the service that is given to the product. Obtain the complete and most current information before you start any job. Caterpillar dealers have the most current information available. For a list of the most current publication form numbers available, see the Service Manual Contents Microfiche, REG1139F.



**When replacement parts are required for this product Caterpillar recommends using Caterpillar replacement parts or parts with equivalent specifications including, but not limited to, physical dimensions, type, strength and material.**

**Failure to heed this warning can lead to premature failures, product damage, personal injury or death.**

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## Foreword

### Literature Information

This manual contains safety, operation instructions, lubrication and maintenance information. This manual should be stored in or near the engine area in a literature holder or literature storage area. Read, study and keep it with the literature and engine information.

English is the primary language for all Caterpillar publications. The English used facilitates translation and consistency in electronic media delivery.

Some photographs or illustrations in this manual show details or attachments that may be different from your engine. Guards and covers may have been removed for illustrative purposes. Continuing improvement and advancement of product design may have caused changes to your engine which are not included in this manual. Whenever a question arises regarding your engine, or this manual, please consult with your Caterpillar dealer for the latest available information.

### Safety

This safety section lists basic safety precautions. In addition, this section identifies hazardous, warning situations. Read and understand the basic precautions listed in the safety section before operating or performing lubrication, maintenance and repair on this product.

### Operation

Operating techniques outlined in this manual are basic. They assist with developing the skills and techniques required to operate the engine more efficiently and economically. Skill and techniques develop as the operator gains knowledge of the engine and its capabilities.

The operation section is a reference for operators. Photographs and illustrations guide the operator through procedures of inspecting, starting, operating and stopping the engine. This section also includes a discussion of electronic diagnostic information.

### Maintenance

The maintenance section is a guide to engine care. The illustrated, step-by-step instructions are grouped by fuel consumption, service hours and/or calendar time maintenance intervals. Items in the maintenance schedule are referenced to detailed instructions that follow.

Use fuel consumption or service hours to determine intervals. Calendar intervals shown (daily, annually, etc.) may be used instead of service meter intervals if they provide more convenient schedules and approximate the indicated service meter reading.

Recommended service should be performed at the appropriate intervals as indicated in the Maintenance Interval Schedule. The actual operating environment of the engine also governs the Maintenance Interval Schedule. Therefore, under extremely severe, dusty, wet or freezing cold operating conditions, more frequent lubrication and maintenance than is specified in the Maintenance Interval Schedule may be necessary.

The maintenance schedule items are organized for a preventive maintenance management program. If the preventive maintenance program is followed, a periodic tune-up is not required. The implementation of a preventive maintenance management program should minimize operating costs through cost avoidances resulting from reductions in unscheduled downtime and failures.

### Maintenance Intervals

Perform maintenance on items at multiples of the original requirement. Each level and/or individual items in each level should be shifted ahead or back depending upon your specific maintenance practices, operation and application. We recommend that the maintenance schedules be reproduced and displayed near the engine as a convenient reminder. We also recommend that a maintenance record be maintained as part of the engine's permanent record.

See the section in the Operation and Maintenance Manual, "Maintenance Records" for information regarding documents that are generally accepted as proof of maintenance or repair. Your authorized Caterpillar dealer can assist you in adjusting your maintenance schedule to meet the needs of your operating environment.

### Overhaul

Major engine overhaul details are not covered in the Operation and Maintenance Manual except for the interval and the maintenance items in that interval. Major repairs are best left to trained personnel or an authorized Caterpillar dealer. Your Caterpillar dealer offers a variety of options regarding overhaul programs. If you experience a major engine failure, there are also numerous after failure overhaul options available from your Caterpillar dealer. Consult with your dealer for information regarding these options.

## California Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

Battery posts, terminals and related accessories contain lead and lead compounds. **Wash hands after handling.**

## Safety Section

### Safety Signs and Labels

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**SMCS Code:** 1000; 7405

There may be several specific warning signs on an engine. The exact location of the hazards and the description of the hazards are reviewed in this section. Please become familiar with all warning signs.

Ensure that all of the warning signs are legible. Clean the warning signs or replace the warning signs if the words cannot be read or if the pictures are not visible. When the warning signs are cleaned, use a cloth, water, and soap. Do not use solvent, gasoline, or other harsh chemicals to clean the warning signs. Solvents, gasoline, or harsh chemicals could loosen the adhesive that secures the warning signs. The warning signs that are loosened could drop off of the engine.

Replace any damaged warning signs or missing warning signs. If a warning sign is attached to a part of the engine that is replaced, install a new warning sign on the replacement part. Any Caterpillar dealer can provide new warning signs.

Do not work on the engine and do not operate the engine unless the instructions and warnings in the Operation and Maintenance Manual are understood. Proper care is your responsibility. Failure to follow the instructions or failure to heed the warnings could result in injury or in death.

The warning labels that may be found on the engine are illustrated and described.

### Ether

The warning label for ether is located on the top, the front, the rear, or the side of the engine.



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Do not spray starting aids such as ether into the air inlet. Such use could result in an explosion and personal injury.

## Clutch

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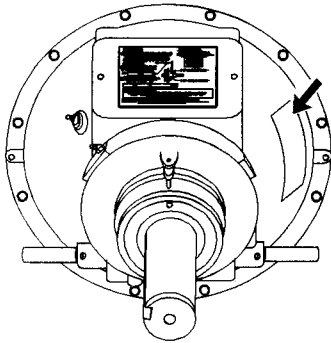
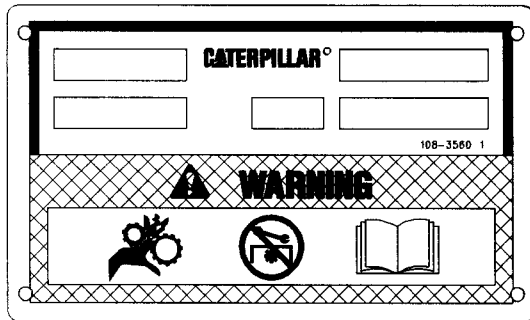


Illustration 1

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The warning label for the clutch is located on the clutch housing (if equipped).



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Rotating gears can cause entanglement of fingers or entanglement of hands. Do not service this component without first reading the operator manual.

## General Hazard Information

**SMCS Code:** 1000; 7405

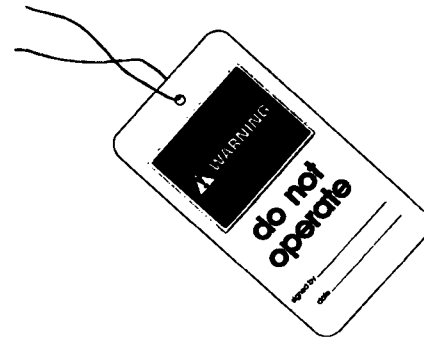


Illustration 2

g00104545

Attach a "Do Not Operate" warning tag or a similar warning tag to the start switch or to the controls before the engine is serviced or before the engine is repaired. These warning tags (Special Instruction, SEHS7332) are available from your Caterpillar dealer. Attach the warning tags to the engine and to each operator control station. When it is appropriate, disconnect the starting controls.

Do not allow unauthorized personnel on the engine, or around the engine when the engine is being serviced.

Engine exhaust contains products of combustion which may be harmful to your health. Always start the engine and operate the engine in a well ventilated area. If the engine is in an enclosed area, vent the engine exhaust to the outside.

Cautiously remove the following parts. To help prevent spraying or splashing of pressurized fluids, hold a rag over the part that is being removed.

- Filler caps
- Grease fittings
- Pressure taps
- Breathers
- Drain plugs

Use caution when cover plates are removed. Gradually loosen, but do not remove the last two bolts or nuts that are located at opposite ends of the cover plate or the device. Before removing the last two bolts or nuts, pry the cover loose in order to relieve any spring pressure or other pressure.

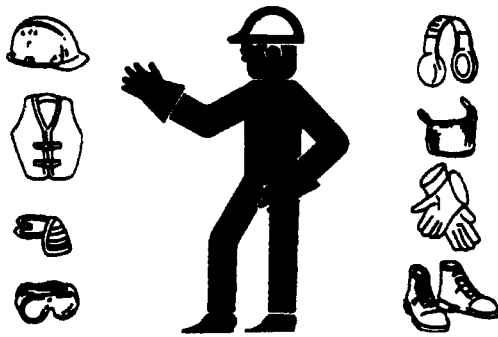


Illustration 3

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- Wear a hard hat, protective glasses, and other protective equipment, as required.
- When work is performed around an engine that is operating, wear protective devices for ears in order to help prevent damage to hearing.
- Do not wear loose clothing or jewelry that can snag on controls or on other parts of the engine.
- Ensure that all protective guards and all covers are secured in place on the engine.
- Never put maintenance fluids into glass containers. Glass containers can break.
- Use all cleaning solutions with care.
- Report all necessary repairs.

**Unless other instructions are provided, perform the maintenance under the following conditions:**

- The engine is stopped. Ensure that the engine cannot be started.
- Disconnect the batteries when maintenance is performed or when the electrical system is serviced. Disconnect the battery ground leads. Tape the leads in order to help prevent sparks.
- Do not attempt any repairs that are not understood. Use the proper tools. Replace any equipment that is damaged or repair the equipment.

## Pressure Air and Water

Pressurized air and/or water can cause debris and/or hot water to be blown out. This could result in personal injury.

When pressure air and/or pressure water is used for cleaning, wear protective clothing, protective shoes, and eye protection. Eye protection includes goggles or a protective face shield.

The maximum air pressure for cleaning purposes must be below 205 kPa (30 psi). The maximum water pressure for cleaning purposes must be below 275 kPa (40 psi).

## Fluid Penetration

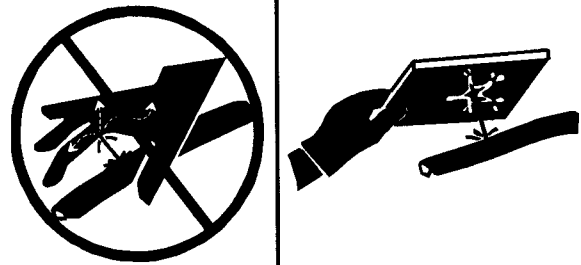


Illustration 4

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Always use a board or cardboard when you check for a leak. Leaking fluid that is under pressure can penetrate body tissue. Fluid penetration can cause serious injury and possible death. A pin hole leak can cause severe injury. If fluid is injected into your skin, you must get treatment immediately. Seek treatment from a doctor that is familiar with this type of injury.

## Containing Fluid Spillage

Care must be taken in order to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the engine. Prepare to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, NENG2500, "Tools and Shop Products Guide" for the following items:

- Tools that are suitable for collecting fluids and equipment that is suitable for collecting fluids
- Tools that are suitable for containing fluids and equipment that is suitable for containing fluids

Obey all local regulations for the disposal of liquids.



## Asbestos Information

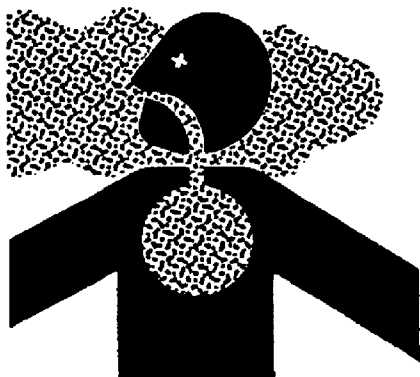


Illustration 5

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Caterpillar equipment and replacement parts that are shipped from Caterpillar are asbestos free. Caterpillar recommends the use of only genuine Caterpillar replacement parts. Use the following guidelines when you handle any replacement parts that contain asbestos or when you handle asbestos debris.

Use caution. Avoid inhaling dust that might be generated when you handle components that contain asbestos fibers. Inhaling this dust can be hazardous to your health. The components that may contain asbestos fibers are brake pads, brake bands, lining material, clutch plates, and some gaskets. The asbestos that is used in these components is usually bound in a resin or sealed in some way. Normal handling is not hazardous unless airborne dust that contains asbestos is generated.

If dust that may contain asbestos is present, there are several guidelines that should be followed:

- Never use compressed air for cleaning.
- Avoid brushing materials that contain asbestos.
- Avoid grinding materials that contain asbestos.
- Use a wet method in order to clean up asbestos materials.
- A vacuum cleaner that is equipped with a high efficiency particulate air filter (HEPA) can also be used.
- Use exhaust ventilation on permanent machining jobs.
- Wear an approved respirator if there is no other way to control the dust.

- Comply with applicable rules and regulations for the work place. In the United States, use Occupational Safety and Health Administration (OSHA) requirements. These OSHA requirements can be found in "29 CFR 1910.1001".
- Obey environmental regulations for the disposal of asbestos.
- Stay away from areas that might have asbestos particles in the air.

## Dispose of Waste Properly

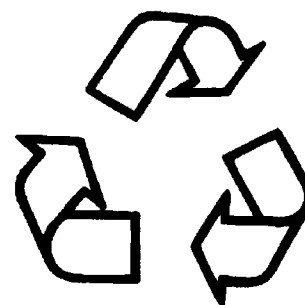


Illustration 6

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Improperly disposing of waste can threaten the environment. Potentially harmful fluids should be disposed of according to local regulations.

Always use leakproof containers when you drain fluids. Do not pour waste onto the ground, down a drain, or into any source of water.

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## Burn Prevention

**SMCS Code:** 1000; 7405

Do not touch any part of an operating engine. Allow the engine to cool before any maintenance is performed on the engine. Relieve all pressure in the air system, in the hydraulic system, in the lubrication system, in the fuel system, or in the cooling system before any lines, fittings or related items are disconnected.

### Coolant

When the engine is at operating temperature, the engine coolant is hot. The coolant is also under pressure. The radiator and all lines to the heaters or to the engine contain hot coolant.

Any contact with hot coolant or with steam can cause severe burns. Allow cooling system components to cool before the cooling system is drained.

Check the coolant level after the engine has stopped and the engine has been allowed to cool.

Ensure that the filler cap is cool before removing the filler cap. The filler cap must be cool enough to touch with a bare hand. Remove the filler cap slowly in order to relieve pressure.

Cooling system conditioner contains alkali. Alkali can cause personal injury. Do not allow alkali to contact the skin, the eyes, or the mouth.

## Oils

Hot oil and hot lubricating components can cause personal injury. Do not allow hot oil to contact the skin. Also, do not allow hot components to contact the skin.

## Batteries

Electrolyte is an acid. Electrolyte can cause personal injury. Do not allow electrolyte to contact the skin or the eyes. Always wear protective glasses for servicing batteries. Wash hands after touching the batteries and connectors. Use of gloves is recommended.

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# Fire Prevention and Explosion Prevention

**SMCS Code:** 1000; 7405

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Illustration 7

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All fuels, most lubricants, and some coolant mixtures are flammable.

Flammable fluids that are leaking or spilled onto hot surfaces or onto electrical components can cause a fire. Fire may cause personal injury and property damage.

A flash fire may result if the covers for the engine crankcase are removed within fifteen minutes after an emergency shutdown.

Determine whether the engine will be operated in an environment that allows combustible gases to be drawn into the air inlet system. These gases could cause the engine to overspeed. Personal injury, property damage, or engine damage could result.

If the application involves the presence of combustible gases, consult your Caterpillar dealer for additional information about suitable protection devices.

Remove all flammable materials such as fuel, oil, and debris from the engine. Do not allow any flammable materials to accumulate on the engine.

Store fuels and lubricants in properly marked containers away from unauthorized persons. Store oily rags and any flammable materials in protective containers. Do not smoke in areas that are used for storing flammable materials.

Do not expose the engine to any flame.

Exhaust shields (if equipped) protect hot exhaust components from oil or fuel spray in case of a line, a tube, or a seal failure. Exhaust shields must be installed correctly.

Do not weld on lines or tanks that contain flammable fluids. Do not flame cut lines or tanks that contain flammable fluid. Clean any such lines or tanks thoroughly with a nonflammable solvent prior to welding or flame cutting.

Wiring must be kept in good condition. All electrical wires must be properly routed and securely attached. Check all electrical wires daily. Repair any wires that are loose or frayed before you operate the engine. Clean all electrical connections and tighten all electrical connections.

Eliminate all wiring that is unattached or unnecessary. Do not use any wires or cables that are smaller than the recommended gauge. Do not bypass any fuses and/or circuit breakers.

Arcing or sparking could cause a fire. Secure connections, recommended wiring, and properly maintained battery cables will help to prevent arcing or sparking.

Inspect all lines and hoses for wear or for deterioration. The hoses must be properly routed. The lines and hoses must have adequate support and secure clamps. Tighten all connections to the recommended torque. Leaks can cause fires.

Oil filters and fuel filters must be properly installed. The filter housings must be tightened to the proper torque.



Illustration 8

g00704059

Use caution when you are refueling an engine. Do not smoke while you are refueling an engine. Do not refuel an engine near open flames or sparks. Always stop the engine before refueling.

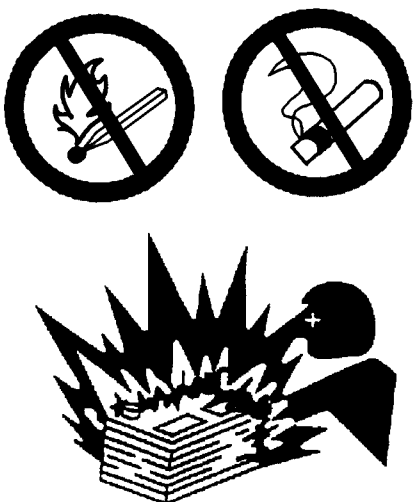


Illustration 9

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Gases from a battery can explode. Keep any open flames or sparks away from the top of a battery. Do not smoke in battery charging areas.

Never check the battery charge by placing a metal object across the terminal posts. Use a voltmeter or a hydrometer.

Improper jumper cable connections can cause an explosion that can result in injury. Refer to the Operation Section of this manual for specific instructions.

Do not charge a frozen battery. This may cause an explosion.

The batteries must be kept clean. The covers (if equipped) must be kept on the cells. Use the recommended cables, connections, and battery box covers when the engine is operated.

## Fire Extinguisher

Make sure that a fire extinguisher is available. Be familiar with the operation of the fire extinguisher. Inspect the fire extinguisher and service the fire extinguisher regularly. Obey the recommendations on the instruction plate.

## Ether

Ether is flammable and poisonous.

Use ether in well ventilated areas. Do not smoke while you are replacing an ether cylinder or while you are using an ether spray.

Do not store ether cylinders in living areas or in the engine compartment. Do not store ether cylinders in direct sunlight or in temperatures above 49 °C (120 °F). Keep ether cylinders away from open flames or sparks.

Dispose of used ether cylinders properly. Do not puncture an ether cylinder. Keep ether cylinders away from unauthorized personnel.

Do not spray ether into an engine if the engine is equipped with a thermal starting aid for cold weather starting.

## Lines, Tubes and Hoses

Do not bend high pressure lines. Do not strike high pressure lines. Do not install any lines that are bent or damaged.

Repair any lines that are loose or damaged. Leaks can cause fires. Consult your Caterpillar dealer for repair or for replacement parts.

Check lines, tubes and hoses carefully. Do not use your bare hand to check for leaks. Use a board or cardboard to check for leaks. Tighten all connections to the recommended torque.

Replace the parts if any of the following conditions are present:

- End fittings are damaged or leaking.
- Outer coverings are chafed or cut.
- Wires are exposed.
- Outer coverings are ballooning.
- Flexible part of the hoses are kinked.
- Outer covers have embedded armoring.
- End fittings are displaced.

Make sure that all clamps, guards, and heat shields are installed correctly. During engine operation, this will help to prevent vibration, rubbing against other parts, and excessive heat.

i01359666

## Crushing Prevention and Cutting Prevention

**SMCS Code:** 1000; 7405

Support the component properly when work beneath the component is performed.

Unless other maintenance instructions are provided, never attempt adjustments while the engine is running.

Stay clear of all rotating parts and of all moving parts. Leave the guards in place until maintenance is performed. After the maintenance is performed, reinstall the guards.

Keep objects away from moving fan blades. The fan blades will throw objects or cut objects.

When objects are struck, wear protective glasses in order to avoid injury to the eyes.

Chips or other debris may fly off objects when objects are struck. Before objects are struck, ensure that no one will be injured by flying debris.

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## Mounting and Dismounting

**SMCS Code:** 1000; 7405

Inspect the steps, the handholds, and the work area before mounting the engine. Keep these items clean and keep these items in good repair.

Mount the engine and dismount the engine only at locations that have steps and/or handholds. Do not climb on the engine, and do not jump off the engine.

Face the engine in order to mount the engine or dismount the engine. Maintain a three-point contact with the steps and handholds. Use two feet and one hand or use one foot and two hands. Do not use any controls as handholds.

Do not stand on components which cannot support your weight. Use an adequate ladder or use a work platform. Secure the climbing equipment so that the equipment will not move.

Do not carry tools or supplies when you mount the engine or when you dismount the engine. Use a hand line to raise and lower tools or supplies.

i01421840

## Before Starting Engine

**SMCS Code:** 1000

Inspect the engine for potential hazards.

Before starting the engine, ensure that no one is on, underneath, or close to the engine. Ensure that the area is free of personnel.

Ensure that the engine is equipped with a lighting system that is suitable for the conditions. Ensure that all lights work properly.

All protective guards and all protective covers must be installed if the engine must be started in order to perform service procedures. To help prevent an accident that is caused by parts in rotation, work around the parts carefully.

Do not bypass the automatic shutoff circuits. Do not disable the automatic shutoff circuits. The circuits are provided in order to help prevent personal injury. The circuits are also provided in order to help prevent engine damage.

For the initial start-up of a new engine and for start-up of an engine that has been serviced, prepare to stop the engine if an overspeed occurs. This may be accomplished by shutting off the fuel and/or the air supply to the engine.

See the Service Manual for repairs and for adjustments.

i01103904

## Engine Starting

**SMCS Code:** 1000

If a warning tag is attached to the engine start switch or to the controls, DO NOT start the engine or move the controls. Consult with the person that attached the warning tag before the engine is started.

All protective guards and all protective covers must be installed if the engine must be started in order to perform service procedures. To help prevent an accident that is caused by parts in rotation, work around the parts carefully.

Start the engine from the operator's compartment or from the engine start switch.

Always start the engine according to the procedure that is described in this Operation and Maintenance Manual, "Engine Starting" topic (Operation Section). Knowing the correct procedure will help to prevent major damage to the engine components. Knowing the procedure will also help to prevent personal injury.

To ensure that the jacket water heater (if equipped) and/or the lube oil heater (if equipped) is working properly, check the water temperature gauge and the oil temperature gauge during the heater operation.

Engine exhaust contains products of combustion that can be harmful to your health. Always start the engine and operate the engine in a well ventilated area. If the engine is started in an enclosed area, vent the engine exhaust to the outside.

### Ether

Ether is poisonous and flammable.

Do not inhale ether, and do not allow ether to contact the skin. Personal injury could result.

Do not smoke while ether cylinders are changed.

Use ether in well ventilated areas.

Use ether with care in order to avoid fires.

Keep ether cylinders out of the reach of unauthorized persons.

Store ether cylinders in authorized storage areas only.

Do not store ether cylinders in direct sunlight or at temperatures above 49 °C (120 °F).

Discard the ether cylinders in a safe place. Do not puncture the ether cylinders. Do not burn the ether cylinders.

i01032808

## Engine Stopping

**SMCS Code:** 1000

To avoid overheating of the engine and accelerated wear of the engine components, stop the engine according to this Operation and Maintenance Manual, "Engine Stopping" topic (Operation Section).

Use the Emergency Stop Button (if equipped) ONLY in an emergency situation. DO NOT use the Emergency Stop Button for normal engine stopping. After an emergency stop, DO NOT start the engine until the problem that caused the emergency stop has been corrected.

On the initial start-up of a new engine or an engine that has been serviced, make provisions to stop the engine if an overspeed condition occurs. This may be accomplished by shutting off the fuel supply and/or the air supply to the engine.

i01481981

## Electrical System

**SMCS Code:** 1000; 1400

Never disconnect any charging unit circuit or battery circuit cable from the battery when the charging unit is operating. A spark can cause the combustible gases that are produced by some batteries to ignite.

To help prevent sparks from igniting combustible gases that are produced by some batteries, the negative "–" jump start cable should be connected last from the external power source to the negative "–" terminal of the starting motor. If the starting motor is not equipped with a negative "–" terminal, connect the jump start cable to the engine block.

Check the electrical wires daily for wires that are loose or frayed. Tighten all loose electrical wires before the engine is started. Repair all frayed electrical wires before the engine is started. See the Operation and Maintenance Manual for specific starting instructions.

## Grounding Practices

---

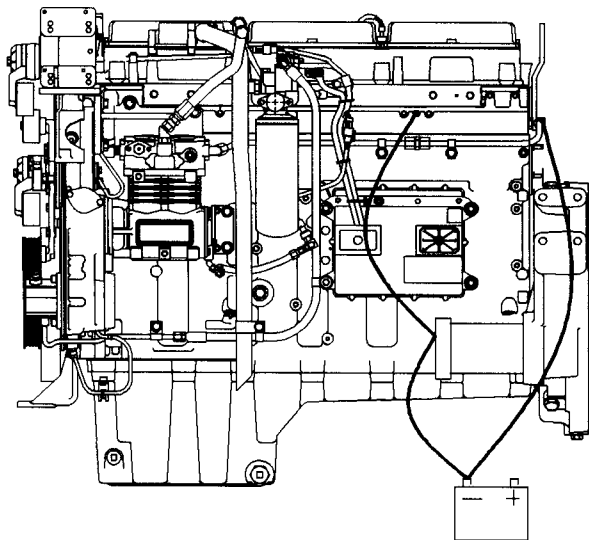


Illustration 10  
Typical example  
Grounding Stud To Battery Ground

g00771448

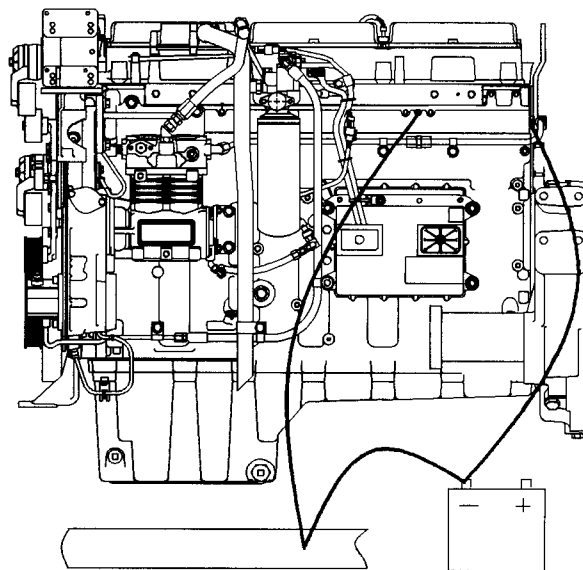


Illustration 11  
Typical example  
Alternate Grounding Stud To Battery Ground

g00771487

Proper grounding for the engine electrical system is necessary for optimum engine performance and reliability. Improper grounding will result in uncontrolled electrical circuit paths and in unreliable electrical circuit paths.

Uncontrolled electrical circuit paths can result in damage to main bearings, to crankshaft bearing journal surfaces, and to aluminum components.

Engines that are installed without engine-to-frame ground straps can be damaged by electrical discharge.

To ensure that the engine and the engine electrical systems function properly, an engine-to-frame ground strap with a direct path to the battery must be used. This path may be provided by way of a starting motor ground, a starting motor ground to the frame, or a direct engine ground to the frame.

All grounds should be tight and free of corrosion. The engine alternator must be grounded to the negative "-" battery terminal with a wire that is adequate to handle the full charging current of the alternator.



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## Product Information Section

### Model Views

i01534170

### Model View Illustrations

**SMCS Code:** 1000

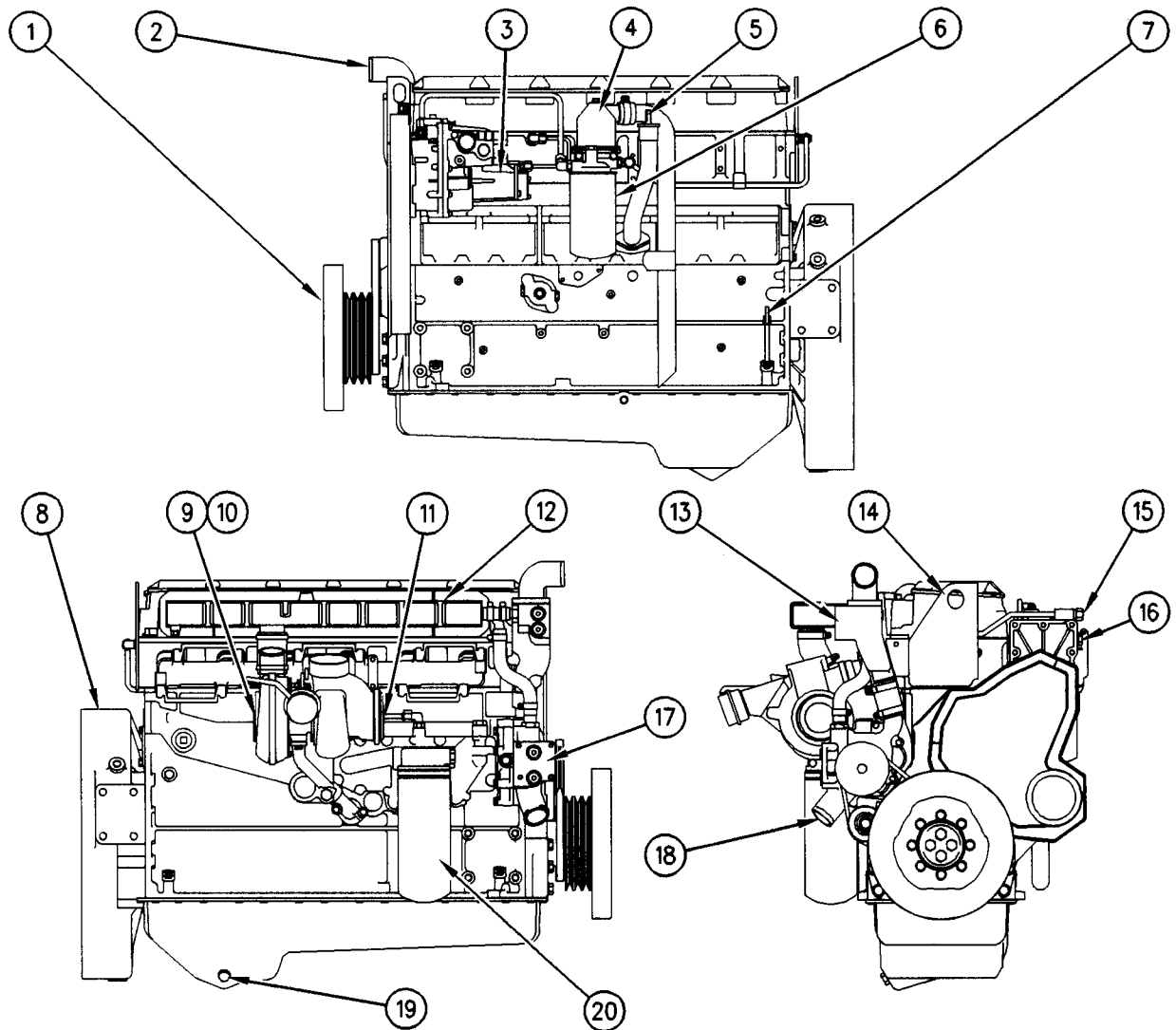


Illustration 12

g00796556

Illustration 12 shows various typical 3100 Engine features.

- |                                 |  |                         |
|---------------------------------|--|-------------------------|
| (1) Crankshaft vibration damper | (8) Flywheel housing                     | (15) Excess fuel return |
| (2) Water outlet                | (9) Air inlet                            | (16) Fuel inlet         |
| (3) Governor                    | (10) Turbocharger                        | (17) Water pump         |
| (4) Crankcase breather          | (11) Exhaust outlet                      | (18) Water inlet        |
| (5) Oil filler cap              | (12) Aftercooler                         | (19) Oil drain plug     |
| (6) Fuel filter                 | (13) Water temperature regulator housing | (20) Oil filter         |
| (7) Oil level gauge             | (14) Lifting eye                         |                         |



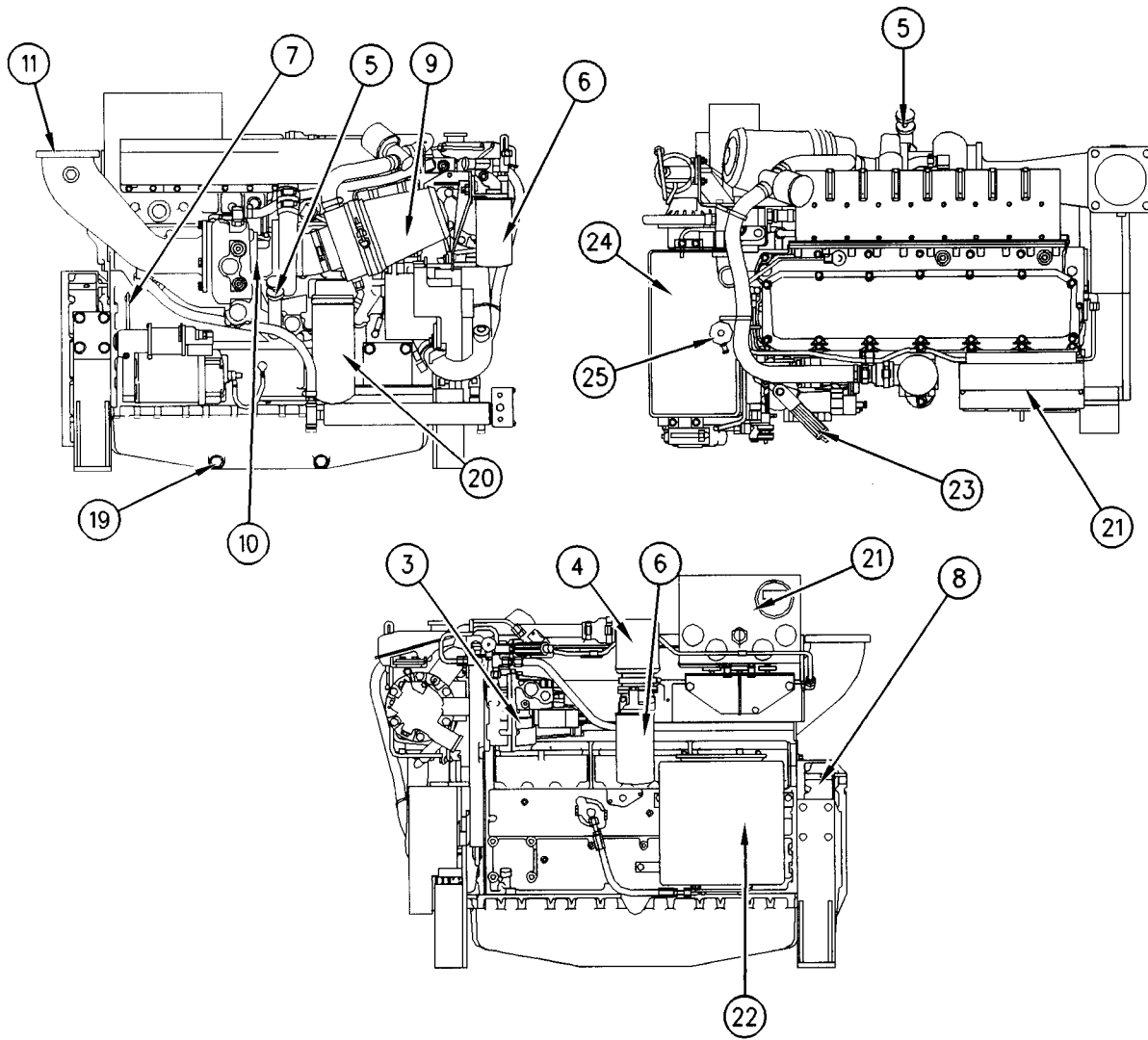


Illustration 13

g00841178

Illustration 13 shows various engine features for Fire Pump Engines.

- |                        |                             |
|------------------------|-----------------------------|
| (3) Governor           | (11) Exhaust outlet         |
| (4) Crankcase breather | (19) Oil drain plug         |
| (5) Oil filler cap     | (20) Oil filter             |
| (6) Fuel filter        | (21) Control panel          |
| (7) Oil level gauge    | (22) Junction box           |
| (8) Flywheel housing   | (23) Governor control lever |
| (9) Air inlet          | (24) Expansion tank         |
| (10) Turbocharger      | (25) Filler cap             |

i01534196

## Engine Description

**SMCS Code:** 1000

The Caterpillar 3114 Engine has the following characteristics:

- Four stroke cycle

- Mechanical fuel system
- Direct fuel injection
- Four in-line cylinders
- Two valves per cylinder
- Turbocharged

The Caterpillar 3116 and 3126 Engines have the following characteristics:

- Four stroke cycle
- Mechanical fuel system
- Direct fuel injection
- Six in-line cylinders
- Two valves per cylinder
- Turbocharged

A hydramechanical governor controls the output of the fuel injector. The governor maintains the selected engine rpm. Individual fuel injectors (one per cylinder) meter fuel and individual fuel injectors pump fuel under high pressure through the fuel injector nozzles to the cylinders.

The fuel ratio control is located on the governor. The fuel ratio control restricts the fuel rack movement. In order to minimize exhaust smoke, only the proper amount of fuel is injected into the cylinders during acceleration.

The inlet air is filtered by an air cleaner. The air is compressed by a turbocharger before the air enters the engine cylinders. The turbocharger is driven by engine exhaust.

## Engine Specifications

**Note:** The front end of the engine is opposite the flywheel end of the engine. The number one cylinder is the front cylinder.

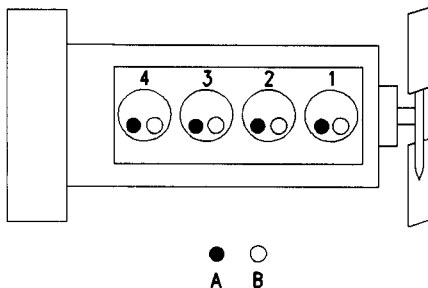


Illustration 14

g00689649

Cylinder and valve location for the 3114 Engine

(A) Exhaust valves  
(B) Inlet valves

Table 1

3114 Engine Specifications	
Number of Cylinders	4 In-line Cylinders
Bore	105.0 mm (4.13 inch)
Stroke	127.0 mm (5.00 inch)
Aspiration	Turbocharged
Compression Ratio	16:1
Displacement	4.4 L (268 in <sup>3</sup> )
Firing Order	1-3-4-2
Rotation (viewed from flywheel)	Counterclockwise
Valve Lash Setting (Inlet)	0.38 mm (0.015 inch)
Valve Lash Setting (Exhaust)	0.64 mm (0.025 inch)

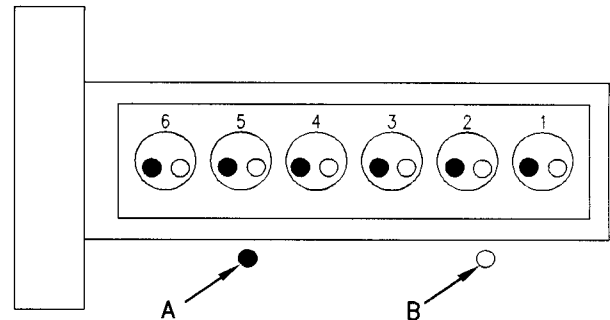


Illustration 15

g00513382

3116 and 3126 Engines

Cylinder and valve locations

(A) Exhaust valve  
(B) Inlet valve

Table 2

3116 Engine Specifications	
Number of Cylinders	6 In-line Cylinders
Bore	105.0 mm (4.13 inch)
Stroke	127.0 mm (5.00 inch)
Aspiration	Turbocharged
Compression Ratio	16:1
Displacement	6.6 L (402 in <sup>3</sup> )
Firing Order	1-5-3-6-2-4
Rotation (viewed from flywheel)	Counterclockwise
Valve Lash Setting (Inlet)	0.38 mm (0.015 inch)
Valve Lash Setting (Exhaust)	0.64 mm (0.025 inch)

Table 3

<b>3126 Engine Specifications</b>	
Number of Cylinders	6 In-line Cylinders
Bore	110.0 mm (4.33 inch)
Stroke	127.0 mm (5.00 inch)
Aspiration	Turbocharged
Compression Ratio	15:1
Displacement	7.24 L (439 in <sup>3</sup> )
Firing Order	1-5-3-6-2-4
Rotation (viewed from flywheel)	Counterclockwise
Valve Lash Setting (Inlet)	0.38 mm (0.015 inch)
Valve Lash Setting (Exhaust)	0.64 mm (0.025 inch)

## Engine Features

The cooling system consists of the following components:

- Engine oil cooler

The engine lubricating oil, that is supplied by a gear type pump, is cooled. The engine lubricating oil is also filtered. Bypass valves provide unrestricted flow of lubrication oil to the engine components during the following conditions:

- High oil viscosity
- Plugged oil cooler or plugged oil filter elements (paper cartridge)

## Engine Service Life

Engine efficiency and maximum utilization of engine performance depend on the adherence to proper operation and maintenance recommendations. In addition, use recommended fuels, coolants and lubricants. Use the Operation and Maintenance Manual as a guide for required engine maintenance.

Expected engine life is generally predicted by the average power demand, which is based on fuel consumption of the engine over a period of time. Reduced hours of operation at full throttle and/or operating at reduced throttle settings result in a lower average power demand. This will increase the length of operating time before an engine overhaul is required. Refer to the Operation and Maintenance Manual, "Overhaul Considerations" topic for more information.

# Product Identification Information

i01441486

## Information Plate

SMCS Code: 1000

## Engine Identification

i01028428

SMCS Code: 1000

Caterpillar engines are identified with serial numbers, with performance specification numbers, and with arrangement numbers. In some of the cases, modification numbers are used. These numbers are shown on the Serial Number Plate and the Information Plate that are mounted on the engine.

Caterpillar dealers need these numbers in order to determine the components that were included with the engine. This permits accurate identification of replacement part numbers.

<b>CAT</b> <sup>®</sup>		SER. NO.	ENGINE MODEL
FULL LOAD RPM			MAX ALT ROTATION
AR NO.			FUEL PUMP/GOV
BARE ENG HI IDLE RPM			INJECTOR
			TURBO
POWER	HP		kW

Illustration 17

g00755014

The Information Plate is on the valve cover. The following information is stamped on the Information Plate: engine's maximum altitude, horsepower, high idle, full load rpm, fuel settings, and other information.

## Serial Number Plate

i00722073

SMCS Code: 1000

ENGINE MODEL	
SERIAL NUMBER	
<b>CATERPILLAR</b> <sup>®</sup> <b>CAT</b> <sup>®</sup>	
ARRANGEMENT NUMBER	
(ALWAYS GIVE ALL NUMBERS) MADE IN U.S.A. 3N-3790 12	

Illustration 16

g00123229

Typical serial number plate

The Serial Number Plate is located on the left side of the cylinder block near the rear of the engine.

The following information is stamped on the Serial Number Plate: engine serial number, model, and arrangement number.

## Reference Numbers

SMCS Code: 1000

Information for the following items may be needed to order parts. Locate the information for your engine. Record the information on the appropriate space. Make a copy of this list for a record. Retain the information for future reference.

## Record for Reference

Engine Model \_\_\_\_\_

Engine Serial No. \_\_\_\_\_

Engine Arrangement No. \_\_\_\_\_

Modification No. \_\_\_\_\_

Engine Low Idle rpm \_\_\_\_\_

Engine Full Load rpm \_\_\_\_\_

Performance Specification No. \_\_\_\_\_

Primary Fuel Filter No. \_\_\_\_\_

Water Separator Element No. \_\_\_\_\_

Secondary Fuel Filter Element No. \_\_\_\_\_

i00610276

Lubrication Oil Filter Element No. \_\_\_\_\_

Auxiliary Oil Filter Element No. \_\_\_\_\_

Supplemental Coolant Additive Maintenance  
Element No. (Optional) \_\_\_\_\_

Total Lubrication System Capacity \_\_\_\_\_

Total Cooling System Capacity \_\_\_\_\_

Air Cleaner Element No. \_\_\_\_\_

Fan Drive Belt No. \_\_\_\_\_

Alternator Belt No. \_\_\_\_\_

i01542360

## Emissions Certification Film

**SMCS Code:** 1000; 7405

**Note:** This information is pertinent in the United  
States and in Canada.

A typical example is shown.

CATERPILLAR INC.		IMPORTANT ENGINE INFORMATION			2000		JDM00001	
ENGINE MODEL : 3116 - DISPLACEMENT : 6.6L - VALVE LASH : 0.38mm INTAKE 0.64mm EXHAUST								
ENGINE FAMILY XCPXL06 6MFB	MAXIMUM ADVERTISED KW (HP) 164 (220)	MAXIMUM RATED SPEED (RPM) 2600	MAXIMUM LOW IDLE SPEED (RPM) 875	MAX. FUEL RATE @MAXIMUM (mm <sup>3</sup> /STROKE) 104	MAXIMUM INITIAL TIMING DEGREES BTDC 11.5	EXHAUST EMISSION CONTROL SYSTEM EM.DI.TC.SPL.CAC		
THIS 3116 ENGINE CONFORMS TO DIRECTIVE 97/68/EC FOR NON-ROAD ENGINES. ECTYPE APPROVAL NO. eURL*97/68AA*0001*00								
THIS 3116 ENGINE CONFORMS TO 2000 U.S. EPA AND CALIFORNIA REGULATIONS LARGE NON-ROAD COMPRESSION-IGNITION ENGINES.								
THIS ENGINE IS CERTIFIED TO OPERATE ON COMMERCIALY AVAILABLE DIESEL FUEL.								
DATE OF MANUFACTURE MONTH : 08								
7E-0050 01								

FMT:3500

The EPA/EU Emissions Certification Film  
(if applicable) is located either on the side,  
the top, or the front of the engine.

CATERPILLAR INC.		INFORMATION IMPORTANTE SUR LE MOTEUR				
MODÈLE MOTEUR : 3116 - DÉBIT : 6,6 l - JEU SOUPAPES : 0,38 mm ADMISSION : 0,64 mm ÉCHAPPEMENT						
FAMILLE DE MOTEURS : XCPXL06 6MFB	Kw (HP) MAXI PUBLIÉS : 164 (220)	MAXI RÉGIME NOMINAL (tr/min) : 2600	MAXI RÉGIME RALENTI (tr/min) : 875	MAXI DÉBIT D'INJ. À PUIS. MAXI (mm <sup>3</sup> /STROKE) (PISTON) : 104	MAXI CALAGE INITIAL D'INJ. (DEGRÉS) (AVANT PMH) : 11.5	DISPOSITIF ANTI-POLLUANT : FM.DI.TC.SPL.CAC
CE MOTEUR 3116 EST CONFORME AUX DIRECTIVES 97/68/EC POUR LES MOTEURS NON ROUTIERS. NO APPROBATION TYPE EC eURL*97/68AA*0001*00						
CE MOTEUR 3116 EST CONFORME AUX RÉGLEMENTATIONS 2000 DE L'AGENCE AMÉRICAINE DE PROTECTION DE L'ENVIRONNEMENT (EPA) ET DE LA CALIFORNIE POUR LES GROS MOTEURS NON ROUTIERS À COMPRESSION-CONTACT.						
CE MOTEUR EST HOMOLOGUÉ POUR FONCTIONNER AVEC LE CARBURANT DIESEL DU COMMERCE.						
DATE DE FABRICATION (MOIS) 08						

Étiquette d'homologation anti-pollution

L'autocollant d'homologation du dispositif  
antipollution EPA/EU (selon équipement) est situé  
soit sur le côté du moteur, soit sur le dessus du  
moteur, soit sur le devant du moteur.

## Operation Section

## Lifting and Storage

### Engine Lifting

**SMCS Code:** 1000; 1122

i01028339

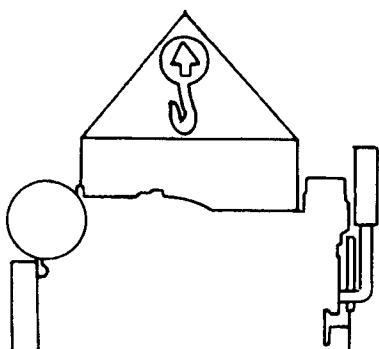


Illustration 19

g00103219

#### NOTICE

Never bend the eyebolts and the brackets. Only load the eyebolts and the brackets under tension. Remember that the capacity of an eyebolt is less as the angle between the supporting members and the object becomes less than 90 degrees.

When it is necessary to remove a component at an angle, only use a link bracket that is properly rated for the weight.

Use a hoist to remove heavy components. Use an adjustable lifting beam to lift the engine. All supporting members (chains and cables) should be parallel to each other. The chains and cables should be perpendicular to the top of the object that is being lifted.

Some removals require lifting the fixtures in order to obtain proper balance and safety.

To remove the engine ONLY, use the lifting eyes that are on the engine.

Lifting eyes are designed and installed for the specific engine arrangement. Alterations to the lifting eyes and/or the engine make the lifting eyes and the lifting fixtures obsolete. If alterations are made, ensure that proper lifting devices are provided. Consult your Caterpillar dealer for information regarding fixtures for proper engine lifting.

### Engine Lifting with a Fuel Tank

#### ⚠ WARNING

**Lift eyes or tank can fail when lifting tank containing fluids resulting in possible personal injury. Drain tank of all fluids before lifting.**

Lifting the engine with a fuel tank that is mounted to the engine requires special equipment and procedures. Do not lift the unit with fuel in the fuel tank. Consult your Caterpillar dealer for information regarding fixtures for proper lifting of your complete package.

i00777190

### Engine Storage

**SMCS Code:** 1000

If the engine will not be started for several weeks, the lubricating oil will drain from the cylinder walls and from the piston rings. Rust can form on the cylinder liner surface. Rust on the cylinder liner surface will cause increased engine wear and a reduction in engine service life.

To help prevent excessive engine wear, use the following guidelines:

- Complete all of the lubrication recommendations that are listed in this Operation and Maintenance Manual, "Maintenance Interval Schedule" (Maintenance Section).
- If freezing temperatures are expected, check the cooling system for adequate protection against freezing. See this Operation and Maintenance Manual, "General Coolant Information" (Maintenance Section).

If an engine is out of operation and if use of the engine is not planned, special precautions should be made. If the engine will be stored for more than one month, a complete protection procedure is recommended.

For more detailed information on engine storage, see Special Instruction, SEHS9031, "Storage Procedure For Caterpillar Products".

Your Caterpillar dealer can assist in preparing the engine for extended storage periods.

## Gauges and Indicators

101139916

### Gauges and Indicators

**SMCS Code:** 1900; 7450

Your engine may not have the same gauges or all of the gauges that are described. For more information about the gauge package, see the OEM information.

Gauges provide indications of engine performance. Ensure that the gauges are in good working order. Determine the normal operating range by observing the gauges over a period of time.

Noticeable changes in gauge readings indicate potential gauge or engine problems. Problems may also be indicated by gauge readings that change even if the readings are within specifications. Determine and correct the cause of any significant change in the readings. Consult your Caterpillar dealer for assistance.

#### NOTICE

If no oil pressure is indicated, **STOP** the engine. If maximum coolant temperature is exceeded, **STOP** the engine. Engine damage can result.



**Engine Oil Pressure** – The oil pressure should be greatest after a cold engine is started. The typical engine oil pressure with SAE10W30 is 207 to 413 kPa (30 to 60 psi) at rated rpm.

A lower oil pressure is normal at low idle. If the load is stable and the gauge reading changes, perform the following procedure:

1. Remove the load.
2. Reduce engine speed to low idle.
3. Check and maintain the oil level.



**Jacket Water Coolant Temperature** – Typical temperature range is 71 to 96°C (160 to 205°F). The maximum allowable temperature with the pressurized cooling system at 48 kPa (7 psi) is 103°C (217°F). Higher temperatures may occur under certain conditions. The water temperature reading may vary according to load. The reading should never exceed the boiling point for the pressurized system that is being used.

If the engine is operating above the normal range and steam becomes apparent, perform the following procedure:

1. Reduce the load and the engine rpm.
2. Inspect the cooling system for leaks.
3. Determine if the engine must be shut down immediately or if the engine can be cooled by reducing the load.



**Tachometer** – This gauge indicates engine speed (rpm). When the throttle control lever is moved to the full throttle position without load, the engine is running at high idle. The engine is running at the full load rpm when the throttle control lever is at the full throttle position with maximum rated load.

#### NOTICE

To help prevent engine damage, never exceed the high idle rpm. Overspeeding can result in serious damage to the engine. The engine can be operated at high idle without damage, but should never be allowed to exceed high idle rpm.

**Note:** The high idle rpm and the full load rpm are stamped on the Information Plate.



**Ammeter** – This gauge indicates the amount of charge or discharge in the battery charging circuit. Operation of the indicator should be to the right side of "0"(zero).



**Fuel Level** – This gauge indicates the fuel level in the fuel tank. The electrically operated fuel level gauge only registers when the "START/STOP" switch is "ON".



**Service Hour Meter** – This gauge indicates the total number of clock hours that the engine has operated.



## Features and Controls

I01007515

### Engine Shutoffs and Engine Alarms

**SMCS Code:** 1900; 7400; 7418

#### Shutoffs

Shutoffs and alarms are electrically operated or mechanically operated. The operation of all electric shutoffs and alarms utilize components which actuate switches in a sensing unit.

Shutoffs are set at critical levels for the following items: operating temperature, operating pressure, operating level, and operating rpm. The particular shutoff may need to be reset before the engine will start.

---

#### NOTICE

**Always determine the cause of the engine shutdown. Make necessary repairs before attempting to restart the engine.**

---

Be familiar with the following items:

- Types and locations of shutoff
- Conditions which cause each shutoff to function
- The resetting procedure that is required to restart the engine

#### Alarms

Alarms consist of a switch and a contactor. The switches are wired to the contactors. The contactors activate alarm circuits in an annunciator panel. Your engine may be equipped with the following switches:

**Engine oil pressure** – The engine oil pressure switch indicates when oil pressure drops below rated system pressure.

**Coolant level** – The low coolant level switch indicates when the coolant level is low.

**Coolant temperature** – The coolant temperature switch indicates high jacket water coolant temperature.

**Note:** The sensing element of the coolant temperature switch must be submerged in coolant in order to operate.

Engines may be equipped with alarms in order to alert the operator when undesirable operating conditions occur.

---

#### NOTICE

**When an alarm is activated, corrective measures must be taken before the situation becomes an emergency in order to avoid possible engine damage.**

---

If corrective measures are not taken within a reasonable time, engine damage could result. The alarm will continue until the condition is corrected. The alarm may need to be reset.

A switch may be installed in the alarm while the engine is stopped for repairs. Before the engine is started, ensure that the switch is moved to the ON position and that the warning lights are flashing. The engine will not be protected if the switch is left in the OFF position.

### Testing the Shutoff and Alarm System

Most control panels are equipped with a lamp test switch. Turn the switch to the ON position in order to check the indicator lights for proper operation. Replace defective bulbs immediately.

---

#### NOTICE

**During testing, abnormal operating conditions must be simulated. Perform the tests correctly in order to help prevent possible engine damage.**

---

Refer to the Service Manual for more information on testing procedures or consult your Caterpillar dealer.

## Engine Starting

i01486758

### Before Starting Engine

**SMCS Code:** 1000; 1400; 1450

Perform the required daily maintenance and other periodic maintenance before the engine is started. Inspect the engine compartment. This inspection can help prevent major repairs at a later date. Refer to the Operation and Maintenance Manual, "Maintenance Interval Schedule" for more information.

- For the maximum service life of the engine, make a thorough inspection before the engine is started. Look for the following items: oil leaks, coolant leaks, loose bolts, and trash buildup. Remove trash buildup and arrange for repairs, as needed.
- Inspect the cooling system hoses for cracks and for loose clamps.
- Inspect the alternator and accessory drive belts for cracks, breaks, and other damage.
- Inspect the wiring for loose connections and for worn wires or frayed wires.
- Check the fuel supply. Drain water from the water separator (if equipped). Open the fuel supply valve.
- Do not start the engine or move any of the controls if there is a "DO NOT OPERATE" warning tag or similar warning tag attached to the start switch or to the controls.
- Ensure that the areas around the rotating parts are clear.
- All of the guards must be put in place. Check for damaged guards or for missing guards. Repair any damaged guards. Replace damaged guards and/or missing guards.
- Disconnect any battery chargers that are not protected against the high current drain that is created when the electric starting motor (if equipped) is engaged. Check electrical cables and check the battery for poor connections and for corrosion.
- Reset all of the shutoffs or alarm components.
- Check the engine lubrication oil level. Maintain the oil level between the "ADD" mark and the "FULL" mark on the oil level gauge.
- Check the coolant level. Observe the coolant level in the coolant recovery tank (if equipped). Maintain the coolant level to the "FULL" mark on the coolant recovery tank.
- If the engine is not equipped with a coolant recovery tank maintain the coolant level within 13 mm (0.5 inch) of the bottom of the filler pipe. If the engine is equipped with a sight glass, maintain the coolant level in the sight glass.
- Observe the air cleaner service indicator (if equipped). Service the air cleaner when the yellow diaphragm enters the red zone, or when the red piston locks in the visible position.
- Ensure that any driven equipment has been disengaged. Minimize electrical loads or remove any electrical loads.

---

#### NOTICE

All valves in the fuel return line must be open before and during engine operation to help prevent high fuel pressure. High fuel pressure may cause filter housing failure or other damage.

---

If the engine has not been started for several weeks, fuel may have drained from the fuel system. Air may have entered the filter housing. Also, when fuel filters have been changed, some air pockets will be trapped in the engine. In these instances, prime the fuel system. Refer to the Operation and Maintenance Manual, "Fuel System - Prime" for more information on priming the fuel system.

#### WARNING

**Engine exhaust contains products of combustion which may be harmful to your health. Always start and operate the engine in a well ventilated area and, if in an enclosed area, vent the exhaust to the outside.**

---

i00970006

## Starting the Engine

**SMCS Code:** 1000; 1450

Refer to the Service Manual for your type of controls. Use the following procedure to start the engine.

1. Place the manual stop control (if equipped) in the RUN position. Turn the ignition switch to the RUN position. Advance the throttle in order to supply fuel to the engine.
2. Turn the ignition switch to the START position in order to crank the engine.

Allow the ignition switch to return to the RUN position as soon as the engine starts.

### NOTICE

Oil pressure should rise within 15 seconds after the engine starts. Do not increase engine speed until the oil pressure gauge indicates normal. If oil pressure is not indicated on the gauge within 15 seconds, **DO NOT** operate the engine. **STOP** the engine, investigate and correct the cause.

3. Move the throttle to approximately one quarter of the engine rpm.
4. Allow the engine to idle for three to five minutes, or allow the engine to idle until the water temperature indicator begins to rise. The engine should run at low idle smoothly until speed is gradually increased to high idle. Allow the white smoke to disperse before proceeding with normal operation.

To minimize white smoke for cold weather starting, start the engine and allow the engine to idle for 30 seconds. Increase the rpm until the engine speed reaches 1200 rpm. Return the engine to low idle rpm.

5. Operate the engine at low load until all systems reach operating temperature. Check the gauges during the warm-up period.

i00998863

## Cold Weather Starting

**SMCS Code:** 1000; 1250; 1450; 1453; 1456; 1900

Refer to the Operation and Maintenance Manual that is for the control panels for detailed information on the control panels.

### WARNING

**When using starting fluid (ether), follow the manufacturer's instructions carefully. Use the starting fluid sparingly and spray only while cranking the engine. Failure to do so could result in an explosion and/or fire and personal injury.**

### NOTICE

The optional ether starting aid is the only starting fluid system that is recommended on the engine.

Startability will be improved at temperatures below  $-18^{\circ}\text{C}$  ( $0^{\circ}\text{F}$ ) from the use of a jacket water heater or extra battery capacity.

When No. 2 diesel fuel is used, the following items provide a means of minimizing starting problems and fuel problems in cold weather: starting aids, engine oil pan heaters, jacket water heaters, fuel heaters, and fuel line insulation.

For temperatures below  $-23^{\circ}\text{C}$  ( $-10^{\circ}\text{F}$ ), consult your Caterpillar dealer.

Use the procedure that follows for cold weather starting.

**Note:** If the engine has not been run for several weeks, fuel may have drained. Air may have moved into the filter housing. Also, when fuel filters have been changed, some air will be left in the filter housing. Refer to the Operation and Maintenance Manual for more information on priming the fuel system.

### NOTICE

**Do not engage the starting motor when flywheel is turning. Do not start the engine under load.**

**If the engine fails to start within 30 seconds, release the starter switch or button and wait two minutes to allow the starting motor to cool before attempting to start the engine again.**

1. Turn the ignition switch to the RUN position. Advance the throttle in order to supply fuel to the engine.

### NOTICE

**Excessive ether can cause piston and piston ring damage. Use ether for cold starting purposes only. Do not use excessive starting fluid while starting the engine. Do not use starting fluid after the engine is running.**

2. If equipped, press the "Starting Aid" switch in order to improve cold weather starting. Release the "Starting Aid" switch when the engine starts. Use the starting fluid sparingly. Carefully follow the instructions of the OEM.

---

**NOTICE**

Oil pressure should rise within 15 seconds after the engine starts. Do not increase engine speed until the oil pressure gauge indicates normal. If oil pressure is not indicated on the gauge within 15 seconds, DO NOT operate the engine. STOP the engine, investigate and correct the cause.

---

3. Increase the engine rpm to approximately 1/4 of the full load rpm.
4. Allow the engine to idle for three to five minutes, or allow the engine to idle until the water temperature indicator begins to rise. The engine should run at low idle smoothly until speed is gradually increased to high idle. Allow the white smoke to disperse before proceeding with normal operation.
5. Operate the engine at low load until all systems reach operating temperature. Check the gauges during the warm-up period.

i01037941

## Starting with Jump Start Cables

**SMCS Code:** 1000; 1401; 1402; 1900

### **WARNING**

**Improper jump start cable connections can cause an explosion resulting in personal injury.**

**Prevent sparks near the batteries. Sparks could cause vapors to explode. Do not allow jump start cable ends to contact each other or the engine.**

---

If the installation is not equipped with a backup battery system, it may be necessary to start the engine from an external electrical source.

First, determine the reason that it is necessary to start with power from an external source. Refer to Special Instruction, SEHS7768, "Use of the 6V-2150 Starting/Charging Analyzer".

Many batteries which are considered unusable are still rechargeable. After jump starting, the alternator may not be able to fully recharge batteries that are severely discharged. The batteries must be charged to the proper voltage with a battery charger. For information on testing and charging, refer to the Special Instruction, SEHS7633, "Battery Test Procedure".

---

### **NOTICE**

Using a battery source with the same voltage as the electric starting motor. Use **ONLY** equal voltage for jump starting. The use of higher voltage will damage the electrical system.

Do not reverse the battery cables. The alternator can be damaged. Attach ground cable last and remove first.

When using an external electrical source to start the engine, turn the engine control switch to the "OFF" position. Turn all electrical accessories OFF before attaching the jump start cables.

Ensure that the main power switch is in the OFF position before attaching the jump start cables to the engine being started.

---

1. Turn the start switch on the stalled engine to the OFF position. Turn off all accessories.
2. Connect one positive end of the jump start cable to the positive cable terminal of the discharged battery. Connect the other positive end of the jump start cable to the positive cable terminal of the electrical source.
3. Connect one negative end of the jump start cable to the negative cable terminal of the electrical source. Connect the other negative end of the jump start cable to the engine block or to the chassis ground. This procedure helps to prevent potential sparks from igniting combustible gases that are produced by some batteries.
4. Charge the batteries. The engine will not continue to run after starting if the batteries have not been charged.
5. Start the engine.
6. Immediately after the stalled engine is started, disconnect the jump start cables in reverse order.

Refer to the Electrical Schematic for your engine. Consult your Caterpillar dealer for more information.

i01491313

## After Starting Engine

**SMCS Code:** 1000

**Note:** In temperatures from 0 to 60°C (32 to 140°F), the warm-up time is approximately five minutes. In temperatures below 0°C (32°F), additional warm-up time may be required.

**Note:** Ensure that the self test for the monitoring system (if equipped) is completed before operating the engine under load.

When the engine idles during warm-up, observe the following conditions:

- Check for any fluid or for any air leaks at idle rpm and at one-half full rpm (no load on the engine) before operating the engine under load. This is not possible in some applications.
- Operate the engine at low idle until all systems achieve operating temperatures. Check all gauges during the warm-up period.

**Note:** Gauge readings should be observed and the data should be recorded frequently while the engine is operating. Comparing the data over time will help to determine normal readings for each gauge. Comparing data over time will also help detect abnormal operating developments. Significant changes in the readings should be investigated.

# Engine Operation

i00718869

## Engine Operation

**SMCS Code:** 1000

Proper operation and maintenance are key factors in obtaining the maximum life and economy of the engine. If the directions in the Operation and Maintenance Manual are followed, costs can be minimized and engine service life can be maximized.

The time that is needed for the engine to reach normal operating temperature can be less than the time needed for a walk-around inspection of the engine.

After the engine is started and after the engine reaches normal operating temperature, the engine can be operated at the rated rpm. The engine will reach normal operating temperature faster when the engine is at rated speed. The engine will reach normal operating temperature faster when the engine is at low power demand. This procedure is more effective than idling the engine at no load. The engine should reach operating temperature in a few minutes.

Gauge readings should be observed and the data should be recorded frequently while the engine is operating. Comparing the data over time will help to determine normal readings for each gauge. Comparing data over time will also help detect abnormal operating developments. Significant changes in the readings should be investigated.

## Engaging the Driven Equipment

**SMCS Code:** 1000

1. Operate the engine at one-half of the rated rpm, when possible.
2. Engage the driven equipment without a load on the equipment, when possible.

Interrupted starts put excessive stress on the drive train. Interrupted starts also waste fuel. To get the driven equipment in motion, engage the clutch smoothly with no load on the equipment. This method should produce a start that is smooth and easy. The engine rpm should not increase and the clutch should not slip.

3. Ensure that the ranges of the gauges are normal when the engine is operating at one-half of the rated rpm. Ensure that all gauges operate properly.
4. Increase the engine rpm to the rated rpm. Always increase the engine rpm to the rated rpm before the load is applied.
5. Apply the load. Begin operating the engine at low load. Check the gauges and equipment for proper operation. After normal oil pressure is reached and the temperature gauge begins to move, the engine may be operated at full load.

Extended operation at low idle or at reduced load may cause increased oil consumption and carbon buildup in the cylinders. This carbon buildup results in a loss of power and/or poor performance. When the engine is operated at reduced load, the engine should be fully loaded in four hour increments. This procedure burns excess carbon from the cylinders. Check the gauges and equipment frequently when the engine is operated under load.

i01593145

## **Automatic Operation (Controller for the Fire Pump )**

**SMCS Code:** 1000; 4450; 7000

**S/N:** CKK1-Up

The basic function of the controller for the fire pump is for starting the engine when there is a drop in pressure in the water supply. The controller provides automatic cycled cranking and alarm protection for various engine failures. After the required period is terminated, the engine may be stopped manually or the engine may be stopped automatically.

Recommended ambient room temperature is 20 °C (68 °F). The jacket water coolant temperature must be maintained at a minimum of 49 °C (120 °F).

## Engine Stopping

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i01057253

### Emergency Stopping

**SMCS Code:** 1000; 7418

#### NOTICE

Emergency shutoff controls are for **EMERGENCY** use **ONLY**. **DO NOT** use emergency shutoff devices or controls for normal stopping procedure.

Ensure that any components for the external system that support the engine operation are secured after the engine is stopped.

### Emergency Stop Button

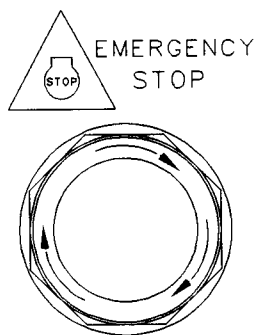


Illustration 20

g00104303

Typical emergency stop button

The emergency stop button is in the OUT position for normal engine operation. Push the emergency stop button. The engine will not start when the button is locked. Turn the button clockwise in order to reset.

## Manual Stop Procedure

**SMCS Code:** 1000

**Note:** Individual applications will have different control systems. Ensure that the shutoff procedures are understood. Use the following general guidelines in order to stop the engine.

1. Remove the load, when possible. Reduce the engine rpm to low idle.
2. Increase the engine rpm to no more than one-half of the rated rpm. Perform this procedure for three to five minutes in order to cool the engine. Reduce the engine rpm to low idle.
3. After the cool down period, turn the start/run switch to the OFF position.



i01402990

## After Stopping Engine

**SMCS Code:** 1000

**Note:** Before you check the engine oil, do not operate the engine for at least 10 minutes in order to allow the engine oil to return to the oil pan.

- Check the crankcase oil level. Maintain the oil level between the "ADD" mark and the "FULL" mark on the oil level gauge.
- If necessary, perform minor adjustments. Repair any leaks and tighten any loose bolts.
- Note the service hour meter reading. Perform the maintenance that is in the Operation and Maintenance Manual, "Maintenance Interval Schedule".
- Fill the fuel tank in order to help prevent accumulation of moisture in the fuel. Do not overfill the fuel tank.

---

### NOTICE

Only use antifreeze/coolant mixtures recommended in the Coolant Specifications that are in the Operation and Maintenance Manual. Failure to do so can cause engine damage.

---

- Allow the engine to cool. Check the coolant level. Maintain the cooling system at 13 mm (0.5 inch) from the bottom of the pipe for filling.
- If freezing temperatures are expected, check the coolant for proper antifreeze protection. The cooling system must be protected against freezing to the lowest expected outside temperature. Add the proper coolant/water mixture, if necessary.
- Perform all required periodic maintenance on all driven equipment. This maintenance is outlined in the instructions from the OEM.

## Cold Weather Operation

i01457051

### Radiator Restrictions

**SMCS Code:** 1353; 1396

Caterpillar discourages the use of airflow restriction devices that are mounted in front of radiators. Airflow restriction can cause the following conditions:

- High exhaust temperatures
- Power loss
- Excessive fan usage
- Reduction in fuel economy

If an airflow restriction device must be used, the device should have a permanent opening directly in line with the fan hub. The device must have a minimum opening dimension of at least 770 cm<sup>2</sup> (120 in<sup>2</sup>).

A centered opening that is directly in line with the fan hub is specified in order to prevent an interrupted airflow on the fan blades. Interrupted airflow on the fan blades could cause a fan failure.

Caterpillar recommends a warning device for the inlet manifold temperature and/or the installation of an inlet air temperature gauge. The warning device for the inlet manifold temperature should be set at 75 °C (167 °F). The inlet manifold air temperature should not exceed 75 °C (167 °F). Temperatures that exceed this limit can cause power loss and potential engine damage.

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### Fuel and the Effect from Cold Weather

**SMCS Code:** 1000; 1250

The following fuels are the grades that are available for Caterpillar engines:

- No. 1
- No. 2
- Blend of No. 1 and No. 2

No. 2 diesel fuel is the most commonly used fuel. Either No. 1 diesel fuel or a blend of No. 1 and No. 2 is best suited for cold weather operation.

Quantities of No. 1 diesel fuel are limited. No. 1 diesel fuels are usually available during the months of the winter in the colder climates. During cold weather operation, if No. 1 diesel fuel is not available, use No. 2 diesel fuel, if necessary.

There are three major differences between No. 1 and No. 2 diesel fuel. No. 1 diesel fuel has the following properties:

- Lower cloud point
- Lower pour point
- Lower rating of kJ (BTU) per unit volume of fuel

When No. 1 diesel fuel is used, a decrease in power and in fuel efficiency may be noticed. Other operating effects should not be experienced.

The cloud point is the temperature when a cloud of wax crystals begins to form in the fuel. These crystals can cause the fuel filters to plug. The pour point is the temperature when diesel fuel will thicken. The diesel fuel becomes more resistant to flow through fuel pumps and through fuel lines.

Be aware of these values when diesel fuel is purchased. Anticipate the average ambient temperature within the area that the engine will be operated. Engines that are fueled in one climate may not operate well if the engines are moved to another climate. Problems can result due to changes in temperature.

Before troubleshooting for low power or for poor performance in the winter, check the type of fuel that is being used.

When No. 2 diesel fuel is used the following components provide a means of minimizing problems in cold weather:

- Starting aids
- Engine oil pan heaters
- Engine coolant heaters
- Fuel heaters
- Fuel line insulation

For more information on cold weather operation, see Operation and Maintenance Manual, SEBU5898, "Cold Weather Recommendations".

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## Fuel Related Components in Cold Weather

**SMCS Code:** 1000; 1250

### Fuel Tanks

Condensation can form in partially filled fuel tanks. Top off the fuel tanks after you operate the engine.

Fuel tanks should contain some provision for draining water and sediment from the bottom of the tanks. Some fuel tanks use supply pipes that allow water and sediment to settle below the end of the fuel supply pipe.

Some fuel tanks use supply lines that take fuel directly from the bottom of the tank. If the engine is equipped with this system, regular maintenance of the fuel system filter is important.

Drain the water and sediment from any fuel storage tank at the following intervals: weekly, oil changes, and refueling of the fuel tank. This will help prevent water and/or sediment from being pumped from the fuel storage tank and into the engine fuel tank.

### Fuel Filters

It is possible that a primary fuel filter is installed between the fuel tank and the engine fuel inlet. After you change the fuel filter, always prime the fuel system in order to remove air bubbles from the fuel system. Refer to the Operation and Maintenance Manual in the Maintenance Section for more information on priming the fuel system.

The micron rating and the location of a primary fuel filter is important in cold weather operation. The primary fuel filter and the fuel supply line are the most common components that are affected by cold fuel.

### Fuel Heaters

Fuel heaters help to prevent fuel filters from plugging in cold weather due to waxing. A fuel heater should be installed in the fuel system before the primary fuel filter.

The following fuel heaters are recommended for Caterpillar engines:

- 7C-3557 Fuel Heater Group
- 7C-3558 Heater Kit

For further information on fuel heaters, consult your Caterpillar dealer.

Disconnect the fuel heater in warm weather.

**Note:** Fuel heaters that are controlled by the water temperature regulator or self-regulating fuel heaters should be used with this engine. Fuel heaters that are not controlled by the water temperature regulator can heat the fuel in excess of 65°C (149°F). A loss of engine power can occur if the fuel supply temperature exceeds 37°C (100°F).

**Note:** Heat exchanger type fuel heaters should have a bypass provision in order to prevent overheating of the fuel in warm weather operation.

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## Fuel Related Components in Cold Weather

**SMCS Code:** 1000; 1250

**S/N:** CKK1-Up

### Fuel Tanks

Condensation can form in partially filled fuel tanks. Top off the fuel tanks after you operate the engine.

Fuel tanks should contain some provision for draining water and sediment from the bottom of the tanks. Some fuel tanks use supply pipes that allow water and sediment to settle below the end of the fuel supply pipe.

Some fuel tanks use supply lines that take fuel directly from the bottom of the tank. If the engine is equipped with this system, regular maintenance of the fuel system filter is important.

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The micron rating and the location of a primary fuel filter is important in cold weather operation. The primary fuel filter and the fuel supply line are the most common components that are affected by cold fuel.

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#### NOTICE

In order to maximize fuel system life and prevent premature wear out from abrasive particles in the fuel, a two micron absolute high efficiency fuel filter is required for all Caterpillar Electronic Unit Injectors. Caterpillar High Efficiency Fuel Filters meet these requirements. Consult your Caterpillar dealer for the proper part numbers.

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## Fuel Heaters

Fuel heaters help to prevent fuel filters from plugging in cold weather due to waxing. A fuel heater should be installed in the fuel system before the primary fuel filter.

The following fuel heaters are recommended for Caterpillar engines:

- **7C-3557** Fuel Heater Group
- **7C-3558** Heater Kit

For further information on fuel heaters, consult your Caterpillar dealer.

Disconnect the fuel heater in warm weather.

**Note:** Fuel heaters that are controlled by the water temperature regulator or self-regulating fuel heaters should be used with this engine. Fuel heaters that are not controlled by the water temperature regulator can heat the fuel in excess of 65°C (149°F). A loss of engine power can occur if the fuel supply temperature exceeds 37°C (100°F).

**Note:** Heat exchanger type fuel heaters should have a bypass provision in order to prevent overheating of the fuel in warm weather operation.

## Maintenance Section

# Torque Specifications

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## General Torque Information

SMCS Code: 7553



### WARNING

Mismatched or incorrect fasteners can result in damage or malfunction, or personal injury.

Take care to avoid mixing metric dimensioned fasteners and inch dimensioned fasteners.

Exceptions to these torques are given in the Service Manual, if necessary.

Prior to installation of any hardware, ensure that components are in near new condition. Bolts and threads must not be worn or damaged. Threads must not have burrs or nicks. Hardware must be free of rust and corrosion. Clean the hardware with a noncorrosive cleaner. Do not lubricate the fastener threads except for the rust preventive. The rust preventive should be applied by the supplier of that component for purposes of shipping and storage. Other applications for lubricating components may also be specified in the Service Manual.

## Standard Torque for Inch Fasteners

SMCS Code: 7553

Table 4

Inch Nuts and Bolts	
Thread Size Inch	Standard Torque
1/4	12 ± 3 N·m (9 ± 2 lb ft)
5/16	25 ± 6 N·m (18 ± 4 lb ft)
3/8	47 ± 9 N·m (35 ± 7 lb ft)
7/16	70 ± 15 N·m (50 ± 11 lb ft)
1/2	105 ± 20 N·m (75 ± 15 lb ft)
9/16	160 ± 30 N·m (120 ± 22 lb ft)
5/8	215 ± 40 N·m (160 ± 30 lb ft)
3/4	370 ± 50 N·m (275 ± 37 lb ft)
7/8	620 ± 80 N·m (460 ± 60 lb ft)
1	900 ± 100 N·m (660 ± 75 lb ft)
1 1/8	1300 ± 150 N·m (960 ± 110 lb ft)
1 1/4	1800 ± 200 N·m (1320 ± 150 lb ft)
1 3/8	2400 ± 300 N·m (1780 ± 220 lb ft)
1 1/2	3100 ± 350 N·m (2280 ± 260 lb ft)

Table 5

Inch Taperlock Studs	
Thread Size Inch	Standard Torque
1/4	8 ± 3 N·m (6 ± 2 lb ft)
5/16	17 ± 5 N·m (13 ± 4 lb ft)
3/8	35 ± 5 N·m (26 ± 4 lb ft)
7/16	45 ± 10 N·m (33 ± 7 lb ft)
1/2	65 ± 10 N·m (48 ± 7 lb ft)
5/8	110 ± 20 N·m (80 ± 15 lb ft)
3/4	170 ± 30 N·m (125 ± 22 lb ft)
7/8	260 ± 40 N·m (190 ± 30 lb ft)
1	400 ± 60 N·m (300 ± 44 lb ft)
1 1/8	525 ± 60 N·m (390 ± 44 lb ft)
1 1/4	750 ± 80 N·m (550 ± 60 lb ft)
1 3/8	950 ± 125 N·m (700 ± 90 lb ft)
1 1/2	1200 ± 150 N·m (880 ± 110 lb ft)

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## Standard Torque for Metric Fasteners

SMCS Code: 7553

Table 6

Metric Nuts and Bolts	
Thread Size Metric	Standard Torque
M6	12 ± 3 N·m (9 ± 2 lb ft)
M8	28 ± 7 N·m (21 ± 5 lb ft)
M10	55 ± 10 N·m (41 ± 7 lb ft)
M12	100 ± 20 N·m (75 ± 15 lb ft)
M14	160 ± 30 N·m (120 ± 22 lb ft)
M16	240 ± 40 N·m (175 ± 30 lb ft)
M20	460 ± 60 N·m (340 ± 44 lb ft)
M24	800 ± 100 N·m (590 ± 75 lb ft)
M30	1600 ± 200 N·m (1180 ± 150 lb ft)
M36	2700 ± 300 N·m (2000 ± 220 lb ft)

Table 7

Metric Taperlock Studs	
Thread Size Metric	Standard Torque
M6	8 ± 3 N·m (6 ± 2 lb ft)
M8	17 ± 5 N·m (13 ± 4 lb ft)
M10	35 ± 5 N·m (26 ± 4 lb ft)
M12	65 ± 10 N·m (48 ± 7 lb ft)
M16	110 ± 20 N·m (80 ± 15 lb ft)
M20	170 ± 30 N·m (125 ± 22 lb ft)
M24	400 ± 60 N·m (300 ± 44 lb ft)
M30	750 ± 80 N·m (550 ± 60 lb ft)
M36	1200 ± 150 N·m (880 ± 110 lb ft)

i01206505

## Standard Torque for Worm Drive Band Hose Clamps

SMCS Code: 7553; 7554

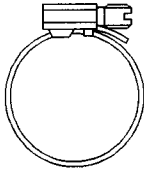


Illustration 21

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Table 8

Width of Clamp	Initial Installation Torque On New Hose
7.9 mm (0.31 inch)	0.9 ± 0.2 N·m (8 ± 2 lb in)
13.5 mm (0.53 inch)	4.5 ± 0.5 N·m (40 ± 4 lb in)
15.9 mm (0.63 inch)	7.5 ± 0.5 N·m (65 ± 4 lb in)
Width of Clamp	Reassembly or Retightening Torque
7.9 mm (0.31 inch)	0.7 ± 0.2 N·m (6 ± 2 lb in)
13.5 mm (0.53 inch)	3.0 ± 0.5 N·m (27 ± 4 lb in)
15.9 mm (0.63 inch)	4.5 ± 0.5 N·m (40 ± 4 lb in)

i01394891

## Standard Torque for Constant Torque Hose Clamps

SMCS Code: 7553; 7554

Use a constant torque hose clamp in place of any standard hose clamp. Ensure that the constant torque hose clamp is the same size as the standard hose clamp. Due to extreme temperature changes, the hose will heat set. Heat setting can cause hose clamps to loosen. Loose hose clamps can result in leaks. There have been reports of component failures that have been caused by hose clamps that have loosened. The constant torque hose clamp will help prevent these failures.

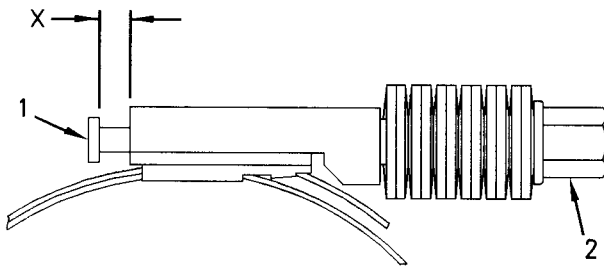


Illustration 22

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Use a torque wrench for proper installation of the constant torque hose clamps. The constant torque hose clamp is installed correctly under the following conditions:

- Screw tip (1) extends 6.35 mm (0.25 inch) (X) beyond the housing.
- The belleville washers are collapsed nearly flat after screw (2) is tightened to a torque of  $11 \pm 1$  N·m ( $98 \pm 9$  lb in).

# Lubricant Specifications

## Lubricant Information

**SMCS Code:** 1000; 1300; 7581

### General Information

Because of government regulations regarding the certification of engine exhaust emissions, the lubricant recommendations must be followed.

### Engine Manufacturers Association (EMA) Oils

The "Engine Manufacturers Association Recommended Guideline on Diesel Engine Oil" is recognized by Caterpillar. For detailed information about this guideline, see the latest edition of EMA publication, "EMA LRG-1".

### API Oils

The Engine Oil Licensing and Certification System by the American Petroleum Institute (API) is recognized by Caterpillar. For detailed information about this system, see the latest edition of the "API publication No. 1509". Engine oils that bear the API symbol are authorized by API.

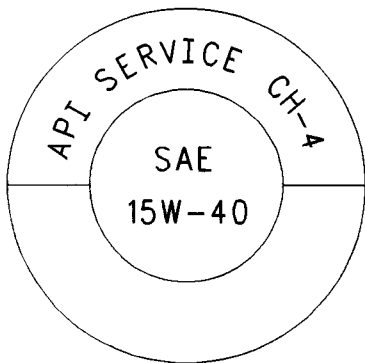


Illustration 23

Typical API symbol

Diesel engine oils CC, CD, CD-2, and CE have not been API authorized classifications since 1 January 1996. Table 9 summarizes the status of the classifications.

i01111306

Table 9

API Classifications	
Current	Obsolete
CF-4, CG-4, CH-4	CE
CF	CC, CD
CF-2 <sup>(1)</sup>	CD-2 <sup>(1)</sup>

<sup>(1)</sup> CD-2 and API CF-2 are classifications for two-cycle diesel engines. Caterpillar does not sell engines that utilize CD-2 and API CF-2 oils.

**Note:** API CF is not the same classification as API CF-4. API CF oils are only recommended for Caterpillar 3600 Series Diesel Engines and Caterpillar engines with precombustion chamber (PC) fuel systems.

### Grease

The classifications of grease are based on the "ASTM D217" worked penetration characteristics. These characteristics for grease are given a defined consistency number.

### Terminology

Certain abbreviations follow the nomenclature of "SAE J754". Some classifications follow "SAE J183" abbreviations, and some classifications follow the "EMA Recommended Guideline on Diesel Engine Oil". In addition to Caterpillar definitions, there are other definitions that will be of assistance in purchasing lubricants. Recommended oil viscosities can be found in this publication, "Engine Oil" topic (Maintenance Section).

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## Engine Oil

**SMCS Code:** 1300; 1348; 7581

### Caterpillar Diesel Engine Oil

Caterpillar Oils have been developed and tested in order to provide the full performance and service life that has been designed and built into Caterpillar Engines. Caterpillar Oils are currently used to fill diesel engines at the factory. These oils are offered by Caterpillar dealers for continued use when the engine oil is changed. Consult your Caterpillar dealer for more information on these oils.

Due to significant variations in the quality and in the performance of commercially available oils, Caterpillar makes the following recommendations:

- **Caterpillar Diesel Engine Oil (10W30)**



### • Caterpillar Diesel Engine Oil (15W40)

Caterpillar multigrade Diesel Engine Oil is formulated with the correct amounts of detergents, dispersants, and alkalinity in order to provide superior performance in Caterpillar Diesel Engines.

Caterpillar multigrade Diesel Engine Oil is available in two viscosity grades (10W30 and 15W40). For direct injection engines, see Table 10 in order to choose the correct viscosity grade for the ambient temperature. Multigrade oils provide the correct viscosity for a broad range of operating temperatures.

Multigrade oils are effective in maintaining low oil consumption and low levels of piston deposits.

Caterpillar multigrade Diesel Engine Oil can be used in other diesel engines and in gasoline engines. See the engine manufacturer's guide for the recommended specifications. Compare the specifications to the specifications of Caterpillar multigrade Diesel Engine Oil. The current industry standards for Caterpillar Diesel Engine Oil are listed on the product label and on the data sheets for the product.

Consult your Caterpillar dealer for part numbers and for available sizes of containers.

## Commercial Oils

The performance of commercial diesel engine oils is based on American Petroleum Institute (API) classifications. These API classifications are developed in order to provide commercial lubricants for a broad range of diesel engines that operate at various conditions.

If Caterpillar multigrade Diesel Engine Oil is not used, only use commercial oils that meet the following classifications:

- EMA LRG-1 multigrade oil (preferred oil)
- API CH-4 multigrade oil (preferred oil)
- API CG-4 multigrade oil (preferred oil)
- API CF-4 multigrade oil (acceptable oil)

In order to make the proper choice of a commercial oil, refer to the following explanations:

**EMA LRG-1** – The Engine Manufacturers Association (EMA) has developed lubricant recommendations as an alternative to the API oil classification system. LRG-1 is a Recommended Guideline that defines a level of oil performance for these types of diesel engines: high speed, four stroke cycle, heavy-duty, and light duty. LRG-1 oils may be used in Caterpillar engines when the following oils are recommended: API CH-4, API CG-4, and API CF-4. LRG-1 oils are intended to provide superior performance in comparison to API CG-4 and API CF-4.

LRG-1 oils will meet the needs of high performance Caterpillar diesel engines that are operating in many applications. The tests and the test limits that are used to define LRG-1 are similar to the new API CH-4 classification. Therefore, these oils will also meet the requirements of the low emissions diesel engines. LRG-1 oils are designed to control the harmful effects of soot with improved wear resistance and improved resistance to plugging of the oil filter. These oils will also provide superior piston deposit control for engines with either two-piece steel pistons or aluminum pistons.

All LRG-1 oils must complete a full test program with the base stock and with the viscosity grade of the finished commercial oil. The use of "API Base Oil Interchange Guidelines" are not appropriate for LRG-1 oils. This feature reduces the variation in performance that can occur when base stocks are changed in commercial oil formulations.

LRG-1 oils are recommended for use in extended oil change interval programs that optimize oil life. These oil change interval programs are based on oil analysis. LRG-1 oils are recommended for conditions that demand a premium oil. Your Caterpillar dealer has the specific guidelines for optimizing oil change intervals.

**API CH-4** – API CH-4 oils were developed in order to meet the requirements of the new high performance diesel engines. Also, the oil was designed to meet the requirements of the low emissions diesel engines. API CH-4 oils are also acceptable for use in older diesel engines and in diesel engines that use high sulfur diesel fuel. API CH-4 oils may be used in Caterpillar engines that use API CG-4 and API CF-4 oils. API CH-4 oils will generally exceed the performance of API CG-4 oils in the following criteria: deposits on pistons, control of oil consumption, wear of piston rings, valve train wear, viscosity control, and corrosion.

Three new engine tests were developed for the API CH-4 oil. The first test specifically evaluates deposits on pistons for engines with the two-piece steel piston. This test (piston deposit) also measures the control of oil consumption. A second test is conducted with moderate oil soot. The second test measures the following criteria: wear of piston rings, wear of cylinder liners, and resistance to corrosion. A third new test measures the following characteristics with high levels of soot in the oil: wear of the valve train, resistance of the oil in plugging the oil filter, and control of sludge.

In addition to the new tests, API CH-4 oils have tougher limits for viscosity control in applications that generate high soot. The oils also have improved oxidation resistance. API CH-4 oils must pass an additional test (piston deposit) for engines that use aluminum pistons (single piece). Oil performance is also established for engines that operate in areas with high sulfur diesel fuel.

All of these improvements allow the API CH-4 oil to achieve optimum oil change intervals. API CH-4 oils are recommended for use in extended oil change intervals. API CH-4 oils are recommended for conditions that demand a premium oil. Your Caterpillar dealer has specific guidelines for optimizing oil change intervals.

**API CG-4** – API CG-4 oils were developed primarily for diesel engines that use a 0.05 percent level of fuel sulfur. However, API CG-4 oils can be used with higher sulfur fuels. The TBN of the new oil determines the maximum fuel sulfur level for API CG-4 and API CF-4 oils. See Illustration 24.

API CG-4 oils are the first oils that are required to pass industry standard tests for foam control and viscosity shear loss. API CG-4 oils must also pass tests that were developed for corrosion, wear and oxidation.

**API CF-4** – These oils service a wide variety of modern diesel engines. API CF-4 oils provide more stable oil control and reduced piston deposits in comparison to API CF and the obsolete CE and CD classifications of oil. API CF-4 oils provide improved soot dispersancy in comparison to API CF and obsolete CD oils. The API CF-4 classification was developed with a 0.40 percent sulfur diesel fuel. This represents the type of diesel fuels that are commonly available worldwide.

**Note:** Do not use single grade API CF oils or multigrade API CF oils in Caterpillar Direct Injection (DI) Commercial Diesel Engines.

Some commercial oils that meet the API classifications may require reduced oil change intervals. To determine the oil change interval, closely monitor the condition of the oil and perform a wear metal analysis. Caterpillar's S-O-S oil analysis program is the preferred method.

#### NOTICE

Failure to follow these oil recommendations can cause shortened engine service life due to deposits and/or excessive wear.

### Total Base Number (TBN) and Fuel Sulfur Levels for Direct Injection (DI) Diesel Engines

The Total Base Number (TBN) for an oil depends on the fuel sulfur level. For direct injection engines that use distillate fuel, the minimum TBN of the new oil must be 10 times the fuel sulfur level. The TBN is defined by "ASTM D2896". The minimum TBN of the oil is 5 regardless of fuel sulfur level. Illustration 24 demonstrates the TBN.

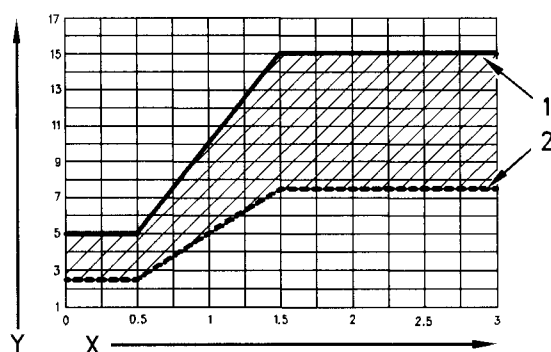


Illustration 24

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(Y) TBN by "ASTM D2896"

(X) Percentage of fuel sulfur by weight

(1) TBN of new oil

(2) Change the oil when the TBN deteriorates to 50 percent of the original TBN.

Use the following guidelines for fuel sulfur levels that exceed 1.5 percent:

- Choose an oil with the highest TBN that meets one of these classifications: EMA LRG-1, API CH-4, API CG-4, and API CF-4.
- Reduce the oil change interval. Base the oil change interval on the oil analysis. Ensure that the oil analysis includes the condition of the oil and a wear metal analysis.

Excessive piston deposits can be produced by an oil with a high TBN. These deposits can lead to a loss of control of the oil consumption and to the polishing of the cylinder bore.

#### NOTICE

Operating Direct Injection (DI) diesel engines with fuel sulfur levels over 1.0 percent may require shortened oil change intervals in order to help maintain adequate wear protection.

### Lubricant Viscosity Recommendations for Direct Injection (DI) Diesel Engines

The proper SAE viscosity grade of oil is determined by the minimum ambient temperature during cold engine start-up, and the maximum ambient temperature during engine operation.

Refer to Table 10 (minimum temperature) in order to determine the required oil viscosity for starting a cold engine.

Refer to Table 10 (maximum temperature) in order to select the oil viscosity for engine operation at the highest ambient temperature that is anticipated.

Generally, use the highest oil viscosity that is available to meet the requirement for the temperature at start-up.

Table 10

Engine Oil Viscosity		
Caterpillar DEO Multigrade EMA LRG-1 API CH-4 API CG-4 and API CF-4 Viscosity Grade	Ambient Temperature	
	Minimum	Maximum
SAE 0W20	-40 °C (-40 °F)	10 °C (50 °F)
SAE 0W30	-40 °C (-40 °F)	30 °C (86 °F)
SAE 0W40	-40 °C (-40 °F)	40 °C (104 °F)
SAE 5W30	-30 °C (-22 °F)	30 °C (86 °F)
SAE 5W40	-30 °C (-22 °F)	40 °C (104 °F)
SAE 10W30	-20 °C (-4 °F)	40 °C (104 °F)
SAE 15W40	-15 °C (5 °F)	50 °C (122 °F)

## Synthetic Base Stock Oils

**SMCS Code:** 1300; 1348; 7581

Synthetic base oils are acceptable for use in Caterpillar engines if these oils meet the performance requirements that are specified for the engine compartment.

Synthetic base oils generally perform better than conventional oils in the following two areas:

- Synthetic base oils have improved flow at low temperatures especially in arctic conditions.
- Synthetic base oils have improved oxidation stability especially at high operating temperatures.

Some synthetic base oils have performance characteristics that enhance the service life of the oil. However, Caterpillar does not recommend the automatic extension of oil change intervals for any type of oil. Oil change intervals for Caterpillar engines can only be adjusted after an oil analysis program that contains the following tests: oil condition and wear metal analysis (Caterpillar's S-O-S oil analysis), trend analysis, fuel consumption, and oil consumption.

## Re-refined Base Stock Oils

**SMCS Code:** 1300; 7581

Re-refined base stock oils are acceptable for use in Caterpillar engines if these oils meet the performance requirements that are specified by Caterpillar. Re-refined base stock oils can be used exclusively in finished oil or in a combination with new base stock oils. The US military specifications and the specifications of other heavy equipment manufacturers also allow the use of re-refined base stock oils that meet the same criteria.

The process that is used to make re-refined base stock oil should adequately remove all wear metals that are in the used oil and all additives that are in the used oil. The process that is used to make re-refined base stock oil generally involves the processes of vacuum distillation and hydrotreating the used oil. Filtering is inadequate for the production of high quality re-refined base stock oils from used oil.

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## Cold Weather Lubricants

**SMCS Code:** 1300; 1348; 7581

When an engine is started and an engine is operated in ambient temperatures below  $-20^{\circ}\text{C}$  ( $-4^{\circ}\text{F}$ ), use multigrade oils that are capable of flowing in low temperatures.

These oils have lubricant viscosity grades of SAE 0W or SAE 5W.

When an engine is started and operated in ambient temperatures below  $-30^{\circ}\text{C}$  ( $-22^{\circ}\text{F}$ ), use a synthetic base stock multigrade oil with a 0W viscosity grade or with a 5W viscosity grade. Use an oil with a pour point that is lower than  $-50^{\circ}\text{C}$  ( $-58^{\circ}\text{F}$ ).

The number of acceptable lubricants is limited in cold weather conditions. Caterpillar recommends the following lubricants for use in cold weather conditions:

**First Choice** – use an oil with an EMA LRG-1 Recommended Guideline or use a CH-4 oil that is API licensed with an SAE 0W20, SAE 0W30, SAE 0W40, SAE 5W30, or SAE 5W40 lubricant viscosity grade. A CG-4 oil that is API licensed with an SAE 0W20, SAE 0W30, SAE 0W40, SAE 5W30, or SAE 5W40 lubricant viscosity grade may also be used. A CF-4 oil that is API licensed with an SAE 0W20, SAE 0W30, SAE 0W40, SAE 5W30, or SAE 5W40 lubricant viscosity grade may also be used.

**Second Choice** – use an oil that contains the CH-4, CG-4, or CF-4 additive package although the oil has not been tested for the requirements of the API license. The oil must have an SAE 0W20, SAE 0W30, SAE 0W40, SAE 5W30, or SAE 5W40 lubricant viscosity grade.

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### NOTICE

Shortened engine service life could result if second choice oils are used.

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## Aftermarket Oil Additives

**SMCS Code:** 1300; 1348; 7581

Caterpillar does not recommend the use of aftermarket additives in oil. It is not necessary to use aftermarket additives in order to achieve the engine's maximum service life or rated performance. Fully formulated, finished oils consist of base oils and of commercial additive packages. These additive packages are blended into the base oils at precise percentages in order to help provide finished oils with performance characteristics that meet industry standards.

There are no industry standard tests that evaluate the performance or the compatibility of aftermarket additives in finished oil. Aftermarket additives may not be compatible with the finished oil's additive package, which could lower the performance of the finished oil. The aftermarket additive could fail to mix with the finished oil. This could produce sludge in the crankcase. Caterpillar discourages the use of aftermarket additives in finished oils.

To achieve the best performance from a Caterpillar engine, conform to the following guidelines:

- Select the proper Caterpillar oil or a commercial oil that meets the "EMA Recommended Guideline on Diesel Engine Oil" or the recommended API classification.
- See the appropriate "Lubricant Viscosities" table in order to find the correct oil viscosity grade for your engine.
- At the specified interval, service the engine compartment. Use new oil and install a new oil filter.
- Perform maintenance at the intervals that are specified in the Operation and Maintenance Manual, "Maintenance Interval Schedule".

## Lubricating Grease

**SMCS Code:** 7581

Caterpillar provides greases in order to cover a variety of applications and extreme temperature conditions. Consult your Caterpillar dealer for part numbers and for available sizes of containers.

**Note:** Some greases may not be used with other greases. When a commercial grease is used, ensure that the grease is compatible with the grease that is currently used in the system. If the commercial grease is not compatible, the system must be purged. If any questions arise concerning the compatibility of a grease, consult the supplier.

## Multipurpose Greases

### Multipurpose Lithium Complex Grease (MPGL)

Multipurpose Lithium Complex Grease (MPGL) is a general purpose lithium complex grease for medium-duty applications. This product has good characteristics at high temperatures such as a dropping point of 260 °C (500 °F). MPGL contains unleaded extreme pressure additives, antiwear inhibitors, and corrosion inhibitors that provide extra protection in the following applications:

- Construction
- Agricultural
- Automotive

MPGL meets the requirements for extended service intervals of automotive chassis points. MPGL also meets the requirements for extended service intervals of wheel bearings with disc brakes in automobiles, in vans and in light trucks. This product meets the NLGI certification of "GC-LB". MPGL is also available in a NLGI No. 2 grade. Normal operating temperatures for this product are -28 to 149 °C (-18 to 300 °F). This product is also available as a white lithium complex grease.

### Multipurpose Lithium Complex Grease with Molybdenum (MPGM)

Multipurpose Lithium Complex Grease with Molybdenum (MPGM) is a general purpose lithium complex grease that is used for light-duty applications and for medium-duty applications. The MPGM is available in the following grades: NLGI No. 2 grade and NLGI No. 0 grade. The MPGM is strengthened with a molybdenum disulfide and a polymer for extra lubrication and protection. MPGM contains unleaded additives. MPGM also contains antiwear inhibitors, rust inhibitors, and corrosion inhibitors that are for protection and lubrication in many environments. The MPGM is formulated with a base fluid that has high viscosity.

The MPGM has the following features:

- Increased protection against water washout

- Increased retention
- Resistance to heavy loads

This product is recommended for heavily loaded pin joints and for journal bearings. This product meets the certification of "GC-LB". Normal operating temperatures for this product are -28 to 149 °C (-18 to 300 °F) for the NLGI No. 0 grade. Normal operating temperatures for this product are -18 to 149 °C (0 to 300 °F) for the NLGI No. 2 grade.

**Note:** If MPGM is not available, use a multipurpose type grease which contains three to five percent molybdenum.

## Special Purpose Grease (SPG)

### Bearing Lubricant (SPG)

Bearing Lubricant (SPG) is available in a NLGI No. 2 grade with a polyurea thickener. This grease is recommended for high temperature antifriction bearings in the following applications: electric starting motors, alternators, fan drives, and generators. The Bearing Lubricant (SPG) has an effective operating range of -29 to 177 °C (-20 to 350 °F).

### Water and Temperature Resistant Grease (WTR)

The Water and Temperature Resistant Grease is designed for use whenever the following conditions are a concern: water washout, severe corrosion, and high operating temperatures. The Water and Temperature Resistant Grease provides extreme pressure protection, antiwear protection, rust protection and corrosion protection. The Water and Temperature Resistant Grease is an environmentally friendly grease which does not contain the following materials: antimony, sulfur, barium, zinc, lead, and phosphorous materials. The Water and Temperature Resistant Grease has excellent shear stability. Water and Temperature Resistant Grease can also resist breakdown in the presence of water. The Water and Temperature Resistant Grease works well in the following applications:

- Construction
- Agricultural
- Automotive
- Industrial
- Marine

This product meets the NLGI certification of "GC-LB". Normal operating temperatures for this product are -40 to 204°C (-40 to 400°F).

## Caterpillar Premium Grease (CPG)

### Desert Gold (CPG)

Desert Gold is a heavy-duty, premium synthetic grease that is developed for the most extreme operating environments. This grease is formulated with the following characteristics: high viscosity synthetic base fluid, polymers, molybdenum disulfide, high viscosity index, and high dropping point.

Desert Gold will protect equipment against heavy shock loads. Desert Gold protects against corrosion in extreme heat, in moist conditions, or in dusty conditions. This product has excellent characteristics of adhesion and of stability. Desert Gold provides longer protection than other greases. Desert Gold is an environmentally friendly grease which does not contain the following materials: antimony, sulfur, barium, zinc, lead, and phosphorous materials. Normal operating temperatures are -6 to 230 °C (21 to 450 °F). Desert Gold can operate at higher temperatures for short time periods. Desert Gold has additional extreme pressure protection for highly loaded pin joints.

### Arctic Platinum (CPG)

Arctic Platinum is a super-premium extreme pressure lubricating grease that is developed for lubrication in temperatures that are below zero to moderate operating temperatures. Arctic Platinum is available in grades 000, 00, 0, 1, and 2. These grades ensure pumpability in central lube systems in a variety of ambient temperatures from -60 to 18 °C (-76 to 65 °F). Arctic Platinum has a high dropping point. Arctic Platinum contains a five percent concentrate of molybdenum disulfide for protection against extra heavy loads. Arctic Platinum provides excellent corrosion protection and rust protection. Arctic Platinum is an environmentally friendly grease which does not contain the following materials: antimony, sulfur, barium, zinc, and phosphorous.

Arctic Platinum is designed for long life lubrication of the following components: horizontal pivot bearings, lower link bearings, steering cylinders, kingbolt bearings, upper hitch link bearings, and ejector carrier roller bearings. This grease is extra tacky for retention on excavator carbody bearings. Arctic Platinum has additional extreme pressure protection for highly loaded pin joints.

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## S-O-S Oil Analysis

**SMCS Code:** 1348; 7542; 7581

Caterpillar recommends the use of the S-O-S oil analysis program in order to monitor the condition and the maintenance requirements of the equipment. The S-O-S oil analysis program will complement the preventive maintenance program.

The S-O-S oil analysis is a diagnostic tool that is used to determine oil performance and component wear rates. Contamination can be identified and measured through the use of the S-O-S oil analysis. The S-O-S oil analysis includes the following tests:

- The Wear Rate Analysis monitors the wear of the engine's metals. The amount of wear metal and type of wear metal that is in the oil is analyzed. The increase in the rate of engine wear metal in the oil is as important as the quantity of engine wear metal in the oil. For this reason, regular sampling at specified intervals is necessary in order to establish wear rates. Intermittent sampling does not allow wear rate trend lines to be established. Engine wear metals in the oil sample are compared to established Caterpillar norms in order to determine acceptability.
- Tests are conducted in order to detect contamination of the oil by water, glycol or fuel.
- The Oil Condition Analysis determines the loss of the oil's lubricating properties. An infrared analysis is used to compare the properties of new oil to the properties of the used oil sample. This analysis allows technicians to determine the amount of deterioration of the oil during use. This analysis also allows technicians to verify the performance of the oil according to the specification during the entire oil change interval.

The test results of the oil samples will then be used as a basis for determining the oil change interval for the engine. The results of the S-O-S oil analysis may allow the engine to operate longer between oil changes without the risk of engine damage.

Table 11

S-O-S Oil Analysis Interval	
Compartment	Interval
Engine crankcase	Every 250 Service Hours

For more information, see Special Publication, PEDP7036, "S-O-S Fluid Analysis". Consult your Caterpillar dealer for complete information and assistance about the program.

# Fuel Specifications

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## Fuel Recommendations

**SMCS Code:** 1250; 1280

Diesel engines have the ability to burn a wide variety of fuels. These fuels are divided into two general groups. The two groups are called the preferred fuels and the permissible fuels.

The preferred fuels provide maximum engine service life and performance. The preferred fuels are distillate fuels. These fuels are commonly called diesel fuel, furnace fuel, gas oil, or kerosene.

The permissible fuels are crude oils or blended fuels. Use of these fuels can result in higher maintenance costs and in reduced engine service life.

Diesel fuels that meet the specifications in Table 12 will help to provide maximum engine service life and performance. In North America, diesel fuel that is identified as No. 1-D or No. 2-D in "ASTM D975" generally meet the specifications. Table 12 is for diesel fuels that are distilled from crude oil. Diesel fuels from other sources could exhibit detrimental properties that are not defined or controlled by this specification.

Table 12

Caterpillar Specifications for Distillate Diesel Fuel		
Specifications	Requirements	ASTM Test
Aromatics	35% maximum	"D1319"
Ash	0.02% maximum (weight)	"D482"
Carbon Residue on 10% Bottoms	0.35% maximum (weight)	"D524"
Cetane Number	40 minimum (DI engines)	"D613"
	35 minimum (PC engines)	
Cloud Point	The cloud point must not exceed the lowest expected ambient temperature.	-
Copper Strip Corrosion	No. 3 maximum	"D130"

(continued)

(Table 12, contd)

Caterpillar Specifications for Distillate Diesel Fuel		
Specifications	Requirements	ASTM Test
Distillation	10% at 282 °C (540 °F) maximum	"D86"
	90% at 360 °C (680 °F) maximum	
Flash Point	legal limit	"D93"
API Gravity	30 minimum	"D287"
	45 maximum	
Pour Point	6 °C (10 °F) minimum below ambient temperature	"D97"
Sulfur <sup>(1)</sup>	3% maximum	"D3605" or "D1552"
Kinematic Viscosity <sup>(2)</sup>	1.4 cSt minimum and 20.0 cSt maximum at 40 °C (104 °F)	"D445"
Water and Sediment	0.1% maximum	"D1796"
Water	0.1% maximum	"D1744"
Sediment	0.05% maximum (weight)	"D473"
Gums and Resins <sup>(3)</sup>	10 mg per 100 mL maximum	"D381"
Lubricity <sup>(4)</sup>	3100 g minimum	"D6078"
	0.45 mm (0.018 inch) maximum at 60 °C (140 °F)	"D6079"
	0.38 mm (0.015 inch) maximum at 25 °C (77 °F)	

(1) Caterpillar fuel systems and engine components can operate on high sulfur fuels. Fuel sulfur levels affect exhaust emissions. High sulfur fuels also increase the potential for corrosion of internal components. Fuel sulfur levels above 1.0 percent may significantly shorten the oil change interval. For additional information, see this publication, "Engine Oil" topic (Maintenance Section).

(2) The values of the fuel viscosity are the values as the fuel is delivered to the fuel injection pumps. If a fuel with a low viscosity is used, cooling of the fuel may be required to maintain a 1.4 cSt viscosity at the fuel injection pump. Fuels with a high viscosity might require fuel heaters in order to bring down the viscosity to a 20 cSt viscosity. For additional information, see Special Publication, SEBD0717, "Diesel Fuel and Your Engine".

(3) Follow the test conditions and procedures for gasoline (motor).

(4) The lubricity of a fuel is a concern with low sulfur fuel. To determine the lubricity of the fuel, use either the "ASTM D6078 Scuffing Load Wear Test (SBOCLE)" or the "ASTM D6079 High Frequency Reciprocating Rig (HFRR)" test. If the lubricity of a fuel does not meet the minimum requirements, consult your fuel supplier. Do not treat the fuel without consulting the fuel supplier. Some additives are not compatible. These additives can cause problems in the fuel system.

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**NOTICE**

Operating with fuels that do not meet Caterpillar's recommendations can cause the following effects: starting difficulty, poor combustion, deposits in the fuel injectors, reduced service life of the fuel system, deposits in the combustion chamber, and reduced service life of the engine.

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In the USA, 0.05 percent diesel fuels have been used in all on-highway truck engines since 1 January 1994. This low sulfur diesel fuel was mandated as a means of directly reducing particulate emissions from diesel truck engines. This low sulfur fuel will also be used in Caterpillar commercial diesel engines when low emissions are required or when the fuel supply sources provide this type of fuel. Caterpillar has not seen any detrimental effects with 0.05 percent sulfur fuel in Caterpillar diesel engines.

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**NOTICE**

Heavy Fuel Oil (HFO), Residual fuel, or Blended fuel must NOT be used in Caterpillar diesel engines (except in 3600 Series HFO engines). Severe component wear and component failures will result if HFO type fuels are used in engines that are configured to use distillate fuel.

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In extreme cold ambient conditions, you may use the distillate fuels that are specified in Table 13. However, the fuel that is selected must meet the requirements that are specified in Table 12. These fuels are intended to be used in operating temperatures that are down to  $-54^{\circ}\text{C}$  ( $-65^{\circ}\text{F}$ ).

Table 13

Distillate Fuels <sup>(1)</sup>	
Specification	Grade
"MIL-T-5624R"	JP-5
"ASTM D1655"	Jet-A-1
"MIL-T-83133D"	JP-8

(1) The fuels that are listed in this Table may not meet the requirements that are specified in the "Caterpillar Specifications for Distillate Diesel Fuel" Table. Consult the supplier for the recommended additives in order to maintain the proper fuel lubricity.

These fuels are lighter than the No. 2 grades of fuel. The cetane number of the fuels in Table 13 must be at least 40. If the viscosity is below 1.4 cSt at  $38^{\circ}\text{C}$  ( $100^{\circ}\text{F}$ ), use the fuel only in temperatures below  $0^{\circ}\text{C}$  ( $32^{\circ}\text{F}$ ). Do not use any fuels with a viscosity of less than 1.2 cSt at  $38^{\circ}\text{C}$  ( $100^{\circ}\text{F}$ ). Fuel cooling may be required in order to maintain the minimum viscosity of 1.4 cSt at the fuel injection pump.

There are many other diesel fuel specifications that are published by governments and by technological societies. Usually, those specifications do not review all the requirements that are addressed in this specification. To ensure optimum engine performance, a complete fuel analysis should be obtained before engine operation. The fuel analysis should include all of the properties that are listed in Table 12.



# Cooling System Specifications

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## General Coolant Information

**SMCS Code:** 1350; 1395

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### NOTICE

Never add coolant to an overheated engine. Engine damage could result. Allow the engine to cool first.

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### NOTICE

If the engine is to be stored in, or shipped to an area with below freezing temperatures, the cooling system must be either protected to the lowest outside temperature or drained completely to prevent damage.

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### NOTICE

In cold weather, frequently check the specific gravity of the coolant solution to ensure adequate protection.

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Clean the cooling system for the following reasons:

- Contamination of the cooling system
- Overheating of the engine
- Foaming of the coolant

**Note:** Air pockets can form in the cooling system if the cooling system is filled at a rate that is greater than 20 L (5 US gal) per minute.

After you drain the cooling system and after you refill the cooling system, operate the engine. Operate the engine without the filler cap until the coolant reaches normal operating temperature and the coolant level stabilizes. Ensure that the coolant is maintained to the proper level.

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### NOTICE

Never operate an engine without water temperature regulators in the cooling system. Water temperature regulators help to maintain the engine coolant at the proper operating temperature. Cooling system problems can develop without water temperature regulators.

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Refer to Special Instruction, SEBD0518, "Know Your Cooling System" and Special Instruction, SEBD0970, "Coolant and Your Engine" for more detailed information.

Many engine failures are related to the cooling system. The following problems are related to cooling system failures: overheating, leakage of the water pump, plugged radiators or heat exchangers, and pitting of the cylinder liners.

These failures can be avoided with proper cooling system maintenance. Cooling system maintenance is as important as maintenance of the fuel system and the lubrication system. Quality of the coolant is as important as the quality of the fuel and the lubricating oil.

Coolant is normally composed of three elements: water, additives, and glycol.

## Water

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### NOTICE

All Caterpillar diesel engines equipped with air-to-air aftercooling (ATAAC) require a minimum of 30 percent glycol to prevent water pump cavitation.

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### NOTICE

Never use water alone without Supplemental Coolant Additives (SCA) or without inhibited coolant. Water alone is corrosive at engine operating temperatures. Water alone does not provide adequate protection against boiling or freezing.

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Water is used in the cooling system in order to transfer heat.

**Distilled water or deionized water is recommended for use in engine cooling systems.**

DO NOT use the following types of water in cooling systems: hard water, softened water that has been conditioned with salt, and sea water.

If distilled water or deionized water is not available, use water with the properties that are listed in Table 14.

Table 14

Caterpillar Minimum Acceptable Water Requirements		
Property	Maximum Limit	ASTM Test
Chloride (Cl)	40 mg/L (2.4 grains/US gal)	"D512", "D4327"
Sulfate (SO <sub>4</sub> )	100 mg/L (5.9 grains/US gal)	"D516"
Total Hardness	170 mg/L (10 grains/US gal)	"D1126"
Total Solids	340 mg/L (20 grain/US gal)	"D1888"
Acidity	pH of 5.5 to 9.0	"D1293"

For a water analysis, consult one of the following sources:

- Caterpillar dealer
- Local water utility company
- Agricultural agent
- Independent laboratory

## Additives

Additives help to protect the metal surfaces of the cooling system. A lack of coolant additives or insufficient amounts of additives enable the following conditions to occur:

- Corrosion
- Formation of mineral deposits
- Rust
- Scale
- Pitting and erosion from cavitation of the cylinder liner
- Foaming of the coolant

Many additives are depleted during engine operation. These additives must be replaced periodically. This can be done by adding Supplemental Coolant Additives (SCA) to Diesel Engine Antifreeze/Coolant (DEAC) or by adding ELC Extender to Extended Life Coolant (ELC).

Additives must be added at the proper concentration. Overconcentration of additives can cause the inhibitors to drop out-of-solution. The deposits can enable the following problems to occur:

- Formation of gel compounds
- Reduction of heat transfer
- Leakage of the water pump seal
- Plugging of radiators, coolers, and small passages

## Glycol

Glycol in the coolant helps to provide protection against the following conditions:

- Boiling
- Freezing
- Cavitation of the water pump and the cylinder liner

For optimum performance, Caterpillar recommends a 1:1 mixture of a water/glycol solution.

### NOTICE

All Caterpillar diesel engines equipped with air-to-air aftercooling (ATAAC) require a minimum of 30 percent glycol to prevent water pump cavitation.

**Note:** Use a mixture that will provide protection against the lowest ambient temperature.

**Note:** 100 percent pure glycol will freeze at a temperature of  $-23^{\circ}\text{C}$  ( $-9^{\circ}\text{F}$ ).

Most conventional heavy-duty coolant/antifreezes use ethylene glycol. Propylene glycol may also be used. In a 1:1 mixture with water, ethylene and propylene glycol provide similar protection against freezing and boiling. See Tables 15 and 16.

Table 15

Ethylene Glycol		
Concentration	Freeze Protection	Boil Protection
50 Percent	$-36^{\circ}\text{C}$ ( $-33^{\circ}\text{F}$ )	$106^{\circ}\text{C}$ ( $223^{\circ}\text{F}$ )
60 Percent	$-51^{\circ}\text{C}$ ( $-60^{\circ}\text{F}$ )	$111^{\circ}\text{C}$ ( $232^{\circ}\text{F}$ )

### NOTICE

Do not use propylene glycol in concentrations that exceed 50 percent glycol because of propylene glycol's reduced heat transfer capability. Use ethylene glycol in conditions that require additional protection against boiling or freezing.

Table 16

Propylene Glycol		
Concentration	Freeze Protection	Boil Protection
50 Percent	-29 °C (-20 °F)	106 °C (223 °F)

To check the concentration of glycol, use the 1U-7298 Coolant/Battery Tester (Degree Celsius) or use the 1U-7297 Coolant/Battery Tester (Degree Fahrenheit). The testers give readings that are immediate and accurate. The testers can be used with ethylene or propylene glycol.

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## Coolant Recommendations

**SMCS Code:** 1350; 1395

The following two coolants are used in Caterpillar diesel engines:

**Preferred** – Caterpillar Extended Life Coolant (ELC) or a commercial extended life coolant that meets the Caterpillar EC-1 specification

**Acceptable** – A Caterpillar Diesel Engine Antifreeze/Coolant (DEAC) or a commercial heavy-duty coolant/antifreeze that meets “ASTM D4985” or “ASTM D5345” specifications

### NOTICE

Do not use a commercial coolant/antifreeze that only meets the ASTM D3306 or D4656 specification. This type of coolant/antifreeze is made for light duty automotive applications.

Caterpillar recommends a 1:1 mixture of water and glycol. This mixture of water and glycol will provide optimum heavy-duty performance as a coolant/antifreeze.

**Note:** Caterpillar DEAC DOES NOT require a treatment with an SCA at the initial fill. Commercial heavy-duty coolant/antifreeze that meets “ASTM D4985” or “ASTM D5345” specifications MAY require a treatment with an SCA at the initial fill. Read the label or the instructions that are provided by the OEM of the product.

In stationary engine applications and marine engine applications that do not require anti-boil protection or freeze protection, a mixture of SCA and water is acceptable. Caterpillar recommends a six percent to eight percent concentration of SCA in those cooling systems. Distilled water or deionized water is preferred. Water which has the recommended properties may be used.

### NOTICE

All Caterpillar diesel engines equipped with air-to-air aftercooling (ATAAC) require a minimum of 30 percent glycol to prevent water pump cavitation.

Table 17

Coolant Service Life	
Coolant Type	Service Life
Caterpillar ELC	6000 Service Hours or Six Years
Caterpillar DEAC	3000 Service Hours or Three Years
Commercial Heavy-Duty Coolant/Antifreeze that meets “ASTM D5345”	3000 Service Hours or Two Years
Commercial Heavy-Duty Coolant/Antifreeze that meets “ASTM D4985”	3000 Service Hours or One Year
Caterpillar SCA and Water	3000 Service Hours or Two Years
Commercial SCA and Water	3000 Service Hours or One Year

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## S-O-S Coolant Analysis

**SMCS Code:** 1352; 1395; 7542

Testing the engine coolant is important to ensure that the engine is protected from internal cavitation and from corrosion. The analysis also tests the ability of the coolant to protect the engine from boiling and from freezing. The S-O-S Coolant Analysis can be done at your Caterpillar dealer. Caterpillar S-O-S Coolant Analysis is the best way to monitor the condition of your coolant and your cooling system. S-O-S Coolant Analysis is a program that is based on periodic samples.

### NOTICE

Do not use the same vacuum sampling pump for extracting oil samples that is used for extracting coolant samples.

A small residue of either type sample may remain in the pump and may cause a false positive analysis for the sample being taken.

Always use a designated pump for oil sampling and a designated pump for coolant sampling.

Failure to do so may cause a false analysis which could lead to customer and dealer concerns.

## New Systems, Refilled Systems, and Converted Systems

Perform a coolant analysis (Level 2) at 500 service hours for new systems, for refilled systems, or for converted systems that use ELC or use DEAC. This 500 hour check will also check for any residual cleaner that may have contaminated the system.

## Recommended Interval for S·O·S Coolant Sample

Perform a coolant analysis (Level 1) at every 500 service hour interval. Perform a coolant analysis (Level 2) annually.

**Note:** Check the standard coolant's Supplemental Coolant Additive at every oil change.

## S·O·S Coolant Analysis (Level 1)

A coolant analysis (Level 1) is a test of the properties of the coolant.

The following properties of the coolant are tested:

- Glycol Concentration for freeze protection
- Ability to protect from erosion and corrosion
- pH
- Conductivity
- Water hardness
- Visual analysis
- Odor analysis

The results are reported, and appropriate recommendations are made.

## S·O·S Coolant Analysis (Level 2)

Level 2 coolant analysis is a comprehensive chemical evaluation of the coolant. This analysis is also a check of the overall condition of the inside of the cooling system.

The S·O·S Coolant Analysis has the following five features:

- Full analysis of Level 1
- Identification of the source of metal corrosion and of contaminants

- Identification of buildup of the impurities that cause corrosion
- Identification of buildup of the impurities that cause scaling
- Determination of possible electrolysis within the engines' cooling system

The results are reported, and appropriate recommendations are made.

For more information on S·O·S Coolant Analysis, consult your Caterpillar dealer.

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## Extended Life Coolant (ELC)

**SMCS Code:** 1350; 1395

Caterpillar provides Extended Life Coolant (ELC) for use in the following applications:

- Heavy-duty spark ignited gas engines
- Heavy-duty diesel engines
- Automotive applications

The anti-corrosion package for Caterpillar ELC is different from the anti-corrosion package for other coolants. Caterpillar ELC is an ethylene glycol base coolant. However, Caterpillar ELC contains organic corrosion inhibitors and antifoam agents with low amounts of nitrite. Caterpillar ELC has been formulated with the correct amount of these additives in order to provide superior corrosion protection for all metals in engine cooling systems.

ELC extends the service life of the coolant to 6000 service hours or six years. ELC does not require a frequent addition of a Supplemental Coolant Additive (SCA). An Extender is the only additional maintenance that is needed at 3000 service hours or one half of the ELC service life.

ELC is available in a 1:1 premixed cooling solution with distilled water. The Premixed ELC provides freeze protection to  $-36^{\circ}\text{C}$  ( $-33^{\circ}\text{F}$ ). The Premixed ELC is recommended for the initial fill of the cooling system. The Premixed ELC is also recommended for topping off the cooling system.

ELC Concentrate is also available. ELC Concentrate can be used to lower the freezing point to  $-51^{\circ}\text{C}$  ( $-60^{\circ}\text{F}$ ) for arctic conditions.

Containers of several sizes are available. Consult your Caterpillar dealer for the part numbers.

**Note:** Caterpillar developed the EC-1 specification. The EC-1 specification is an industry standard. The EC-1 specification defines all of the performance requirements that are needed for an engine coolant to be sold as an extended life coolant for Caterpillar engines. ELC can be used in most OEM engines of the following types: diesel, gasoline, and natural gas. ELC meets the performance requirements of "ASTM D4985" and "ASTM D5345" for heavy-duty low silicate antifreeze/coolants. ELC also meets the performance requirements of "ASTM D3306" and "ASTM D4656" for automotive applications.

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## Extended Life Coolant (ELC) Cooling System Maintenance

**SMCS Code:** 1350; 1352; 1395

### Proper additions to the Extended Life Coolant

#### NOTICE

Use only Caterpillar products or commercial products that have passed Caterpillar's EC-1 specification for pre-mixed or concentrated coolants.

Use only Caterpillar Extender with Extended Life Coolant.

Mixing Extended Life Coolant with other products reduces the Extended Life Coolant service life. Failure to follow the recommendations can reduce cooling system components life unless appropriate corrective action is performed.

In order to maintain the correct balance between the antifreeze and the additives, you must maintain the recommended concentration of Extended Life Coolant (ELC). Lowering the proportion of antifreeze lowers the proportion of additive. This will lower the ability of the coolant to protect the system from pitting, from cavitation, from erosion, and from deposits.

#### NOTICE

Do not use a conventional coolant to top-off a cooling system that is filled with Extended Life Coolant (ELC).

Do not use standard supplemental coolant additive (SCA). Only use ELC Extender in cooling systems that are filled with ELC.

## Caterpillar ELC Extender

Caterpillar ELC Extender is added to the cooling system halfway through the ELC service life. Treat the cooling system with ELC Extender at 3000 hours or one half of the coolant service life. Use Table 18 in order to determine the proper amount of ELC Extender that is required.

Containers of several sizes are available. Consult your Caterpillar dealer for the part numbers.

Table 18

Caterpillar ELC Extender Additions by Cooling System Capacity	
Cooling System Capacity	Addition of ELC Extender
22 to 30 L (6 to 8 US gal)	0.57 L (20 fl oz)
31 to 38 L (9 to 10 US gal)	0.71 L (24 fl oz)
39 to 49 L (11 to 13 US gal)	0.95 L (32 fl oz)
50 to 64 L (14 to 17 US gal)	1.18 L (40 fl oz)
65 to 83 L (18 to 22 US gal)	1.60 L (54 fl oz)
84 to 114 L (23 to 30 US gal)	2.15 L (72 fl oz)
115 to 163 L (31 to 43 US gal)	3.00 L (100 fl oz)
164 to 242 L (44 to 64 US gal)	4.40 L (148 fl oz)

For cooling system capacities that exceed the capacities that are specified in Table 18, use the equation that is in Table 19 in order to determine the proper amount of ELC Extender that is required.

Table 19

Equation For Adding ELC Extender To ELC
$V \times 0.02 = X$ <p>V is the total volume of the cooling system.</p> <p>X is the amount of ELC Extender that is required.</p>

Table 20 is an example for using the equation that is in Table 19.

Table 20

Example Of The Equation For Adding ELC Extender To ELC		
Total Volume of the Cooling System (V)	Multiplication Factor	Amount of ELC Extender that is Required (X)
946 L (250 US gal)	$\times 0.02$	19 L (5 US gal)

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**NOTICE**

When using Caterpillar ELC, do not use standard SCA's or SCA filters. To avoid SCA contamination of an ELC system, remove the SCA filter base and plug off or by-pass the coolant lines.

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## ELC Cooling System Cleaning

**Note:** If the cooling system is already using ELC, cleaning agents are not required to be used at the specified coolant change interval. Cleaning agents are only required if the system has been contaminated by the addition of some other type of coolant or by cooling system damage.

Clean water is the only cleaning agent that is required when ELC is drained from the cooling system.

ELC can be recycled. The drained coolant mixture can be distilled in order to remove the ethylene glycol and the water. The ethylene glycol and the water can be reused. Consult your Caterpillar dealer for more information.

After the cooling system is drained and after the cooling system is refilled, operate the engine while the cooling system filler cap is removed. Operate the engine until the coolant level reaches the normal operating temperature and until the coolant level stabilizes. As needed, add the coolant mixture in order to fill the system to the proper level.

## Changing to Caterpillar ELC

To change from heavy-duty coolant/antifreeze to the Caterpillar ELC, perform the following steps:

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**NOTICE**

Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

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1. Drain the coolant into a suitable container.
2. Dispose of the coolant according to local regulations.

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**NOTICE**

Do not leave an empty SCA filter on an ELC system.

The filter housing may corrode and leak causing an engine failure.

Remove the SCA filter base and plug off or by-pass the coolant lines.

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3. Remove the empty SCA filter and remove the filter base. Plug the coolant lines or bypass the coolant lines.
4. Flush the system with clean water in order to remove any debris.
5. Use Caterpillar cleaner to clean the system. Follow the instruction on the label.
6. Drain the cleaner into a suitable container. Flush the cooling system with clean water.
7. Fill the cooling system with clean water and operate the engine until the engine is warmed to 49° to 66°C (120° to 150°F).

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**NOTICE**

Improper or incomplete rinsing of the cooling system can result in damage to copper and other metal components.

To avoid damage to the cooling system, make sure to completely flush the cooling system with clear water. Continue to flush the system until all signs of the cleaning agent are gone.

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8. Drain the cooling system into a suitable container and flush the cooling system with clean water.

**Note:** The cooling system cleaner must be thoroughly flushed from the cooling system. Cooling system cleaner that is left in the system will contaminate the coolant. The cleaner may also corrode the cooling system.

9. Repeat Steps 7 and 8 until the system is completely clean.
10. Fill the cooling system with the Caterpillar premixed ELC.
11. Attach the Special Publication, PEEP5027, "Label" to the cooling system filler for the engine in order to indicate the use of Caterpillar ELC.

## ELC Cooling System Contamination

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### NOTICE

Mixing ELC with other products reduces the effectiveness of the ELC and shortens the ELC service life. Use only Caterpillar products or commercial products that have passed the Caterpillar EC-1 specification for premixed or concentrate coolants. Use only Caterpillar ELC Extender with Caterpillar ELC. Failure to follow these recommendations can result in shortened cooling system component life.

ELC cooling systems can withstand contamination to a maximum of ten percent of conventional heavy-duty coolant/antifreeze or SCA. If the contamination exceeds ten percent of the total system capacity, perform ONE of the following procedures:

- Drain the cooling system into a suitable container. Dispose of the coolant according to local regulations. Flush the system with clean water. Fill the system with the Caterpillar ELC.
- Drain a portion of the cooling system into a suitable container according to local regulations. Then, fill the cooling system with premixed ELC. This should lower the contamination to less than 10 percent.
- Maintain the system as a conventional Diesel Engine Antifreeze/Coolant (DEAC). Treat the system with an SCA. Change the coolant at the interval that is recommended for the conventional Diesel Engine Antifreeze/Coolant (DEAC).

## Commercial ELC

If Caterpillar ELC is not used, then select a commercial ELC that meets the Caterpillar specification of EC-1 and either the "ASTM D5345" specification or the "ASTM D4985" specification. Do not use an extended life coolant that does not meet the EC-1 specification. Follow the maintenance guide for the coolant from the supplier of the commercial ELC. Follow the Caterpillar guidelines for the quality of water and the specified coolant change interval.

## Diesel Engine Antifreeze/Coolant (DEAC)

**SMCS Code:** 1350; 1395

Caterpillar recommends using Caterpillar Diesel Engine Antifreeze/Coolant (DEAC) for cooling systems that require a heavy-duty coolant/antifreeze. Caterpillar DEAC is an alkaline single-phase ethylene glycol type antifreeze that contains corrosion inhibitors and antifoam agents.

Caterpillar DEAC is formulated with the correct amount of Caterpillar Supplemental Coolant Additive (SCA). Do not use SCA at the initial fill when DEAC is used.

Containers of several sizes are available. Consult your Caterpillar dealer for the part numbers.

If concentrated DEAC is used, Caterpillar recommends mixing the concentrate with distilled water or with deionized water. If distilled water is not available or deionized water is not available, use water which has the required properties. For the water properties, see this publication, "General Coolant Information" topic (Maintenance Section).

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## Supplemental Coolant Additive (SCA)

**SMCS Code:** 1350; 1352; 1395

The use of SCA helps to prevent the following conditions from occurring:

- Corrosion
- Formation of mineral deposits
- Cavitation erosion of the cylinder liners
- Foaming of the coolant

Caterpillar Diesel Engine Antifreeze/Coolant (DEAC) is formulated with the correct level of Caterpillar SCA. When the cooling system is initially filled with DEAC, adding more SCA is not necessary until the concentration of SCA has been depleted. To ensure that the correct amount of SCA is in the cooling system, the concentration of SCA must be tested on a scheduled basis. Refer to the specific engine's Operation and Maintenance Manual, "Maintenance Interval Schedule".

Containers of SCA are available in several sizes.  
Consult your Caterpillar dealer for the part numbers.

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## Commercial Heavy-Duty Coolant/Antifreeze and SCA

**SMCS Code:** 1350; 1395

If Caterpillar DEAC is not used, select a coolant/antifreeze with low silicate content for heavy-duty applications that meets "ASTM D5345" or "ASTM D4985" specifications.

**Note:** When you are not using Caterpillar DEAC the cooling system must be drained one time during every year. The cooling system must be flushed at this time as well.

When a heavy-duty coolant/antifreeze is used, treat the cooling system with three to six percent Caterpillar SCA by volume. For more information, see this publication, "Conventional Coolant/Antifreeze Cooling System Maintenance" topic (Maintenance Section).

If Caterpillar SCA is not used, select a commercial SCA. The commercial SCA must provide a minimum of 1200 mg/L or 1200 ppm (70 grains/US gal) of nitrites in the final coolant mixture.

Coolant/antifreeze that meets "ASTM D5345" or "ASTM D4985" specifications MAY require treatment with SCA at the initial fill. These coolants WILL require treatment with SCA on a maintenance basis.

When concentrated coolant/antifreeze is mixed, Caterpillar recommends mixing the concentrate with distilled water or with deionized water. If distilled water or deionized water is not available, water which has the required properties may be used. For the water properties, see this publication, "General Coolant Information" topic (Maintenance Section).

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## Water/Supplemental Coolant Additive (SCA)

**SMCS Code:** 1350; 1352; 1395

### NOTICE

All Caterpillar diesel engines equipped with air-to-air aftercooling (ATAAC) require a minimum of 30 percent glycol to prevent water pump cavitation.

### NOTICE

Never use water alone without Supplemental Coolant Additives (SCA) or without inhibited coolant. Water alone is corrosive at engine operating temperatures. Water alone does not provide adequate protection against boiling or freezing.

**Note:** Premix the coolant solution in order to provide protection to the lowest ambient temperature that is expected.

**Note:** Pure undiluted antifreeze freezes at  $-23^{\circ}\text{C}$  ( $-9^{\circ}\text{F}$ ).

In engine cooling systems that use water alone, Caterpillar recommends the use of SCA. SCA helps to prevent the following conditions from occurring:

- Corrosion
- Formation of mineral deposits
- Cavitation erosion of the cylinder liner
- Foaming of the coolant

If Caterpillar SCA is not used, select a commercial SCA. The commercial SCA must provide a minimum of 2400 mg/L or 2400 ppm (140 grains/US gal) of nitrites in the final coolant mixture.

The quality of the water is a very important factor in this type of cooling system. Distilled water or deionized water is recommended for use in cooling systems. If distilled water or deionized water is not available, use water that meets the minimum requirements that are listed in the table for recommended water properties in this publication, "General Coolant Information" topic (Maintenance Section).

A cooling system that uses a mixture of SCA and water only needs more SCA than a cooling system that uses a mixture of glycol and water. The SCA concentration in a cooling system that uses SCA and water should be six to eight percent by volume. Refer to Table 21 for the amount of SCA that is required for various capacities of the cooling system.



Table 21

Caterpillar SCA Requirements for SCA and Water Cooling Systems		
Cooling System Capacity	Caterpillar SCA at Initial Fill	Caterpillar SCA at 250 Hours
22 to 30 L (6 to 8 US gal)	1.75 L (64 fl oz)	0.44 L (15 fl oz)
31 to 38 L (9 to 10 US gal)	2.30 L (80 fl oz)	0.57 L (20 fl oz)
39 to 49 L (11 to 13 US gal)	3.00 L (100 fl oz)	0.75 L (25 fl oz)
50 to 64 L (14 to 17 US gal)	3.90 L (128 fl oz)	0.95 L (32 fl oz)
65 to 83 L (18 to 22 US gal)	5.00 L (168 fl oz)	1.25 L (42 fl oz)
84 to 110 L (23 to 29 US gal)	6.60 L (224 fl oz)	1.65 L (56 fl oz)
111 to 145 L (30 to 38 US gal)	8.75 L (296 fl oz)	2.19 L (74 fl oz)
146 to 190 L (39 to 50 US gal)	11.50 L (392 fl oz)	2.88 L (98 fl oz)
191 to 250 L (51 to 66 US gal)	15.00 L (512 fl oz)	3.75 L (128 fl oz)

Refer to Table 22 for part numbers and for quantities of SCA.

Table 22

Caterpillar Liquid SCA	
Part Number	Quantity
6V-3542	0.24 L (8 oz)
111-2372	0.36 L (12 oz)
8T-1589	0.47 L (16 oz)
3P-2044	0.94 L (32 oz)
8C-3680	19 L (5 US gal)
5P-2907	208 L (55 US gal)

Maintain the SCA in the same way as you would maintain a cooling system that uses heavy-duty coolant/antifreeze. Adjust the maintenance for the amount of SCA additions. See Table 21 for the amount of SCA that is required.

## Cooling Systems with Larger Capacities

### Adding the SCA to Water at the Initial Fill

Use the equation that is in Table 23 to determine the amount of Caterpillar SCA that is required at the initial fill. This equation is for a mixture of only SCA and water.

Table 23

Equation For Adding The SCA To Water At The Initial Fill
$V \times 0.07 = X$
V is the total volume of the cooling system.
X is the amount of SCA that is required.

Table 24 is an example for using the equation that is in Table 23.

Table 24

Example Of The Equation For Adding The SCA To Water At The Initial Fill		
Total Volume of the Cooling System (V)	Multiplication Factor	Amount of SCA that is Required (X)
946 L (250 US gal)	$\times 0.07$	66 L (18 US gal)

### Adding the SCA to Water for Maintenance

For the recommended service interval, refer to the Operation and Maintenance Manual, "Maintenance Interval Schedule" for your engine.

Use the **8T-5296** Coolant Conditioner Test Kit to test the concentration of SCA. Make the following modifications to Steps 3 and 5 of the **8T-5296** Coolant Conditioner Test Kit instructions:

**STEP 3** – Add tap water to the vial up to the "20 ml" mark.

**STEP 5** – When the defined procedure is used, a concentration of six to eight percent will yield between 20 drops and 27 drops. If the number of drops is below 20 drops, the concentration of SCA is low. If the number of drops is above 27 drops, the concentration of SCA is high. Make the appropriate adjustments to the concentration of SCA.

Test the concentration of SCA or submit a coolant sample to your Caterpillar dealer. See this publication, "S·O·S Coolant Analysis" topic (Maintenance Section).

Additions of SCA are based on the results of the test or based on the results of the coolant analysis. The size of the cooling system determines the amount of SCA that is required.

Use the equation that is in Table 23 to determine the amount of Caterpillar SCA that is required for maintenance, if necessary:

Table 25

SCA To Water Addition Equation For Maintenance		
$V \times 0.023 = X$		
V is the total volume of the cooling system.		
X is the amount of SCA that is required.		

Table 26 is an example for using the equation that is in Table 23.

Table 26

SCA To Water Addition Equation Example For Maintenance		
Total Volume of the Cooling System (V)	Multiplication Factor	Amount of SCA that is Required (X)
946 L (250 US gal)	$\times 0.023$	22 L (6 US gal)

**Note:** Specific engine applications may require maintenance practices to be periodically evaluated in order to properly maintain the engine's cooling system.

Table 22 lists part numbers and quantities of SCA that is available from your Caterpillar dealer.

Check the coolant/antifreeze (glycol concentration) in order to ensure adequate protection against boiling or freezing. Caterpillar recommends the use of a refractometer for checking the glycol concentration. Use the **1U-7298** Coolant/Battery Tester (Degree Celsius) or use the **1U-7297** Coolant/Battery Tester (Degree Fahrenheit). The testers give readings that are immediate and accurate. The testers can be used with ethylene or with propylene glycol.

Caterpillar engine cooling systems should be tested at 250 hour intervals for the concentration of Supplemental Coolant Additive (SCA). SCA test kits are available from your Caterpillar dealer. Test the concentration of SCA or submit a coolant sample to your Caterpillar dealer at 250 hour intervals. Refer to S-O-S Coolant Analysis for more information on this topic.

Additions of SCA are based on the results of the test or based on the results of the coolant analysis. An SCA that is liquid or a maintenance element for an SCA (if equipped) may be needed at 250 hour intervals.

Table 27 lists the amount of Caterpillar SCA that is needed at the initial fill in order to treat coolant/antifreeze. These amounts of SCA are for systems that use heavy-duty coolant/antifreeze.

Table 27 also lists additions of SCA for liquid and for maintenance elements at 250 hours. The additions are required for Caterpillar DEAC and for commercial coolant/antifreezes.

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## Conventional Coolant/Antifreeze Cooling System Maintenance

**SMCS Code:** 1350; 1352; 1395

### NOTICE

Never operate an engine without water temperature regulators in the cooling system. Water temperature regulators help to maintain the engine coolant at the proper operating temperature. Cooling system problems can develop without water temperature regulators.

Table 27

<b>Caterpillar SCA Requirements for Heavy-Duty Coolant/Antifreeze</b>			
<b>Cooling System Capacity</b>	<b>Initial Fill<sup>(1)</sup></b>	<b>250 Service Hour Maintenance<sup>(2)</sup></b>	<b>Spin-on Element at 250 Service Hour Maintenance (If Equipped)<sup>(3)</sup></b>
22 to 30 L (6 to 8 US gal)	0.95 L (32 fl oz)	0.24 L (8 fl oz)	111-2370 (1)
31 to 38 L (9 to 10 US gal)	1.18 L (40 fl oz)	0.36 L (12 fl oz)	111-2369 (1)
39 to 49 L (11 to 13 US gal)	1.42 L (48 fl oz)	0.36 L (12 fl oz)	111-2369 (1)
50 to 64 L (14 to 17 US gal)	1.90 L (64 fl oz)	0.47 L (16 fl oz)	9N-3368 (1)
65 to 83 L (18 to 22 US gal)	2.37 L (80 fl oz)	0.60 L (20 fl oz)	111-2371 (1)
84 to 114 L (23 to 30 US gal)	3.32 L (112 fl oz)	0.95 L (32 fl oz)	9N-3718 (1)
115 to 163 L (31 to 43 US gal)	4.75 L (160 fl oz)	1.18 L (40 fl oz)	111-2371 (2)
164 to 242 L (44 to 64 US gal)	7.60 L (256 fl oz)	1.90 L (64 fl oz)	9N-3718 (2)

- (1) When the coolant system is first filled, the SCA is not required to be used with Caterpillar DEAC.  
 (2) Do not exceed the six percent maximum concentration. Check the concentration of SCA with a SCA test kit.  
 (3) Do not use the maintenance element for the SCA and the liquid for the SCA at the same time.

**Note:** Specific engine applications may require maintenance practices to be periodically evaluated in order to properly maintain the engine's cooling system.

Refer to Table 28 for part numbers and for quantities of SCA.

Table 28

<b>Caterpillar Liquid SCA</b>	
<b>Part Number</b>	<b>Quantity</b>
6V-3542	0.24 L (8 oz)
111-2372	0.36 L (12 oz)
8T-1589	0.47 L (16 oz)
3P-2044	0.94 L (32 oz)
8C-3680	19 L (5 US gal)
5P-2907	208 L (55 US gal)

## Cooling Systems with Larger Capacities

### Adding the SCA to Conventional Coolant/Antifreeze at the Initial Fill

**Note:** Caterpillar DEAC DOES NOT require an addition of SCA when the cooling system is initially filled.

Commercial heavy-duty coolant/antifreeze that meets "ASTM D4985" or "ASTM D5345" specifications MAY require an addition of SCA at the initial fill. Read the label or the instructions that are provided by the OEM of the product.

Use the equation that is in Table 29 to determine the amount of Caterpillar SCA that is required when the cooling system is initially filled with the following fluids:

- "ASTM D4985"
- "ASTM D5345"

Table 29

<b>Equation For Adding The SCA To Conventional Coolant/Antifreeze At The Initial Fill</b>
$V \times 0.045 = X$
V is the total volume of the cooling system.
X is the amount of SCA that is required.

Table 30 is an example for using the equation that is in Table 29.

Table 30

<b>Example Of The Equation For Adding The SCA To Conventional Coolant/Antifreeze At The Initial Fill</b>		
<b>Total Volume of the Cooling System (V)</b>	<b>Multiplication Factor</b>	<b>Amount of SCA that is Required (X)</b>
946 L (250 US gal)	$\times 0.045$	43 L (11 US gal)

### Adding the SCA to Conventional Coolant/Antifreeze For Maintenance

Heavy duty coolant/antifreeze of all types REQUIRE periodic additions of an SCA.

Test the coolant/antifreeze periodically for the concentration of SCA. For the interval, see the Operation and Maintenance Manual, "Maintenance Interval Schedule" (Maintenance Section). SCA test kits are available from your Caterpillar dealer. Test the concentration of SCA or submit a coolant sample to your Caterpillar dealer. See this publication, "S-O-S Coolant Analysis" topic (Maintenance Section).

Additions of SCA are based on the results of the test or based on the results of the coolant analysis. The size of the cooling system determines the amount of SCA that is needed.

Use the equation that is in Table 31 to determine the amount of Caterpillar SCA that is required, if necessary:

Table 31

<b>Equation For Adding The SCA To Conventional Coolant/Antifreeze For Maintenance</b>
$V \times 0.014 = X$
V is the total volume of the cooling system.
X is the amount of SCA that is required.

Table 32 is an example for using the equation that is in Table 31.

Table 32

<b>Example Of The Equation For Adding The SCA To Conventional Coolant/Antifreeze For Maintenance</b>		
<b>Total Volume of the Cooling System (V)</b>	<b>Multiplication Factor</b>	<b>Amount of SCA that is Required (X)</b>
946 L (250 US gal)	$\times 0.014$	9 L (4 US gal)

**Note:** Specific engine applications may require maintenance practices to be periodically evaluated in order to properly maintain the engine's cooling system.

Table 28 lists part numbers and quantities of SCA that is available from your Caterpillar dealer.

### Cleaning the System of Heavy-Duty Coolant/Antifreeze

Caterpillar cooling system cleaners are designed to clean the cooling system of harmful scale and corrosion. Caterpillar cooling system cleaners dissolve mineral scale, corrosion products, light oil contamination and sludge.

- Clean the cooling system after used coolant is drained or before the cooling system is filled with new coolant.
- Clean the cooling system whenever the coolant is contaminated or whenever the coolant is foaming.
- For the recommended service interval, refer to the Operation and Maintenance Manual, "Maintenance Interval Schedule" for your engine.

# Refill Capacities

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## Refill Capacities

**SMCS Code:** 1348; 1395; 7560

## Lubrication System

The refill capacities for the engine crankcase reflect the approximate capacity of the crankcase or sump plus standard oil filters. Auxiliary oil filter systems will require additional oil. Refer to the OEM specifications for the capacity of the auxiliary oil filter.

Table 33

Approximate Refill Capacities for the Crankcase Oil Sump		
Engine	Liters	Quarts
<b>3114 All</b>	12	12.7
<b>3116 Stationary</b>	21	22
<b>3126 Fire Pump</b>	24	25
<b>3116 Mobile and 3126 All</b>	32	34

**Note:** These values are the approximate capacities for the crankcase oil sump which include the standard oil filters that are installed at the factory. Engines with auxiliary oil filters will require additional oil. Refer to the OEM for the capacity of the auxiliary oil filters.

## Cooling System

In order to maintain the cooling system, the Total Cooling System capacity must be known. The approximate capacity for Only the Engine cooling system is listed. External System capacities will vary among applications. Refer to the OEM specifications for the External System capacity. This capacity information will be needed in order to determine the amount of coolant/antifreeze that is required for the Total Cooling System.

Table 34

Approximate Refill Capacity for the 3114 Cooling System		
Compartment or System	Liters	Quarts
Engine Only	10.4	11
External System (OEM) <sup>(1)</sup>		
Total Cooling System		

<sup>(1)</sup> The External System includes an expansion tank with the following components: radiator and piping. Refer to the OEM specifications and enter the capacity for the External System in this row.

Table 35

Approximate Refill Capacity for the 3116 and 3126 Cooling System		
Compartment or System	Liters	Quarts
Engine Only	13.2	14
External System (OEM) <sup>(1)</sup>		
Total Cooling System		

<sup>(1)</sup> The External System includes an expansion tank with the following components: radiator and piping. Refer to the OEM specifications and enter the capacity for the External System in this row.

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## Maintenance Interval Schedule (3114 Industrial Engines)

**SMCS Code:** 1000; 7500

**S/N:** 5EF1-Up

**S/N:** 6AF1-Up

**S/N:** 1ZG1-Up

**S/N:** 5JG1-Up

**Note:** Ensure that the Safety Information, warnings, and instructions are read and understood before operation or maintenance procedures are performed.

**Note:** Use fuel consumption, service hours, or calendar time, **whichever occurs first**, in order to determine the maintenance intervals. Engines that operate in severe operating conditions may require more frequent maintenance.

Before each consecutive interval is performed, all of the maintenance requirements from the previous interval must also be performed.

### When Required

Battery - Replace .....	66
Battery Electrolyte Level - Check .....	66
Battery or Battery Cable - Disconnect .....	67
Engine - Clean .....	74
Engine Storage Procedure - Check .....	83
Ether Starting Aid Cylinder - Replace .....	83
Fuel System - Prime .....	85
Severe Service Application - Check .....	93

### Daily

Cooling System Coolant Level - Check .....	71
Driven Equipment - Check .....	74
Engine Air Cleaner Element (Dual Element) - Clean/Replace .....	74
Engine Air Cleaner Service Indicator - Inspect .....	78
Engine Air Precleaner - Check/Clean .....	79
Engine Oil Level - Check .....	80
Fuel System Water Separator - Drain .....	88
Walk-Around Inspection .....	95

### Every 1000 Service Hours

Engine Protective Devices - Check .....	82
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### Every 6000 Service Hours or 6 Years

Cooling System Coolant (ELC) - Change .....	69
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### First 3750 L (1000 US gal) of Fuel or 250 Service Hours

Engine Valve Lash - Inspect/Adjust .....	83
Fuel Injection Timing - Check .....	84

### PM Level 1 - Every 3750 L (1000 US gal) of Fuel or 250 Service Hours or 6 Months

Aftercooler Core - Clean/Test .....	65
Alternator - Inspect .....	65
Alternator and Fan Belts - Inspect/Adjust/ Replace .....	65
Battery Electrolyte Level - Check .....	66
Cooling System Supplemental Coolant Additive (SCA) - Test/Add .....	71
Engine Crankcase Breather - Clean .....	79
Engine Oil Sample - Obtain .....	80
Engine Oil and Filter - Change .....	81
Fan Drive Bearing - Lubricate .....	84
Fuel Inlet Screen - Clean/Inspect/Replace .....	84
Fuel System Primary Filter - Clean/Replace .....	86
Fuel System Primary Filter/Water Separator Element - Replace .....	86
Fuel System Secondary Filter - Replace .....	87
Fuel Tank Water and Sediment - Drain .....	88
Hoses and Clamps - Inspect/Replace .....	89
Radiator - Clean .....	93

### PM Level 2 - Every 30 000 L (8000 US gal) of Fuel or 2000 Service Hours or 1 Year

Engine Valve Lash - Inspect/Adjust .....	83
Fuel Injection Timing - Check .....	84

### PM Level 3 - Every 45 000 L (12 000 US gal) of Fuel or 3000 Service Hours or 2 Years

Cooling System Coolant (DEAC) - Change .....	67
Cooling System Coolant Extender (ELC) - Add ....	70
Cooling System Water Temperature Regulator - Replace .....	73
Crankshaft Vibration Damper - Inspect .....	73
Engine Mounts - Inspect .....	79

### Every 75 000 L (20 000 US gal) of Fuel or 5000 Service Hours

Overhaul Considerations .....	90
Starting Motor - Inspect .....	94
Turbocharger - Inspect/Clean .....	94
Water Pump - Inspect .....	96

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## Maintenance Interval Schedule (3116 and 3126 Industrial Engines)

**SMCS Code:** 1000; 7500

**S/N:** 2SG1-Up

**S/N:** 2WG1-Up

**S/N:** 4PG1-Up

**S/N:** 1NJ1-Up

**S/N:** CKK1-Up

**S/N:** 5EN1-Up

**S/N:** 2MR1-Up

**S/N:** 9ZR1-Up

**S/N:** 6MS1-Up

**Note:** Ensure that the Safety Information, warnings, and instructions are read and understood before operation or maintenance procedures are performed.

**Note:** Use fuel consumption, service hours, or calendar time, **whichever occurs first**, in order to determine the maintenance intervals. Engines that operate in severe operating conditions may require more frequent maintenance.

Before each consecutive interval is performed, all of the maintenance requirements from the previous interval must also be performed.

### When Required

Battery - Replace .....	66
Battery Electrolyte Level - Check .....	66
Battery or Battery Cable - Disconnect .....	67
Engine - Clean .....	74
Engine Storage Procedure - Check .....	83
Ether Starting Aid Cylinder - Replace .....	83
Fuel System - Prime .....	85
Severe Service Application - Check .....	93

### Daily

Cooling System Coolant Level - Check .....	71
Driven Equipment - Check .....	74
Engine Air Cleaner Element (Dual Element) - Clean/Replace .....	74
Engine Air Cleaner Service Indicator - Inspect .....	78
Engine Air Precleaner - Check/Clean .....	79
Engine Oil Level - Check .....	80
Fuel System Water Separator - Drain .....	88
Walk-Around Inspection .....	95

### Every Week

Engine Operation - Test .....	82
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### Every 1000 Service Hours

Engine Protective Devices - Check .....	82
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### Every 6000 Service Hours or 6 Years

Cooling System Coolant (ELC) - Change .....	69
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### First 5700 L (1500 US gal) of Fuel or 250 Service Hours

Engine Valve Lash - Inspect/Adjust .....	83
Fuel Injection Timing - Check .....	84

### PM Level 1 - Every 5700 L (1500 US gal) of Fuel or 250 Service Hours or 6 Months

Aftercooler Core - Clean/Test .....	65
Alternator - Inspect .....	65
Alternator and Fan Belts - Inspect/Adjust/ Replace .....	65
Battery Electrolyte Level - Check .....	66
Cooling System Supplemental Coolant Additive (SCA) - Test/Add .....	71
Engine Crankcase Breather - Clean .....	79
Engine Oil Sample - Obtain .....	80
Engine Oil and Filter - Change .....	81
Fan Drive Bearing - Lubricate .....	84
Fuel Inlet Screen - Clean/Inspect/Replace .....	84
Fuel System Primary Filter - Clean/Replace .....	86
Fuel System Primary Filter/Water Separator Element - Replace .....	86
Fuel System Secondary Filter - Replace .....	87
Fuel Tank Water and Sediment - Drain .....	88
Hoses and Clamps - Inspect/Replace .....	89
Radiator - Clean .....	93

### PM Level 2 - Every 45 600 L (12 000 US gal) of Fuel or 2000 Service Hours or 1 Year

Engine Valve Lash - Inspect/Adjust .....	83
Fuel Injection Timing - Check .....	84

### Every 114 000 L (30 000 US gal) of Fuel or 5000 Service Hours

Overhaul Considerations .....	90
Starting Motor - Inspect .....	94
Turbocharger - Inspect/Clean .....	94
Water Pump - Inspect .....	96

### PM Level 3 - Every 68 000 L (18 000 US gal) of Fuel or 3000 Service Hours or 2 Years

Cooling System Coolant (DEAC) - Change .....	67
Cooling System Coolant Extender (ELC) - Add .....	70
Cooling System Water Temperature Regulator - Replace .....	73
Crankshaft Vibration Damper - Inspect .....	73

Engine Mounts - Inspect .....	79
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## Aftercooler Core - Clean/Test (Air-To-Air Aftercooler)

**SMCS Code:** 1064-070; 1064-081

**Note:** Adjust the frequency of cleaning according to the effects of the operating environment.

Inspect the aftercooler for these items: damaged fins, corrosion, dirt, grease, insects, leaves, oil, and other debris. Clean the aftercooler, if necessary.

For air-to-air aftercoolers, use the same methods that are used for cleaning radiators.



**Personal injury can result from air pressure.**

**Personal injury can result without following proper procedure. When using pressure air, wear a protective face shield and protective clothing.**

**Maximum air pressure at the nozzle must be less than 205 kPa (30 psi) for cleaning purposes.**

Pressurized air is the preferred method for removing loose debris. Direct the air in the opposite direction of the fan's air flow. Hold the nozzle approximately 6 mm (0.25 inch) away from the fins. Slowly move the air nozzle in a direction that is parallel with the tubes. This will remove debris that is between the tubes.

Pressurized water may also be used for cleaning. The maximum water pressure for cleaning purposes must be less than 275 kPa (40 psi). Use pressurized water in order to soften mud. Clean the core from both sides.

Use a degreaser and steam for removal of oil and grease. Clean both sides of the core. Wash the core with detergent and hot water. Thoroughly rinse the core with clean water.

After cleaning, start the engine and accelerate the engine to high idle rpm. This will help in the removal of debris and drying of the core. Stop the engine. Use a light bulb behind the core in order to inspect the core for cleanliness. Repeat the cleaning, if necessary.

Inspect the fins for damage. Bent fins may be opened with a "comb".

**Note:** If parts of the aftercooler system are repaired or replaced, a leak test is highly recommended.

Inspect these items for good condition: welds, mounting brackets, air lines, connections, clamps, and seals. Make repairs, if necessary.

For more detailed information on cleaning and inspection, see Special Publication, SEBD0518, "Know Your Cooling System".

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## Alternator - Inspect

**SMCS Code:** 1405-040

Caterpillar recommends a scheduled inspection of the alternator. Inspect the alternator for loose connections and proper battery charging. Inspect the ammeter (if equipped) during engine operation in order to ensure proper battery performance and/or proper performance of the electrical system. Make repairs, as required. Refer to the Service Manual.

Check the alternator and the battery charger for proper operation. If the batteries are properly charged, the ammeter reading should be very near zero. All batteries should be kept charged. The batteries should be kept warm because temperature affects the cranking power. If the battery is too cold, the battery will not crank the engine. The battery will not crank the engine, even if the engine is warm. When the engine is not run for long periods of time or if the engine is run for short periods, the batteries may not fully charge. A battery with a low charge will freeze more easily than a battery with a full charge.

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## Alternator and Fan Belts - Inspect/Adjust/Replace

**SMCS Code:** 1357-039

### Inspection

To maximize the engine performance, inspect the belts for wear and for cracking. Check the belt tension. Adjust the belt tension in order to minimize belt slippage. Belt slippage will decrease the life of the belts.

To check the belt tension, apply 110 N (25 lb) of force midway between the pulleys. A correctly adjusted belt will deflect 13 to 19 mm (0.50 to 0.75 inch).

## Adjustment

If the belts are too loose, the belts will vibrate. This vibration is enough to cause unnecessary wear on the belts and on the pulleys.

If the belts are too tight, unnecessary stresses are placed upon the pulley bearings and upon the belts. These stresses will shorten the life of the belts and of the pulley bearings.

If new belts are installed, check the tension again after 30 minutes of engine operation at the rated rpm.

## Replacement

For applications that require multiple drive belts, replace the belts in matched sets. Replacing only one belt of a matched set will cause the new belt to carry more load because the older belt is stretched. The additional load on the new belt could cause the new belt to break.

Refer to the Service Manual for more information on the procedures for the following topics: belt removal and belt installation procedure.

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## Battery - Replace

**SMCS Code:** 1401-510

### **WARNING**

**Batteries give off combustible gases which can explode. A spark can cause the combustible gases to ignite. This can result in severe personal injury or death.**

**Ensure proper ventilation for batteries that are in an enclosure. Follow the proper procedures in order to help prevent electrical arcs and/or sparks near batteries. Do not smoke when batteries are serviced.**

### **WARNING**

**The battery cables or the batteries should not be removed with the battery cover in place. The battery cover should be removed before any servicing is attempted.**

**Removing the battery cables or the batteries with the cover in place may cause a battery explosion resulting in personal injury.**

1. Turn the key start switch to the OFF position. Remove the key and all electrical loads.
2. Turn OFF the battery charger. Disconnect the charger.
3. The NEGATIVE "-" cable connects the NEGATIVE "-" battery terminal to the ground plane. Disconnect the cable from the NEGATIVE "-" battery terminal.
4. The POSITIVE "+" cable connects the POSITIVE "+" battery terminal to the starting motor. Disconnect the cable from the POSITIVE "+" battery terminal.

**Note:** Always recycle a battery. Never discard a battery. Return used batteries to an appropriate recycling facility.

5. Remove the used battery.

6. Install the new battery.

**Note:** Before the cables are connected, ensure that the key start switch is OFF.

7. Connect the cable from the starting motor to the POSITIVE "+" battery terminal.
8. Connect the cable from the ground plane to the NEGATIVE "-" battery terminal.

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## Battery Electrolyte Level - Check

**SMCS Code:** 1401-535

When the engine is not run for long periods of time or when the engine is run for short periods, the batteries may not fully recharge. Ensure a full charge in order to help prevent the battery from freezing. If batteries are properly charged, ammeter reading should be very near zero.

### **WARNING**

**All lead-acid batteries contain sulfuric acid which can burn the skin and clothing. Always wear a face shield and protective clothing when working on or near batteries.**

1. Remove the filler caps. Maintain the electrolyte level to the "FULL" mark on the battery.

If the addition of water is necessary, use distilled water. If distilled water is not available use clean water that is low in minerals. Do not use artificially softened water.

2. Check the condition of the electrolyte with the 1U-7298 Coolant/Battery Tester (°C) or the 1U-7297 Coolant/Battery Tester (°F).

3. Keep the batteries clean.

Clean the battery case with one of the following cleaning solutions:

- A mixture of 0.1 L (0.11 qt) of baking soda and 1 L (1 qt) of clean water
- A mixture of 0.1 L (0.11 qt) of ammonia and 1 L (1 qt) of clean water

Thoroughly rinse the battery case with clean water.

Use a fine grade of sandpaper to clean the terminals and the cable clamps. Clean the items until the surfaces are bright or shiny. DO NOT remove material excessively. Excessive removal of material can cause the clamps to not fit properly. Coat the clamps and the terminals with 5N-5561 Silicone Lubricant, petroleum jelly or MPM grease.

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## Battery or Battery Cable - Disconnect

**SMCS Code:** 1402-029

### WARNING

**The battery cables or the batteries should not be removed with the battery cover in place. The battery cover should be removed before any servicing is attempted.**

**Removing the battery cables or the batteries with the cover in place may cause a battery explosion resulting in personal injury.**

1. Turn the start switch to the OFF position. Turn the ignition switch (if equipped) to the OFF position and remove the key and all electrical loads.
2. Disconnect the negative battery terminal at the battery that goes to the start switch. Ensure that the cable cannot contact the terminal. When four 12 volt batteries are involved, the negative side of two batteries must be disconnected.

3. Tape the leads in order to help prevent accidental starting.
4. Proceed with necessary system repairs. Reverse the steps in order to reconnect all of the cables.

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## Cooling System Coolant (DEAC) - Change

**SMCS Code:** 1350-070; 1395-044

Clean the cooling system and flush the cooling system before the recommended maintenance interval if the following conditions exist:

- The engine overheats frequently.
- Foaming is observed.
- The oil has entered the cooling system and the coolant is contaminated.
- The fuel has entered the cooling system and the coolant is contaminated.

### NOTICE

Use of commercially available cooling system cleaners may cause damage to cooling system components. Use only cooling system cleaners that are approved for Caterpillar engines.

**Note:** Inspect the water pump and the water temperature regulator after the cooling system has been drained. This is a good opportunity to replace the water pump, the water temperature regulator and the hoses, if necessary.

## Drain

### WARNING

**Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.**

1. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap.
2. Open the cooling system drain valve (if equipped). If the cooling system is not equipped with a drain valve, remove one of the drain plugs.

Allow the coolant to drain.

---

**NOTICE**

Dispose of used engine coolant properly or recycle. Various methods have been proposed to reclaim used coolant for reuse in engine cooling systems. The full distillation procedure is the only method acceptable by Caterpillar to reclaim the used coolant.

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For information regarding the disposal and the recycling of used coolant, consult your Caterpillar dealer or consult Caterpillar Service Technology Group:

Outside Illinois: 1-800-542-TOOL  
Inside Illinois: 1-800-541-TOOL  
Canada: 1-800-523-TOOL

## Flush

1. Flush the cooling system with clean water in order to remove any debris.
2. Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. Refer to the Operation and Maintenance Manual, "Torque Specifications" topic (Maintenance Section) for more information on the proper torques.

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**NOTICE**

Fill the cooling system no faster than 19 L (5 US gal) per minute to avoid air locks.

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3. Fill the cooling system with a mixture of clean water and Caterpillar Fast Acting Cooling System Cleaner. Add 0.5 L (1 pint) of cleaner per 15 L (4 US gal) of the cooling system capacity. Install the cooling system filler cap.
4. Start and run the engine at low idle for a minimum of 30 minutes. The coolant temperature should be at least 82 °C (180 °F).

---

**NOTICE**

Improper or incomplete rinsing of the cooling system can result in damage to copper and other metal components.

To avoid damage to the cooling system, make sure to completely flush the cooling system with clear water. Continue to flush the system until all signs of the cleaning agent are gone.

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5. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap. Open the drain valve (if equipped) or remove the cooling system drain plugs. Allow the water to drain. Flush the cooling system with clean water. Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. Refer to the Operation and Maintenance Manual, "Torque Specifications" topic (Maintenance Section) for more information on the proper torques.

## Cooling Systems with Heavy Deposits or Plugging

**Note:** For the following procedure to be effective, there must be some active flow through the cooling system components.

1. Flush the cooling system with clean water in order to remove any debris.
2. Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. Refer to the Operation and Maintenance Manual, "Torque Specifications" topic (Maintenance Section) for more information on the proper torques.

---

**NOTICE**

Fill the cooling system no faster than 19 L (5 US gal) per minute to avoid air locks.

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3. Fill the cooling system with a mixture of clean water and Caterpillar Fast Acting Cooling System Cleaner. Add 0.5 L (1 pint) of cleaner per 3.8 to 7.6 L (1 to 2 US gal) of the cooling system capacity. Install the cooling system filler cap.
4. Start and run the engine at low idle for a minimum of 90 minutes. The coolant temperature should be at least 82 °C (180 °F).

---

**NOTICE**

Improper or incomplete rinsing of the cooling system can result in damage to copper and other metal components.

To avoid damage to the cooling system, make sure to completely flush the cooling system with clear water. Continue to flush the system until all signs of the cleaning agent are gone.

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5. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap. Open the drain valve (if equipped) or remove the cooling system drain plugs. Allow the water to drain. Flush the cooling system with clean water. Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. Refer to the Operation and Maintenance Manual, "Torque Specifications" topic (Maintenance Section) for more information on the proper torques.

## Fill

### NOTICE

Fill the cooling system no faster than 19 L (5 US gal) per minute to avoid air locks.

1. Fill the cooling system with coolant/antifreeze. Refer to the Operation and Maintenance Manual, "Cooling System Specifications" topic (Maintenance Section) for more information on cooling system specifications. Do not install the cooling system filler cap.
2. Start and run the engine at low idle. Increase the engine rpm to 1500 rpm. Run the engine at high idle for one minute in order to purge the air from the cavities of the engine block. Stop the engine.
3. Check the coolant level. Maintain the coolant level within 13 mm (0.5 inch) below the bottom of the pipe for filling. Maintain the coolant level within 13 mm (0.5 inch) to the proper level on the sight glass (if equipped).
4. Clean the cooling system filler cap. Inspect the gasket that is on the cooling system filler cap. If the gasket that is on the cooling system filler cap is damaged, discard the old cooling system filler cap and install a new cooling system filler cap. If the gasket that is on the cooling system filler cap is not damaged, perform a pressure test. A 9S-8140 Pressurizing Pump is used to perform the pressure test. The correct pressure for the cooling system filler cap is stamped on the face of the cooling system filler cap. If the cooling system filler cap does not retain the correct pressure, install a new cooling system filler cap.
5. Start the engine. Inspect the cooling system for leaks and for proper operating temperature.

## Cooling System Coolant (ELC) - Change

**SMCS Code:** 1350-070; 1395-044

Clean the cooling system and flush the cooling system before the recommended maintenance interval if the following conditions exist:

- The engine overheats frequently.
- Foaming is observed.
- The oil has entered the cooling system and the coolant is contaminated.
- The fuel has entered the cooling system and the coolant is contaminated.

**Note:** When the cooling system is cleaned, only clean water is needed when the ELC is drained and replaced.

**Note:** Inspect the water pump and the water temperature regulator after the cooling system has been drained. This is a good opportunity to replace the water pump, the water temperature regulator and the hoses, if necessary.

## Drain

### WARNING

**Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.**

1. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap.
2. Open the cooling system drain valve (if equipped). If the cooling system is not equipped with a drain valve, remove the cooling system drain plugs.

Allow the coolant to drain.

**NOTICE**

Dispose of used engine coolant properly or recycle. Various methods have been proposed to reclaim used coolant for reuse in engine cooling systems. The full distillation procedure is the only method acceptable by Caterpillar to reclaim the used coolant.

For information regarding the disposal and the recycling of used coolant, consult your Caterpillar dealer or consult Caterpillar Service Technology Group:

Outside Illinois: 1-800-542-TOOL

Inside Illinois: 1-800-541-TOOL

Canada: 1-800-523-TOOL

**Flush**

1. Flush the cooling system with clean water in order to remove any debris.
2. Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. Refer to the Operation and Maintenance Manual, "Torque Specifications" topic (Maintenance Section) for more information on the proper torques.

**NOTICE**

Fill the cooling system no faster than 19 L (5 US gal) per minute to avoid air locks.

3. Fill the cooling system with clean water. Install the cooling system filler cap.
4. Start and run the engine at low idle until the temperature reaches 49 to 66 °C (120 to 150 °F).
5. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap. Open the drain valve (if equipped) or remove the cooling system drain plugs. Allow the water to drain. Flush the cooling system with clean water. Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. Refer to the Operation and Maintenance Manual, "Torque Specifications" topic (Maintenance Section) for more information on the proper torques.

**Fill****NOTICE**

Fill the cooling system no faster than 19 L (5 US gal) per minute to avoid air locks.

1. Fill the cooling system with Extended Life Coolant (ELC). Refer to the Operation and Maintenance Manual, "Cooling System Specifications" topic (Maintenance Section) for more information on cooling system specifications. Do not install the cooling system filler cap.
2. Start and run the engine at low idle. Increase the engine rpm to high idle. Run the engine at high idle for one minute in order to purge the air from the cavities of the engine block. Stop the engine.
3. Check the coolant level. Maintain the coolant level within 13 mm (0.5 inch) below the bottom of the pipe for filling. Maintain the coolant level within 13 mm (0.5 inch) to the proper level on the sight glass (if equipped).
4. Clean the cooling system filler cap. Inspect the gasket that is on the cooling system filler cap. If the gasket that is on the cooling system filler cap is damaged, discard the old cooling system filler cap and install a new cooling system filler cap. If the gasket that is on the cooling system filler cap is not damaged, use a **9S-8140** Pressurizing Pump in order to pressure test the cooling system filler cap. The correct pressure for the cooling system filler cap is stamped on the face of the cooling system filler cap. If the cooling system filler cap does not retain the correct pressure, install a new cooling system filler cap.
5. Start the engine. Inspect the cooling system for leaks and for proper operating temperature.

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## Cooling System Coolant Extender (ELC) - Add

**SMCS Code:** 1352-045; 1395-081

Caterpillar Extended Life Coolant (ELC) does not require the frequent Supplemental Coolant Additive (SCA) additions associated with the present conventional coolants. The Extender only needs to be added once.

Check the cooling system only when the engine is stopped and cool.

1. Loosen the cooling system filler cap slowly in order to relieve pressure. Remove the cooling system filler cap.
2. It may be necessary to drain enough coolant from the cooling system in order to add the Extender.

3. Add Extender according to the requirements for your engine's cooling system capacity. Refer to the Operation and Maintenance Manual, "Refill Capacities" in the Maintenance Section for the capacity of the cooling system for your engine. Refer to the Operation and Maintenance Manual, "Cooling System Specifications" information for the Caterpillar ELC Extender additions.
4. Clean the cooling system filler cap. Inspect the cooling system filler cap gaskets. Replace the cooling system filler cap if the cooling system filler cap gaskets are damaged. Install the cooling system filler cap.

i01197583

## Cooling System Coolant Level - Check

**SMCS Code:** 1395-082

Check the coolant level when the engine is stopped and cool.

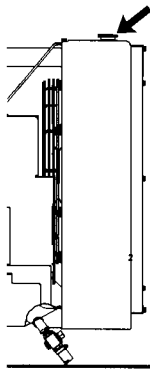


Illustration 25

g00285520

Cooling system filler cap

### WARNING

**Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.**

1. Remove the cooling system filler cap slowly in order to relieve pressure.
2. Maintain the coolant level within 13 mm (0.5 inch) of the bottom of the filler pipe. If the engine is equipped with a sight glass, maintain the coolant level to the proper level in the sight glass.

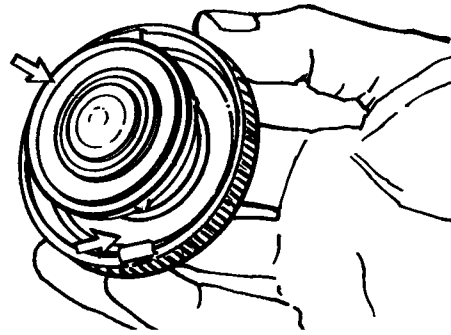


Illustration 26

g00103639

Typical filler cap gaskets

3. Clean the cooling system filler cap and check the condition of the filler cap gaskets. Replace the cooling system filler cap if the filler cap gaskets are damaged. Reinstall the cooling system filler cap.
4. Inspect the cooling system for leaks.

i01463635

## Cooling System Supplemental Coolant Additive (SCA) - Test/Add

**SMCS Code:** 1352-045; 1395-081

### WARNING

**Cooling system coolant additive contains alkali. To help prevent personal injury, avoid contact with the skin and the eyes. Do not drink cooling system coolant additive.**

**Note:** Test the concentration of the Supplemental Coolant Additive (SCA) or test the SCA concentration as part of an S·O·S Coolant Analysis.

## Test for SCA Concentration

### Coolant/Antifreeze and SCA

#### NOTICE

**Do not exceed the recommended six percent supplemental coolant additive concentration.**

Use the **8T-5296** Coolant Conditioner Test Kit or use the **4C-9301** Coolant Conditioner Test Kit in order to check the concentration of the SCA. Refer to the Operation and Maintenance Manual for more information.

---

## Water and SCA

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### NOTICE

Do not exceed the recommended eight percent supplemental coolant additive concentration.

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Test the concentration of the SCA with the **8T-5296** Coolant Conditioner Test Kit. Refer to the Operation and Maintenance Manual, "Water/Supplemental Coolant Additive (SCA)" topic (Maintenance Section). Refer to the Operation and Maintenance Manual, "Conventional Coolant/Antifreeze Cooling System Maintenance" topic (Maintenance Section).

## S·O·S Coolant Analysis

S·O·S coolant samples can be analyzed at your Caterpillar dealer. S·O·S Coolant Analysis is a program that is based on periodic samples.

### Level 1

Level 1 is a basic analysis of the coolant. The following items are tested:

- Glycol Concentration
- Concentration of SCA
- pH
- Conductivity

The results are reported, and recommendations are made according to the results. Consult your Caterpillar dealer for information on the benefits of managing your equipment with an S·O·S Coolant Analysis.

### Level 2

This level coolant analysis is recommended when the engine is overhauled. Refer to the Operations and Maintenance Manual, "Overhaul Considerations" for further information.

---

## Add the SCA, If Necessary

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### NOTICE

Do not exceed the recommended amount of supplemental coolant additive concentration. Excessive supplemental coolant additive concentration can form deposits on the higher temperature surfaces of the cooling system, reducing the engine's heat transfer characteristics. Reduced heat transfer could cause cracking of the cylinder head and other high temperature components. Excessive supplemental coolant additive concentration could also result in radiator tube blockage, overheating, and/or accelerated water pump seal wear. Never use both liquid supplemental coolant additive and the spin-on element (if equipped) at the same time. The use of those additives together could result in supplemental coolant additive concentration exceeding the recommended maximum.

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### WARNING

**Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.**

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1. Slowly loosen the cooling system filler cap in order to relieve the pressure. Remove the cooling system filler cap.

**Note:** Always discard drained fluids according to local regulations.

2. If necessary, drain some coolant from the cooling system into a suitable container in order to allow space for the extra SCA.
3. Add the proper amount of SCA. Refer to the Operation and Maintenance Manual for more information on SCA requirements.
4. Clean the cooling system filler cap. Inspect the gaskets of the cooling system filler cap. If the gaskets are damaged, replace the old cooling system filler cap with a new cooling system filler cap. Install the cooling system filler cap.



i00912898

i00894991

## Cooling System Water Temperature Regulator - Replace

**SMCS Code:** 1355-510

Replace the water temperature regulator before the water temperature regulator fails. This is a recommended preventive maintenance practice. Replacing the water temperature regulator reduces the chances for unscheduled downtime.

A water temperature regulator that fails in a partially opened position can cause overheating or overcooling of the engine.

A water temperature regulator that fails in the closed position can cause excessive overheating. Excessive overheating could result in cracking of the cylinder head or piston seizure problems.

A water temperature regulator that fails in the open position will cause the engine operating temperature to be too low during partial load operation. Low engine operating temperatures during partial loads could cause an excessive carbon buildup inside the cylinders. This excessive carbon buildup could result in an accelerated wear of the piston rings and wear of the cylinder liner.

---

### NOTICE

Failure to replace your water temperature regulator on a regularly scheduled basis could cause severe engine damage.

Caterpillar engines incorporate a shunt design cooling system and require operating the engine with a water temperature regulator installed.

If the water temperature regulator is installed incorrectly, the engine may overheat, causing cylinder head damage. Ensure that the new water temperature regulator is installed in the original position. Ensure that the water temperature regulator vent hole is open.

Do not use liquid gasket material on the gasket or cylinder head surface.

---

Refer to the Service Manual for the replacement procedure of the water temperature regulator, or consult your Caterpillar dealer.

**Note:** If only the water temperature regulators are replaced, drain the coolant from the cooling system to a level that is below the water temperature regulator housing.

## Crankshaft Vibration Damper - Inspect

**SMCS Code:** 1205-040

Damage to the crankshaft vibration damper or failure of the crankshaft vibration damper can increase torsional vibrations. This can result in damage to the crankshaft and to other engine components. A deteriorating damper can cause excessive gear train noise at variable points in the speed range.

The damper is mounted to the crankshaft which is located behind the belt guard on the front of the engine.

### Rubber Damper

Your engine may be equipped with a rubber damper. The rubber damper uses a ring which is mounted in rubber in order to reduce vibrations in the crankshaft.

Inspect the damper and repair or replace the damper for any of the following reasons:

- There is deterioration and cracking of the rubber.
- There is slippage of the outer ring from the original position.
- The engine has had a failure because of a broken crankshaft.
- Analysis of the oil has revealed that the front main bearing is badly worn.
- There is a large amount of gear train wear that is not caused by lack of oil.

Refer to the Service Manual or consult your Caterpillar dealer for information about damper replacement.

### Visconic Damper

Your engine may be equipped with a visconic damper. The visconic damper has a weight that is located inside a fluid filled case. The weight moves in the case in order to limit torsional vibration.

Inspect the damper for evidence of fluid leaks. If a fluid leak is found, determine the type of fluid. The fluid in the damper is silicone. Silicone has the following characteristics: transparent, viscous, smooth, and difficult to remove from surfaces.

If the fluid leak is oil, inspect the crankshaft seals for leaks. If a leak is observed, replace the crankshaft seals.

Inspect the damper and repair or replace the damper for any of the following reasons:

- The damper is dented, cracked, or leaking.
- The paint on the damper is discolored from heat.
- The engine has had a failure because of a broken crankshaft.
- Analysis of the oil has revealed that the front main bearing is badly worn.
- There is a large amount of gear train wear that is not caused by a lack of oil.

Refer to the Service Manual or consult your Caterpillar dealer for information about damper replacement.

i00174798

## Driven Equipment - Check

**SMCS Code:** 3279-535

Refer to the OEM specifications for more information on the following maintenance recommendations for the driven equipment:

- Inspection
- Adjustment
- Lubrication
- Other maintenance recommendations

Perform any maintenance for the driven equipment which is recommended by the OEM.

i01239442

## Engine - Clean

**SMCS Code:** 1000-070

### **WARNING**

**Personal injury or death can result from high voltage.**

**Moisture can create paths of electrical conductivity.**

**Make sure that the electrical system is OFF. Lock out the starting controls and tag the controls "DO NOT OPERATE".**

### **NOTICE**

Water and/or condensation can cause damage to electrical components. Protect all electrical components from exposure to water.

### **NOTICE**

Accumulated grease and oil on an engine is a fire hazard. Keep the engine clean. Remove debris and fluid spills whenever a significant quantity accumulates on the engine.

Periodic cleaning of the engine is recommended. Steam cleaning the engine will remove accumulated oil and grease. A clean engine provides the following benefits:

- Easy detection of fluid leaks
- Maximum heat transfer characteristics
- Ease of maintenance

i01089660

## Engine Air Cleaner Element (Dual Element) - Clean/Replace

**SMCS Code:** 1054-037; 1054-510

Perform the Operation and Maintenance Manual, "Engine Air Cleaner Service Indicator-Inspect" procedure and perform the Operation and Maintenance Manual, "Engine Air Precleaner Check/Clean" procedure (if equipped) before performing the following procedure.

**NOTICE**

Never run the engine without an air cleaner element installed. Never run the engine with a damaged air cleaner element. Do not use air cleaner elements with damaged pleats, gaskets or seals. Dirt entering the engine causes premature wear and damage to engine components. Air cleaner elements help to prevent air-borne debris from entering the air inlet.

**NOTICE**

Never service the air cleaner element with the engine running since this will allow dirt to enter the engine.

## Servicing the Air Cleaner Elements

If the air cleaner element becomes plugged, the air can split the material of the air cleaner element. Unfiltered air will drastically accelerate internal engine wear. Your Caterpillar dealer has the proper air cleaner elements for your application. Consult your Caterpillar dealer for the correct air cleaner element.

- Check the precleaner (if equipped) daily for accumulation of dirt and debris. Remove any dirt and debris, as needed.
- Operating conditions (dust, dirt and debris) may require more frequent service of the air cleaner element.
- The air cleaner element may be cleaned up to six times if the element is properly cleaned and inspected.
- The air cleaner element should be replaced at least one time per year. This replacement should be performed regardless of the number of cleanings.

Replace the dirty paper air cleaner elements with clean air cleaner elements. Before installation, the air cleaner elements should be thoroughly checked for tears and/or holes in the filter material. Inspect the gasket or the seal of the air cleaner element for damage. Maintain a supply of suitable air cleaner elements for replacement purposes.

## Air Cleaners With Dual Elements

An air cleaner with a dual element contains a primary air cleaner element and a secondary air cleaner element. The primary air cleaner element can be used up to six times if the element is properly cleaned and inspected. The primary air cleaner element should be replaced at least one time per year. This replacement should be performed regardless of the number of cleanings.

The secondary air cleaner element is not serviceable or washable. The secondary air cleaner element should be removed and discarded for every three cleanings of the primary air cleaner element. When the engine is operating in environments that are dusty or dirty, air cleaner elements may require more frequent replacement.

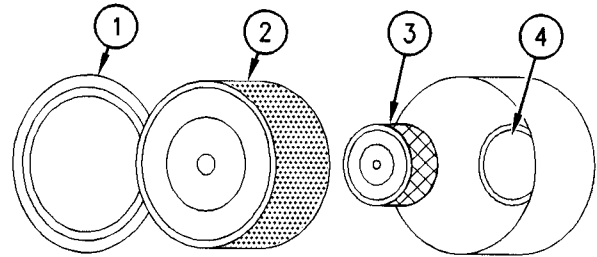


Illustration 27

g00123209

(1) Cover. (2) Primary air cleaner element. (3) Secondary air cleaner element. (4) Turbocharger air inlet.

1. Remove the cover. Remove the primary air cleaner element.
  2. The secondary air cleaner element should be removed and discarded for every three cleanings of the primary air cleaner element.
- Note:** Refer to "Cleaning the Primary Air Filter Elements".
3. Cover the turbocharger air inlet with tape in order to keep dirt out.
  4. Clean the inside of the air cleaner cover and body with a clean, dry cloth.
  5. Remove the tape for the turbocharger air inlet. Install the secondary air cleaner element. Install a primary air cleaner element that is new or cleaned.
  6. Install the air cleaner cover.
  7. Reset the service indicator.

## Cleaning the Primary Air Cleaner Elements

The primary air cleaner element can be used up to six times if the element is properly cleaned and inspected. When the primary air cleaner element is cleaned, check for rips or tears in the filter material. The primary air cleaner element should be replaced at least one time per year. This replacement should be performed regardless of the number of cleanings.

Use clean primary air cleaner elements while dirty elements are being cleaned.

---

### NOTICE

Do not clean the air cleaner elements by bumping or tapping. This could damage the seals. Do not use elements with damaged pleats, gaskets or seals. Damaged elements will allow dirt to pass through. Engine damage could result.

---

Visually inspect the primary air cleaner elements before cleaning. Inspect the air cleaner elements for damage to the seal, the gaskets, and the outer cover. Discard any damaged air cleaner elements.

There are four common methods that are used to clean primary air cleaner elements:

- Pressurized water
- Pressurized air
- Vacuum cleaning
- Washing with nonsudsing detergent

### Pressurized Water

Pressurized water will clean the primary air cleaner element unless carbon and oil have accumulated on the surface of the primary air cleaner element. The maximum water pressure for cleaning purposes must be below 275 kPa (40 psi). Do not use a spray nozzle.

**Note:** When the primary air cleaner element is cleaned, always begin with the clean side (inside) in order to force dirt particles toward the dirty side (outside).

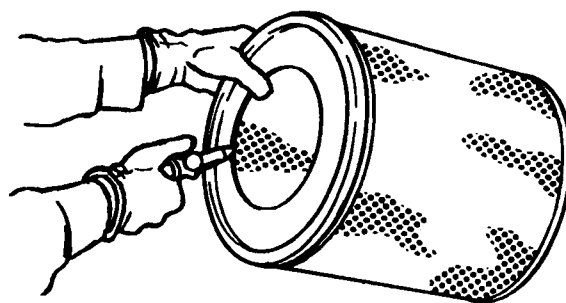
Aim the hose so that the water flows inside the element along the length of the filter in order to help prevent damage to the paper pleats. Do not aim the stream of water directly at the primary air cleaner element. Dirt could be forced further into the pleats.

**Note:** Refer to "Drying the Primary Air Cleaner Elements". Refer to "Inspecting the Primary Air Cleaner Elements".

### Pressurized Air

Pressurized air can be used to clean primary air cleaner elements that have not been cleaned more than two times. Pressurized air will not remove deposits of carbon and oil. Use filtered, dry air with a maximum pressure of 207 kPa (30 psi).

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Illustration 28

g00281692

**Note:** When the primary air cleaner elements are cleaned, always begin with the clean side (inside) in order to force dirt particles toward the dirty side (outside).

Aim the hose so that the air flows inside the element along the length of the filter in order to help prevent damage to the paper pleats. Do not aim the stream of air directly at the primary air cleaner element. Dirt could be forced further into the pleats.

**Note:** Refer to "Inspecting the Primary Air Cleaner Elements".

### Vacuum Cleaning

Vacuum cleaning is a good method for cleaning primary air cleaner elements which require daily cleaning because of a dry, dusty environment. Cleaning with pressurized air is recommended prior to vacuum cleaning. Vacuum cleaning will not remove deposits of carbon and oil.

**Note:** Refer to "Inspecting the Primary Air Cleaner Elements".

## Washing the Primary Air Cleaner Elements with Nonsudsing Detergent

### WARNING

**Do not wash air cleaner elements in any flammable solution such as diesel fuel or gasoline. Doing so can cause fire or an engine runaway and can result in personal injury.**

Washing with nonsudsing detergent is effective for cleaning primary air cleaner elements that have deposits of carbon or oil. Use a cleaning agent that is specifically manufactured for cleaning primary air cleaner elements. Cleaning with pressurized water, pressurized air, or a vacuum is recommended prior to washing with nonsudsing detergent.

1. Place the primary air cleaner element into a wash tank so that the gasket is up. The wash tank should be equipped with a rack so that the primary air cleaner element does not sit on the bottom of the wash tank.

**Note:** Caterpillar does not recommend a process for washing the primary air cleaner element which includes vigorously shaking. By vigorously shaking the element, carbon particles may be distributed.

2. Fill the wash tank with the cleaning agent and warm water to a maximum temperature of 60°C (140°F). Follow the manufacturers recommendations for the cleaning agent. Allow the primary air cleaner element to soak for six hours.
3. Drain the wash tank. Do not use the cleaning agent more than one time. Remove the primary air cleaner element from the wash tank. Rinse the primary air cleaner element with the method for using pressurized water.

**Note:** Refer to "Drying the Primary Air Cleaner Elements". Refer to "Inspecting the Primary Air Cleaner Elements".

## Drying the Primary Air Cleaner Elements

The oven method may be used in order to dry primary air cleaner elements. If an oven is used, do not expose the primary air cleaner elements to temperatures that exceed 82°C (160°F).

**Note:** Do not use compressed air in order to dry the primary air cleaner elements.

Primary air cleaner elements may be allowed to air dry. Allow two days for the primary air cleaner elements to air dry before the elements are inspected and installed.

## Inspecting the Primary Air Cleaner Elements

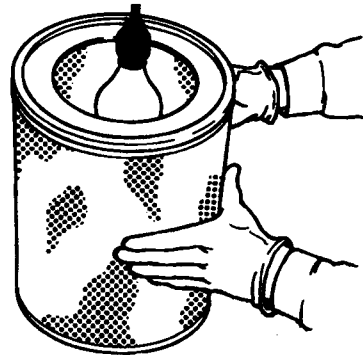


Illustration 29

g00281693

Inspect the clean, dry primary air cleaner element. Use a 60 watt blue light in a dark room or in a similar facility. Place the blue light in the primary air cleaner element. Rotate the primary air cleaner element. Inspect the primary air cleaner element for tears and/or holes. Inspect the primary air cleaner element for light that may show through the filter material. If it is necessary in order to confirm the result, compare the primary air cleaner element to a new primary air cleaner element that has the same part number.

Do not use a primary air cleaner element that has any tears and/or holes in the filter material. Do not use an primary air cleaner element with damaged pleats, gaskets or seals. Discard damaged primary air cleaner elements.

## Storing Primary Air Cleaner Elements

If a primary air cleaner element that passes inspection will not be used, the primary air cleaner element can be stored for future use.

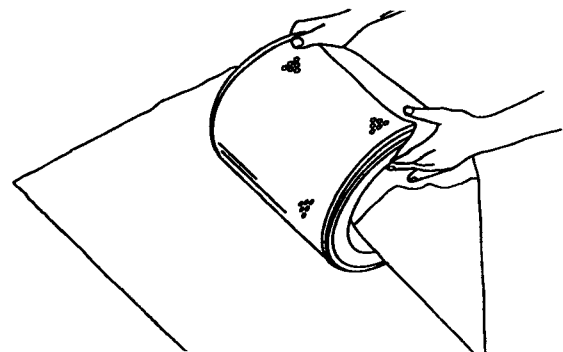


Illustration 30

g00281694

Do not use paint, a waterproof cover, or plastic as a protective covering for storage. Restricted air flow may result. To protect against dirt and damage, wrap the primary air cleaner elements in Volalite Corrosion Inhibited (VCI) paper.

Place the primary air cleaner element into a box for storage. For identification, mark the outside of the box and mark the primary air cleaner element. Include the following information:

- Date of the cleaning
- Number of cleanings

Store the box in a dry location.

For more detailed information on cleaning the primary air cleaner element, refer to Special Publication, SEBF8062, "Procedure to Inspect and Clean Air Filters".

i01175055

## Engine Air Cleaner Service Indicator - Inspect

**SMCS Code:** 7452-040

Some engines may be equipped with a different service indicator.

Some engines are equipped with a differential gauge for inlet air pressure. The differential gauge for inlet air pressure displays the difference in the pressure that is measured before the air cleaner element and the pressure that is measured after the air cleaner element. As the air cleaner element becomes dirty, the pressure differential rises. If your engine is equipped with a different type of service indicator, follow the OEM recommendations in order to service the air cleaner service indicator.

The service indicator may be mounted on the air cleaner element or in a remote location.

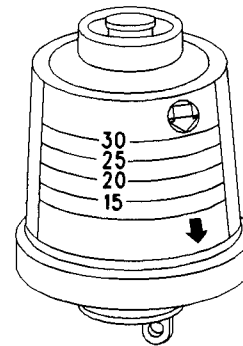


Illustration 31

g00103777

Typical service indicator

Observe the service indicator. The air cleaner element should be cleaned or the air cleaner element should be replaced when one of the following conditions occur:

- The yellow diaphragm enters the red zone.
- The red piston locks in the visible position.

## Test the Service Indicator

Service indicators are important instruments.

- Check for ease of resetting. The service indicator should reset in less than three pushes.
- Check the movement of the yellow core when the engine is accelerated to the engine rated speed. The yellow core should latch approximately at the greatest vacuum that is attained.

If the service indicator does not reset easily, or if the yellow core does not latch at the greatest vacuum, the service indicator should be replaced. If the new service indicator will not reset, the hole for the service indicator may be plugged.

The service indicator may need to be replaced frequently in environments that are severely dusty, if necessary. Replace the service indicator annually regardless of the operating conditions. Replace the service indicator when the engine is overhauled, and whenever major engine components are replaced.

**Note:** When a new service indicator is installed, excessive force may crack the top of the service indicator. Tighten the service indicator to a torque of 2 N·m (18 lb in).

i00720883

## Engine Air Precleaner - Check/Clean

**SMCS Code:** 1055-070; 1055-535

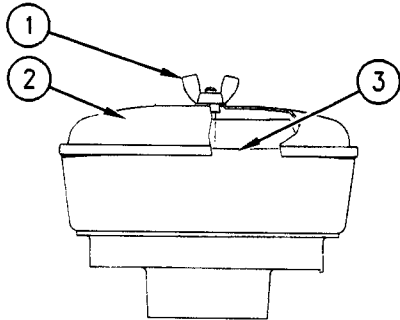


Illustration 32

g00287039

Typical engine precleaner

- (1) Wing nut
- (2) Cover
- (3) Body

Remove wing nut (1) and cover (2). Check for an accumulation of dirt and debris in body (3). Clean the body, if necessary.

After cleaning the precleaner, install cover (2) and wing nut (1).

**Note:** When the engine is operated in dusty applications, more frequent cleaning is required.

i01007514

## Engine Crankcase Breather - Clean

**SMCS Code:** 1317-070

### NOTICE

Perform this maintenance with the engine stopped.

If the crankcase breather is not maintained on a regular basis, the crankcase breather will become plugged. A plugged crankcase breather will cause excessive crankcase pressure that may cause crankshaft seal leakage.

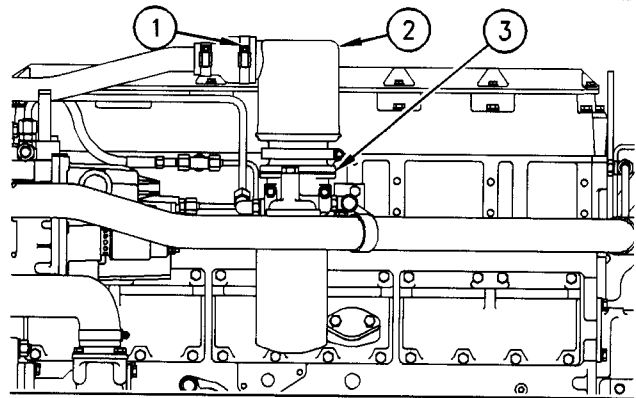


Illustration 33

g00516808

- (1) Hose clamp
- (2) Breather assembly
- (3) Seal

1. Loosen hose clamp (1) and remove the hose from breather assembly (2).
2. Remove breather assembly (2) and seal (3).
3. Wash the breather element in solvent that is clean and nonflammable. Allow the breather element to dry before installation.
4. Install a breather element that is clean and dry. Install seal (3) and breather assembly (2).
5. Install the hose. Install hose clamp (1). Refer to the Operation and Maintenance Manual, "Torque Specifications" topic (Maintenance Section) for the proper torque.

i00259257

## Engine Mounts - Inspect

**SMCS Code:** 1152-040

Inspect the engine mounts for deterioration and for proper bolt torque. Engine vibration can be caused by the following conditions:

- Improper mounting of the engine
- Deterioration of the engine mounts

Any engine mount that shows deterioration should be replaced. Refer to the Service Manual for the recommended torques. Refer to the OEM recommendations for more information.

i00623423

## Engine Oil Level - Check

**SMCS Code:** 1348-535-FLV

### WARNING

**Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the skin.**

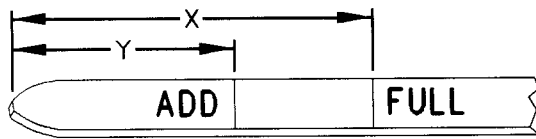


Illustration 34

g00110310

(Y) "ADD" mark. (X) "FULL" mark.

### NOTICE

Perform this maintenance with the engine stopped.

1. Maintain the oil level between "ADD" mark (Y) and "FULL" mark (X) on oil level gauge (1). Do not fill the crankcase above "FULL" mark (X).

### NOTICE

Operating your engine when the oil level is above the "FULL" mark could cause your crankshaft to dip into the oil. The air bubbles created from the crankshaft dipping into the oil reduces the oil's lubricating characteristics and could result in the loss of power.

2. Remove the oil filler cap and add oil, if necessary. Clean the oil filler cap. Install the oil filler cap.

i01534451

## Engine Oil Sample - Obtain

**SMCS Code:** 1000-008; 1348-554-SM;  
7542-554-OC, SM

In addition to a good preventive maintenance program, Caterpillar recommends using S-O-S oil analysis at regularly scheduled intervals in order to monitor the condition of the engine and the maintenance requirements of the engine.

## Obtain the Sample and the Analysis

### WARNING

**Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the skin.**

Before you take the oil sample, complete the Label, PEEP5031 for identification of the sample. In order to help obtain the most accurate analysis, provide the following information:

- Engine model
- Service hours on the engine
- The number of hours that have accumulated since the last oil change
- The amount of oil that has been added since the last oil change

To ensure that the sample is representative of the oil in the crankcase, obtain a warm, well mixed oil sample.

To avoid contamination of the oil samples, the tools and the supplies that are used for obtaining oil samples must be clean.

Caterpillar recommends using the sampling valve in order to obtain oil samples. The quality and the consistency of the samples are better when the sampling valve is used. The location of the sampling valve allows oil that is flowing under pressure to be obtained during normal engine operation.

The **169-8373** Fluid Sampling Bottle is recommended for use with the sampling valve. The fluid sampling bottle includes the parts that are needed for obtaining oil samples. Instructions are also provided.

### NOTICE

Do not use the same vacuum sampling pump for extracting oil samples that is used for extracting coolant samples.

A small residue of either type sample may remain in the pump and may cause a false positive analysis for the sample being taken.

Always use a designated pump for oil sampling and a designated pump for coolant sampling.

Failure to do so may cause a false analysis which could lead to customer and dealer concerns.



If the engine is not equipped with a sampling valve, use the **1U-5718** Vacuum Pump. The pump is designed to accept sampling bottles. Disposable tubing must be attached to the pump for insertion into the sump.

For instructions, see Special Publication, PEHP6001, "How To Take A Good Oil Sample". Consult your Caterpillar dealer for complete information and assistance in establishing an S-O-S program for your engine.

i01591548

## Engine Oil and Filter - Change

**SMCS Code:** 1318-510; 1348-044

### WARNING

**Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the skin.**

Do not drain the oil when the engine is cold. As the oil cools, suspended waste particles settle on the bottom of the oil pan. The waste particles are not removed with the draining cold oil. Drain the crankcase with the engine stopped. Drain the crankcase with the oil warm. This draining method allows the waste particles that are suspended in the oil to be drained properly.

Failure to follow this recommended procedure will cause the waste particles to be recirculated through the engine lubrication system with the new oil.

## Drain the Engine Oil

After the engine has been run at the normal operating temperature, stop the engine. Use one of the following methods to drain the engine crankcase oil:

- If the engine is equipped with a drain valve, turn the drain valve knob counterclockwise in order to drain the oil. After the oil has drained, turn the drain valve knob clockwise in order to close the drain valve.
- If the engine is not equipped with a drain valve, remove the oil drain plug in order to allow the oil to drain. If the engine is equipped with a shallow sump, remove the bottom oil drain plugs from both ends of the oil pan.

After the oil has drained, the oil drain plugs should be cleaned and installed.

## Replace the Oil Filter

### NOTICE

Caterpillar oil filters are built to Caterpillar specifications. Use of an oil filter not recommended by Caterpillar could result in severe engine damage to the engine bearings, crankshaft, etc., as a result of the larger waste particles from unfiltered oil entering the engine lubricating system. Only use oil filters recommended by Caterpillar.

1. Remove the oil filter with a **1U-8760** Chain Wrench.
2. Cut the oil filter open with a **175-7546** Oil Filter Cutter Gp. Break apart the pleats and inspect the oil filter for metal debris. An excessive amount of metal debris in the oil filter may indicate early wear or a pending failure.

Use a magnet to differentiate between the ferrous metals and the nonferrous metals that are found in the oil filter element. Ferrous metals may indicate wear on the steel and cast iron parts of the engine.

Nonferrous metals may indicate wear on the aluminum parts, brass parts or bronze parts of the engine. Parts that may be affected include the following items: main bearings, rod bearings, turbocharger bearings, and cylinder heads.

Due to normal wear and friction, it is not uncommon to find small amounts of debris in the oil filter. Consult your Caterpillar dealer in order to arrange for a further analysis if an excessive amount of debris is found in the oil filter.

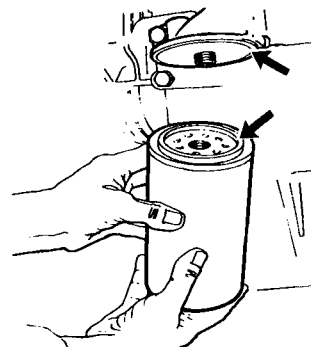


Illustration 35

900103713

Typical filter mounting base and filter gasket

3. Clean the sealing surface of the filter mounting base. Ensure that all of the old oil filter gasket is removed.
4. Apply clean engine oil to the new oil filter gasket.

---

**NOTICE**

Do not fill the oil filters with oil before installing them. This oil would not be filtered and could be contaminated. Contaminated oil can cause accelerated wear to engine components.

---

5. Install the oil filter. Tighten the oil filter until the oil filter gasket contacts the base. Tighten the oil filter by hand according to the instructions that are shown on the oil filter. Do not overtighten the oil filter.

## Fill the Engine Crankcase

1. Remove the oil filler cap. Refer to the Operation and Maintenance Manual for more information on lubricant specifications. Fill the crankcase with the proper amount of oil. Refer to the Operation and Maintenance Manual for more information on refill capacities.

---

**NOTICE**

If equipped with an auxiliary oil filter system or a remote oil filter system, follow the OEM or filter manufacturer's recommendations. Under filling or overfilling the crankcase with oil can cause engine damage.

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**NOTICE**

To prevent crankshaft bearing damage, crank the engine with the fuel OFF. This will fill the oil filters before starting the engine. Do not crank the engine for more than 30 seconds.

---

2. Start the engine and run the engine at "LOW IDLE" for two minutes. Perform this procedure in order to ensure that the lubrication system has oil and that the oil filters are filled. Inspect the oil filter for oil leaks.
3. Stop the engine and allow the oil to drain back to the sump for a minimum of ten minutes.
4. Remove the oil level gauge in order to check the oil level. Maintain the oil level between the "ADD" and "FULL" marks on the oil level gauge.

i01592900

## Engine Operation - Test

**SMCS Code:** 1000-081

**S/N:** CKK1-Up

In accordance with NFPA-20, start the engine and run the engine for a minimum of 30 minutes in order to attain normal operating temperature.

## Automatic Operation

The basic function of a fire pump controller is automatically starting the engine. The fire pump controller will start the engine upon a drop in pressure in the water supply or from a number of other demand signals. The controller provides automatic cycled cranking and the controller provides alarm protection for various engine failures. After the demand period is terminated, The engine may be manually stopped or the engine may be automatically stopped.

Recommended ambient room temperature is 20 °C (68 °F). The jacket water coolant temperature must be maintained at a minimum of 49 °C (120 °F).

i00626013

## Engine Protective Devices - Check

**SMCS Code:** 7400-535

Alarms and shutoffs must function properly. Alarms provide timely warning to the operator. Shutoffs help to prevent damage to the engine. It is impossible to determine if the engine protective devices are in good working order during normal operation. Malfunctions must be simulated in order to test the engine protective devices.

A calibration check of the engine protective devices will ensure that the alarms and shutoffs activate at the setpoints. Ensure that the engine protective devices are functioning properly.

---

**NOTICE**

During testing, abnormal operating conditions must be simulated.

The tests must be performed correctly in order to prevent possible damage to the engine.

---

To prevent damage to the engine, only authorized service personnel or your Caterpillar dealer should perform the tests.

## Visual Inspection

Visually check the condition of all gauges, sensors and wiring. Look for wiring and components that are loose, broken, or damaged. Damaged wiring or components should be repaired or replaced immediately.

i01430860

## Engine Storage Procedure - Check

**SMCS Code:** 1000-535

Caterpillar requires all engines that are stored for more than 3 months to follow storage procedures and start-up procedures. These procedures provide maximum protection to internal engine components. Refer to Special Instruction, SEHS9031, "Storage Procedure For Caterpillar Products" for information on these procedures.

An extension of the oil change interval to 12 months is permitted if you follow the required procedures for storage and start-up. This extension is permitted if the following intervals in the Operation and Maintenance Manual, "Maintenance Interval Schedule" have not been reached:

- Operating hours
- Fuel consumption

i00869628

## Engine Valve Lash - Inspect/Adjust

**SMCS Code:** 1102-025

The initial valve lash adjustment on new engines, rebuilt engines, or remanufactured engines is recommended at the first scheduled oil change. The adjustment is necessary due to the initial wear of the valve train components and to the seating of the valve train components.

This maintenance is recommended by Caterpillar as part of a lubrication and preventive maintenance schedule in order to help provide maximum engine life.

### NOTICE

Only qualified service personnel should perform this maintenance. Refer to the Service Manual or your Caterpillar dealer for the complete valve lash adjustment procedure.

Operation of Caterpillar engines with improper valve adjustments can reduce engine efficiency. This reduced efficiency could result in excessive fuel usage and/or shortened engine component life.

### WARNING

**Ensure that the engine can not be started while this maintenance is being performed. To help prevent possible injury, do not use the starting motor to turn the flywheel.**

**Hot engine components can cause burns. Allow additional time for the engine to cool before measuring/adjusting valve lash clearance.**

Ensure that the engine is stopped before measuring the valve lash. To obtain an accurate measurement, allow the valves to cool before this maintenance is performed.

Refer to the Service Manual for more information.

i00805059

## Ether Starting Aid Cylinder - Replace (If Equipped)

**SMCS Code:** 1456-510-CD

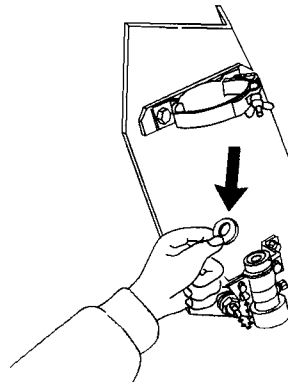


Illustration 36

g00104888

Typical example

1. Loosen the ether cylinder clamp. Unscrew and remove the empty ether cylinder.
2. Remove the used gasket. Install the new gasket that is provided with each new ether cylinder.
3. Install the new ether cylinder. Hand tighten the ether cylinder. Tighten the ether cylinder clamp securely.

i01602288

## Fan Drive Bearing - Lubricate (If Equipped)

**SMCS Code:** 1359-086-BD

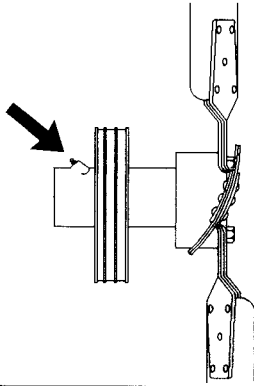


Illustration 37

g00123252

Typical grease fitting for the fan drive bearing

Lubricate the fan drive bearing with Bearing Lubricant Special Purpose Grease or the equivalent.

Inspect the fan drive pulley assembly. If the shaft is loose, an inspection of the internal components should be performed. Refer to the Service Manual.

i00850658

## Fuel Injection Timing - Check

**SMCS Code:** 1251-036-TM; 1290-036-TM

**Note:** The correct fuel timing specification is found on the Engine Information Plate. Fuel timing specifications may vary for different engine applications and/or for different power ratings.

A qualified mechanic should adjust the fuel injector timing because special tools and training are required.

Refer to your Caterpillar dealer for the complete adjustment procedure for the fuel injector timing.

i01534632

## Fuel Inlet Screen - Clean/Inspect/Replace

**SMCS Code:** 1250-510-Z3; 1250-571-Z3;  
1252-040-Z3; 1252-070-Z3; 1252-510-Z3;  
1252-571; 1252-571-Z3; 1252; 1256-040-Z3;  
1256-070-Z3; 1256-510-Z3; 1256

### **WARNING**

**Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire.**

### **NOTICE**

Do not allow dirt to enter the fuel system. Thoroughly clean the area around a fuel system component that will be disconnected. Fit a suitable cover over disconnected fuel system component.

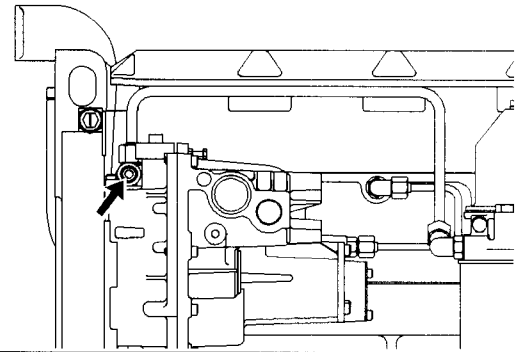


Illustration 38

g00796911

1. Disconnect the fuel supply line.
2. Remove the fuel inlet screen.
3. Clean the fuel inlet screen with a nonflammable solvent.
4. Install the fuel inlet screen.
5. Connect the fuel supply line.

i01007661

## Fuel System - Prime

SMCS Code: 1258-548

### WARNING

**Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the start switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.**

Prime the fuel system in order to fill the fuel filter. Prime the fuel system in order to purge trapped air. The fuel system should be primed under the following conditions:

- Running out of fuel
- Storage
- Replacement of the fuel filter

### Engines that are Equipped with a Fuel Priming Pump

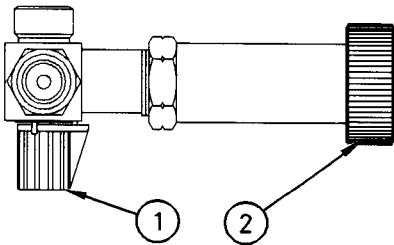


Illustration 39

g00516899

- (1) Select knob  
(2) Plunger

1. Turn select knob (1) counterclockwise until the indicator is in line with the body of the priming pump.
2. Unlock the plunger and operate the plunger until a resistance is felt. A considerable number of pump strokes may be required.
3. Push in plunger (2) and tighten by hand.
4. Turn select knob (1) clockwise until the indicator is in line with the fuel outlet.

### NOTICE

Do not crank the engine continuously for more than 30 seconds. Allow the starting motor to cool for two minutes before cranking the engine again.

5. Promptly start the engine. If the engine runs rough, increase the engine rpm to one half of the rated rpm.

**Note:** If the engine will not start, further priming may be necessary. If the engine continues to misfire or smoke after starting, further priming may be necessary.

### Engines that are Not Equipped with a Fuel Priming Pump

### NOTICE

Do not allow dirt to enter the fuel system. Thoroughly clean the area around a fuel system component that will be disconnected. Fit a suitable cover over any disconnected fuel system components.

If the engine is not equipped with a fuel priming pump, it may be necessary to fill the fuel filter with clean fuel. The following procedure will only allow filtered fuel to enter the fuel system.

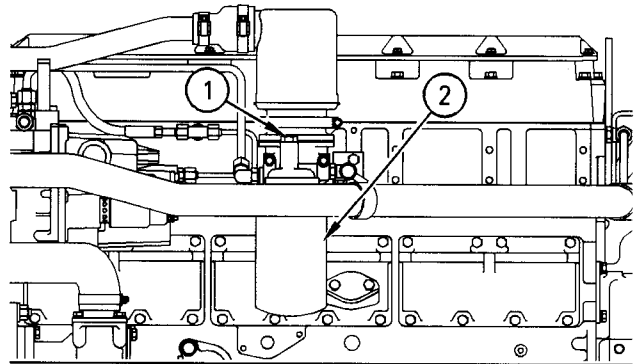


Illustration 40

g00516900

- (1) Plug  
(2) Fuel filter

1. Remove plug (1) in order to fill fuel filter (2). Ensure that air is able to vent from the fitting of the plug while the fuel filter is being filled. Clean up any spilled fuel immediately. Clean plug (1). Install plug (1).

### NOTICE

Do not crank the engine continuously for more than 30 seconds. Allow the starting motor to cool for two minutes before cranking the engine again.

2. Start the engine and immediately increase the engine rpm to one half of the rated rpm.
3. Maintain the engine rpm until the engine operates smoothly.
4. Reduce the engine rpm to low idle.

i00951418

## Fuel System Primary Filter - Clean/Replace

**SMCS Code:** 1260-070; 1260-510

### WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the start switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.

1. Stop the engine.
2. Turn the start switch to the "OFF" position. Disconnect the battery.
3. Shut off the fuel tank supply valve to the engine.
4. If the primary fuel filter is equipped with a drain valve, open the drain valve in order to drain any fuel from the filter case. Close the drain valve.

### NOTICE

Use a suitable container to catch any fuel that might spill. Clean up any spilled fuel immediately.

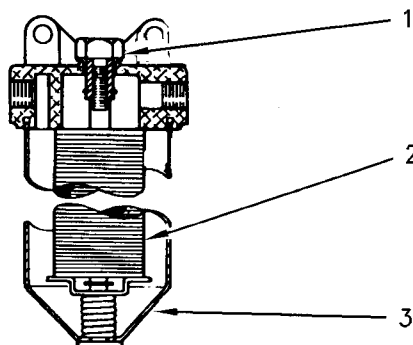


Illustration 41

g00485293

- (1) Bolt  
(2) Element  
(3) Case

5. Loosen the bolt (1) that is on the filter housing. Remove the filter case (3).

6. Remove the element (2) and wash the element in clean, nonflammable solvent.

### NOTICE

Do not fill the fuel filters with fuel before installing them. The fuel would not be filtered and could be contaminated. Contaminated fuel will cause accelerated wear to fuel system parts.

7. Install the element (2) and the filter case (3). Tighten the bolt (1) to a torque of  $24 \pm 4$  N·m ( $18 \pm 3$  lb ft).

i00914347

## Fuel System Primary Filter/Water Separator Element - Replace

**SMCS Code:** 1260-510-FQ; 1263-510-FQ

Water in the fuel can cause the engine to run rough. Water in the fuel may cause fuel system components to fail. If the fuel has been contaminated with water, the element should be changed before the regularly scheduled interval.

The primary filter/water separator also provides filtration in order to help extend the life of the secondary fuel filter. The element should be changed regularly. The primary filter/water separator should be changed when the vacuum gauge (if equipped) registers 50 to 70 kPa (15 to 20 in Hg).

### Replace the Element

### WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the start switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.

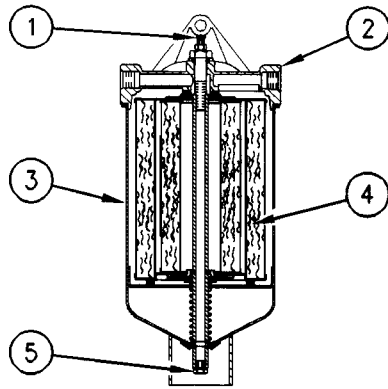


Illustration 42

g00467033

- (1) Vent valve
- (2) Base
- (3) Can
- (4) Element
- (5) Drain plug

1. Close the main fuel supply valve.
2. Remove drain plug (5). Depress vent valve (1) in order to start the flow of fuel. Allow the fuel to drain into a suitable container. Dispose of the fuel properly.
3. Install the drain plug.
4. Remove can (3) from base (2).
5. Remove element (4) from the can. Dispose of the used element.
6. Remove the gasket. Clean the following components:
  - Can
  - Gasket
  - BaseInspect the gasket for damage and for deterioration. Replace the gasket, if necessary.
7. Install the gasket. Lubricate the gasket with clean diesel fuel.

#### NOTICE

The primary filter/water separator may be prefilled with fuel to avoid rough running/stalling of the engine due to air. Do not fill the secondary filter with fuel before installation. The fuel would not be filtered and could be contaminated. Contaminated fuel will cause accelerated wear to fuel system parts.

8. Install a new element in the can. The can may be filled with fuel at this time.

9. Install the can on the base. Tighten the can by hand. Do not use tools in order to tighten the can.

#### NOTICE

The water separator is under suction during normal engine operation. Ensure that the vent plug is tightened securely to help prevent air from entering the fuel system.

10. Open the main fuel supply valve.
11. Start the engine and check for leaks. Run the engine for one minute. Stop the engine and check for leaks again.

Leaks are difficult to detect while the engine is running. The primary filter/water separator is under suction. A leak will allow air to enter the fuel. The air in the fuel can cause low power due to aeration of the fuel. If air enters the fuel, ensure that all components are properly tightened.

i01007602

## Fuel System Secondary Filter - Replace

**SMCS Code:** 1261-510-SE

### WARNING

**Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the start switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.**

1. Stop the engine.
2. Turn off the start switch, or disconnect the battery (starting motor) when maintenance is performed on fuel filters.
3. Shut off the fuel tank supply valve to the engine.

#### NOTICE

Use a suitable container to catch any fuel that might spill. Clean up any spilled fuel immediately.

4. Unlock the fuel priming pump (if equipped). This relieves any residual pressure in the fuel system.
5. Remove the used fuel filter. Use a cloth, or use a container to catch excess fuel.
6. Clean the gasket sealing surface of the fuel filter base. Ensure that all of the old gasket is removed.

7. Apply clean diesel fuel to the new fuel filter gasket.

---

#### NOTICE

Do not fill the secondary fuel filter with fuel before installing. The fuel would not be filtered and could be contaminated. Contaminated fuel will cause accelerated wear to fuel system parts.

---

8. Install a new fuel filter, and tighten the fuel filter until the gasket contacts the base.
9. Tighten the fuel filter by hand according to the instructions that are shown on the fuel filter.

**Do not overtighten the fuel filter.**

10. Lock the fuel priming pump (if equipped). Open the fuel tank supply valve.
11. If the engine stalls, refer to the Operation and Maintenance Manual, "Fuel System - Prime" topic (Maintenance Section) for more information.

i00909035

## Fuel System Water Separator - Drain

SMCS Code: 1263-543



### WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire.

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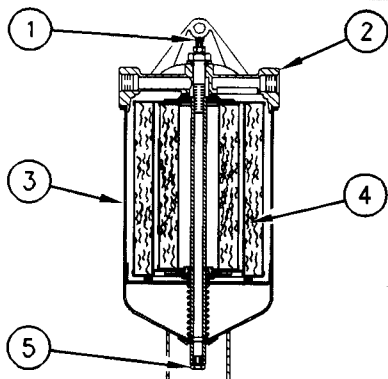


Illustration 43

g00467033

- (1) Vent valve
- (2) Base
- (3) Can
- (4) Element
- (5) Drain plug

Water in the fuel can cause fuel system components to fail. Drain the water separator daily. Drain the water separator more frequently when a large concentration of water is present in the fuel system.

1. Close the fuel supply valve.

---

#### NOTICE

Use a suitable container to catch any fuel that might spill. Clean up any spilled fuel immediately.

---

2. Remove drain plug (5). Depress vent valve (1) in order to start the flow. Allow the water to drain into a suitable container. Allow the water to flow until fuel flows from the drain.
3. Install the drain plug. Dispose of the liquid properly.
4. Open the fuel supply valve.

---

#### NOTICE

The water separator is under suction during normal engine operation. Ensure that the drain valve is tightened securely to help prevent air from entering the fuel system.

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i00073301

## Fuel Tank Water and Sediment - Drain

SMCS Code: 1273-543-M&S

### Fuel Tank

Fuel quality is critical to the performance and to the service life of the engine. Water in the fuel can cause excessive fuel system wear. Condensation occurs during the heating and cooling of fuel. The condensation occurs as the fuel passes through the fuel system and the fuel returns to the fuel tank. This causes water to accumulate in fuel tanks. Draining the fuel tank regularly and obtaining fuel from reliable sources can help to eliminate water in the fuel.

### Drain the Water and the Sediment

Fuel tanks should contain some provision for draining water and draining sediment from the bottom of the fuel tanks.

Open the drain valve on the bottom of the fuel tank in order to drain the water and the sediment. Close the drain valve.



Check the fuel daily. Drain the water and sediment from the fuel tank after operating the engine or drain the water and sediment from the fuel tank after the fuel tank has been filled. Allow five to ten minutes before performing this procedure.

Fill the fuel tank after operating the engine in order to drive out moist air. This will help prevent condensation. Do not fill the tank to the top. The fuel expands as the fuel gets warm. The tank may overflow.

Some fuel tanks use supply pipes that allow water and sediment to settle below the end of the fuel supply pipe. Some fuel tanks use supply lines that take fuel directly from the bottom of the tank. If the engine is equipped with this system, regular maintenance of the fuel system filter is important.

## Fuel Storage Tanks

Drain the water and the sediment from the fuel storage tank during the following conditions:

- Weekly
- Oil change
- Refill of the tank

This will help prevent water or sediment from being pumped from the storage tank into the engine fuel tank.

If a bulk storage tank has been refilled or moved recently, allow adequate time for the sediment to settle before filling the engine fuel tank. Internal baffles in the bulk storage tank will also help trap sediment. Filtering fuel that is pumped from the storage tank helps to ensure the quality of the fuel. When possible, water separators should be used.

i00907072

## Hoses and Clamps - Inspect/Replace

**SMCS Code:** 7554-040; 7554-510

Inspect all hoses for leaks that are caused by the following conditions:

- Cracking
- Softness
- Loose clamps

Replace hoses that are cracked or soft. Tighten any loose clamps.

### NOTICE

Do not bend or strike high pressure lines. Do not install bent or damaged lines, tubes or hoses. Repair any loose or damaged fuel and oil lines, tubes and hoses. Leaks can cause fires. Inspect all lines, tubes and hoses carefully. Tighten all connections to the recommended torque.

Check for the following conditions:

- End fittings that are damaged or leaking
- Outer covering that is chafed or cut
- Exposed wire that is used for reinforcement
- Outer covering that is ballooning locally
- Flexible part of the hose that is kinked or crushed
- Armoring that is embedded in the outer covering

A constant torque hose clamp can be used in place of any standard hose clamp. Ensure that the constant torque hose clamp is the same size as the standard clamp.

Due to extreme temperature changes, the hose will heat set. Heat setting causes hose clamps to loosen. This can result in leaks. A constant torque hose clamp will help to prevent loose hose clamps.

Each installation application can be different. The differences depend on the following factors:

- Type of hose
- Type of fitting material
- Anticipated expansion and contraction of the hose
- Anticipated expansion and contraction of the fittings

## Replace the Hoses and the Clamps

### WARNING

**Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.**

1. Stop the engine. Allow the engine to cool.

2. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap.

**Note:** Drain the coolant into a suitable, clean container. The coolant can be reused.

3. Drain the coolant from the cooling system to a level that is below the hose that is being replaced.
4. Remove the hose clamps.
5. Disconnect the old hose.
6. Replace the old hose with a new hose.

**Note:** For torques on hose clamps, see this Operation and Maintenance Manual, "Torque Specifications" (Maintenance Section).

7. Install the hose clamps with a torque wrench.

**Note:** For the proper coolant to use, see this Operation and Maintenance Manual, "Coolant Recommendations" (Maintenance Section).

8. Refill the cooling system.
9. Clean the cooling system filler cap. Inspect the cooling system filler cap's gaskets. Replace the cooling system filler cap if the gaskets are damaged. Install the cooling system filler cap.
10. Start the engine. Inspect the cooling system for leaks.

i01452713

## Overhaul Considerations

**SMCS Code:** 7595-043

Reduced hours of operation at full load will result in a lower average power demand. A decreased average power demand should increase both the engine service life and the overhaul interval.

The need for an overhaul is generally indicated by increased fuel consumption and by reduced power.

The following factors are important when a decision is being made on the proper time for an engine overhaul:

- The need for preventive maintenance
- The quality of the fuel that is being used
- The operating conditions

- The results of the S-O-S analysis

## Oil Consumption as an Overhaul Indicator

Oil consumption, fuel consumption, and maintenance information can be used to estimate the total operating cost for your Caterpillar engine. Oil consumption can also be used to estimate the required capacity of a makeup oil tank that is suitable for the maintenance intervals.

Oil consumption is in proportion to the percentage of the rated engine load. As the percentage of the engine load is increased, the amount of oil that is consumed per hour also increases.

The oil consumption rate (brake specific oil consumption) is measured in grams per kW/h (lb per bhp). The brake specific oil consumption (BSOC) depends on the engine load. Consult your Caterpillar dealer for assistance in determining the typical oil consumption rate for your engine.

When an engine's oil consumption has risen to three times the original oil consumption rate due to normal wear, an engine overhaul should be scheduled. There may be a corresponding increase in blowby and a slight increase in fuel consumption.

## Overhaul Options

### Before Failure Overhaul

A planned overhaul before failure may be the best value for the following reasons:

- Costly unplanned downtime can be avoided.
- Many original parts can be reused according to the standards for reusable parts.
- The engine's service life can be extended without the risk of a major catastrophe due to engine failure.
- The best cost/value relationship per hour of extended life can be attained.

### After Failure Overhaul

If a major engine failure occurs and the engine must be removed, many options are available. An overhaul should be performed if the engine block or the crankshaft needs to be repaired.

If the engine block is repairable and/or the crankshaft is repairable, the overhaul cost should be between 40 percent and 50 percent of the cost of a new engine with a similar exchange core.

This lower cost can be attributed to three aspects:

- Specially designed Caterpillar engine features
- Caterpillar dealer exchange components
- Caterpillar Inc. remanufactured exchange components

## Overhaul Recommendation

To minimize downtime, Caterpillar Inc. recommends a scheduled engine overhaul by your Caterpillar dealer before the engine fails. This will provide you with the best cost/value relationship.

**Note:** Overhaul programs vary according to the engine application and according to the dealer that performs the overhaul. Consult your Caterpillar dealer for specific information about the available overhaul programs and about overhaul services for extending the engine life.

If an overhaul is performed without overhaul service from your Caterpillar dealer, be aware of the following maintenance recommendations.

## Rebuild or Exchange

### Cylinder Head Assembly, Cylinder Packs, Oil Pump, and Fuel Transfer Pump

These components should be inspected according to the instructions that are found in various Caterpillar reusability publications. The Special Publication, SEBF8029 lists the reusability publications that are needed for inspecting the engine parts.

If the parts comply with the established inspection specifications that are expressed in the reusable parts guideline, the parts should be reused.

Parts that are not within the established inspection specifications should be dealt with in one of the following manners:

- Salvaging
- Repairing
- Replacing

Using out-of-spec parts can result in the following problems:

- Unscheduled downtime
- Costly repairs
- Damage to other engine parts

- Reduced engine efficiency
- Increased fuel consumption

Reduced engine efficiency and increased fuel consumption translates into higher operating costs. Therefore, Caterpillar Inc. recommends repairing out-of-spec parts or replacing out-of-spec parts.

## Inspection and/or Replacement

### Crankshaft Bearings, Valve Rotators, and Crankshaft Seals

The following components may not last until the second overhaul.

- Thrust bearings
- Main bearings
- Rod bearings
- Valve rotators
- Crankshaft seals

Caterpillar Inc. recommends the installation of new parts at each overhaul period.

Inspect these parts while the engine is disassembled for an overhaul.

Inspect the crankshaft for any of the following conditions:

- Deflection
- Damage to the journals
- Bearing material that has seized to the journals

Check the journal taper and the profile of the crankshaft journals. Check these components by interpreting the wear patterns on the following components:

- Rod bearing
- Main bearings

Inspect the camshaft for damage to the journals and to the lobes.

**Note:** If the camshaft is removed for any reason, use the magnetic particle inspection process to check for cracks in the camshaft.

Inspect the following components for signs of wear or for signs of scuffing:

- Camshaft bearings
- Camshaft followers

Caterpillar Inc. recommends replacing the crankshaft vibration damper.

### Oil Cooler Core

During an overhaul, Caterpillar Inc. recommends the removal of the oil cooler core. Clean the oil cooler core. Then, pressure test the oil cooler core.

#### NOTICE

Do not use caustic cleaners to clean the core.

Caustic cleaners can attack the internal metals of the core and cause leakage.

**Note:** Use this cleaning procedure to clean the oil cooler core.

1. Remove the oil cooler core.
2. Remove any debris from the oil cooler core. To remove debris from the oil cooler core, turn the oil cooler core onto one end.
3. Flush the oil cooler core internally with cleaner in order to loosen foreign substances. This will also help to remove oil from the oil cooler core.

**Note:** Caterpillar Inc. recommends the use of Hydrosolv Liquid Cleaners. Table 36 lists the Hydrosolv Liquid Cleaners that are available from your Caterpillar dealer.

Table 36

Hydrosolv Liquid Cleaners		
Part Number	Description	Size
1U-8812	Hydrosolv4165	4 L (1 US gallon)
1U-5490		19 L (5 US gallon)
8T-7570		208 L (55 US gallon)
1U-8804	Hydrosolv100	4 L (1 US gallon)
1U-5492		19 L (5 US gallon)
8T-5571		208 L (55 US gallon)

4. Use steam to clean the oil cooler core. This removes any remaining residue from the cleaner. Flush the fins of the oil cooler core. Remove any other trapped debris.
5. Wash the oil cooler core with hot, soapy water. Rinse the oil cooler core thoroughly with clean water.

### WARNING

**Personal injury can result from air pressure.**

**Personal injury can result without following proper procedure. When using pressure air, wear a protective face shield and protective clothing.**

**Maximum air pressure at the nozzle must be less than 205 kPa (30 psi) for cleaning purposes.**

6. Dry the oil cooler core with compressed air. Direct the air in the reverse direction of the normal flow.
7. Inspect the components in order to ensure cleanliness. The oil cooler core should be pressure tested. Repair the oil cooler core, if necessary. Install the oil cooler core.

For more information about cleaning the cores, consult your Caterpillar dealer.

### Obtain Coolant Analysis

The concentration of supplemental coolant additive (SCA) should be checked regularly with test kits or with S-O-S Coolant Analysis (Level 1). Further coolant analysis is recommended when the engine is overhauled.

For example, considerable deposits are found in the water jacket areas on the external cooling system, but the concentrations of coolant additives were carefully maintained. The coolant water probably contained minerals that were deposited on the engine over time.

A coolant analysis can be conducted in order to verify the condition of the water that is being used in the cooling system. A full water analysis can be obtained by consulting your local water utility company or an agricultural agent. Private laboratories are also available for water analysis.

Caterpillar Inc. recommends an S-O-S Coolant Analysis (Level 2).

### S-O-S Coolant Analysis (Level 2)

An S-O-S Coolant Analysis (Level 2) is a comprehensive coolant analysis which completely analyzes the coolant and the effects on the cooling system. An S-O-S Coolant Analysis (Level 2) provides the following information:

- Complete S-O-S Coolant Analysis (Level 1)
- Visual inspection of properties

- Identification of metal corrosion
- Identification of contaminants
- Identification of built up impurities (corrosion and scale)

S·O·S Coolant Analysis (Level 2) provides a report of the results of both the analysis and the maintenance recommendations.

For more information about coolant analysis, see your Caterpillar dealer.

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## Radiator - Clean

**SMCS Code:** 1353-070

**Note:** Adjust the frequency of cleaning according to the effects of the operating environment.

Inspect the radiator for these items: damaged fins, corrosion, dirt, grease, insects, leaves, oil, and other debris. Clean the radiator, if necessary.



### WARNING

**Personal injury can result from air pressure.**

**Personal injury can result without following proper procedure. When using pressure air, wear a protective face shield and protective clothing.**

**Maximum air pressure at the nozzle must be less than 205 kPa (30 psi) for cleaning purposes.**

Pressurized air is the preferred method for removing loose debris. Direct the air in the opposite direction of the fan's air flow. Hold the nozzle approximately 6 mm (0.25 inch) away from the fins. Slowly move the air nozzle in a direction that is parallel with the tubes. This will remove debris that is between the tubes.

Pressurized water may also be used for cleaning. The maximum water pressure for cleaning purposes must be less than 275 kPa (40 psi). Use pressurized water in order to soften mud. Clean the core from both sides.

Use a degreaser and steam for removal of oil and grease. Clean both sides of the core. Wash the core with detergent and hot water. Thoroughly rinse the core with clean water.

After cleaning, start the engine and accelerate the engine to high idle rpm. This will help in the removal of debris and drying of the core. Stop the engine. Use a light bulb behind the core in order to inspect the core for cleanliness. Repeat the cleaning, if necessary.

Inspect the fins for damage. Bent fins may be opened with a "comb". Inspect these items for good condition: welds, mounting brackets, air lines, connections, clamps, and seals. Make repairs, if necessary.

For more detailed information on cleaning and inspection, refer to Special Publication, SEBD0518, "Know Your Cooling System".

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## Severe Service Application - Check

**SMCS Code:** 1000-535

Severe service is an application of an engine that exceeds current published standards for that engine. Caterpillar maintains standards for the following engine parameters:

- Performance (power range, speed range, and fuel consumption)
- Fuel quality
- Altitude range
- Maintenance intervals
- Oil selection and maintenance
- Coolant selection and maintenance
- Environmental qualities
- Installation

Refer to the standards for the engine or consult with your Caterpillar dealer in order to determine if the engine is operating within the defined parameters.

Severe service operation can accelerate component wear. Engines that operate under severe conditions may need more frequent maintenance intervals in order to ensure maximum reliability and retention of full service life.

Due to individual applications, it is not possible to identify all of the factors which can contribute to severe service operation. Consult your Caterpillar dealer for the unique maintenance that is necessary for the engine.

The operating environment, improper operating procedures and improper maintenance procedures can be factors which contribute to severe service conditions.

## Environmental Factors

**Ambient temperatures** – The engine may be exposed to extended operation in extremely cold environments or hot environments. Valve components can be damaged by carbon buildup if the engine is frequently started and stopped in very cold temperatures. Extremely hot inlet air reduces engine performance.

**Air Quality** – The engine may be exposed to extended operation in an environment that is dirty or dusty, unless the equipment is cleaned regularly. Mud, dirt and dust can encase components. Maintenance can be very difficult. The buildup can contain corrosive chemicals.

**Buildup** – Compounds, elements, corrosive chemicals and salt can damage some components.

**Altitude** – Problems can arise when the engine is operated at altitudes that are higher than the intended settings for that application. Necessary adjustments should be made.

## Improper Operating Procedures

- Extended operation at low idle
- Frequent hot shutdowns
- Operating at excessive loads
- Operating at excessive speeds
- Operating outside the intended application

## Improper Maintenance Procedures

- Extending the maintenance intervals
- Failure to use recommended fuel, lubricants and coolant/antifreeze

i00651416

## Starting Motor - Inspect

**SMCS Code:** 1451-040; 1453-040

Caterpillar Inc. recommends a scheduled inspection of the starting motor. If the starting motor fails, the engine may not start in an emergency situation.

Check the starting motor for proper operation. Check the electrical connections and clean the electrical connections. Refer to the Service Manual for more information on the checking procedure and for specifications or consult your Caterpillar dealer for assistance.

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## Turbocharger - Inspect/Clean

**SMCS Code:** 1052-571

Periodic inspection and cleaning is recommended for the turbocharger compressor housing (inlet side). Any fumes from the crankcase are filtered through the air inlet system. Therefore, by-products from oil and from combustion can collect in the turbocharger compressor housing. Over time, this buildup can contribute to loss of engine power, increased black smoke and overall loss of engine efficiency.

If the turbocharger fails during engine operation, damage to the turbocharger compressor wheel and/or to the engine may occur. Damage to the turbocharger compressor wheel can cause additional damage to the pistons, the valves, and the cylinder head.

---

### NOTICE

Turbocharger bearing failures can cause large quantities of oil to enter the air inlet and exhaust systems. Loss of engine lubricant can result in serious engine damage.

Minor leakage of a turbocharger housing under extended low idle operation should not cause problems as long as a turbocharger bearing failure has not occurred.

When a turbocharger bearing failure is accompanied by a significant engine performance loss (exhaust smoke or engine rpm up at no load), do not continue engine operation until the turbocharger is repaired or replaced.

---

An inspection of the turbocharger can minimize unscheduled downtime. An inspection of the turbocharger can also reduce the chance for potential damage to other engine parts.

**Note:** Turbocharger components require precision clearances. The turbocharger cartridge must be balanced due to high rpm. Severe Service Applications can accelerate component wear. Severe Service Applications require more frequent inspections of the cartridge.

## Removal and Installation

For options regarding the removal, installation, repair and replacement, consult your Caterpillar dealer. Refer to the Service Manual for this engine for the procedure and specifications.

## Cleaning and Inspecting

1. Remove the exhaust outlet piping and remove the air inlet piping from the turbocharger. Visually inspect the piping for the presence of oil.
2. Turn the compressor wheel and the turbine wheel by hand. The assembly should turn freely. Inspect the compressor wheel and the turbine wheel for contact with the turbocharger housing. There should not be any visible signs of contact between the turbine wheel or compressor wheel and the turbocharger housing. If there is any indication of contact between the rotating turbine wheel or the compressor wheel and the turbocharger housing, the turbocharger must be reconditioned.
3. Check the compressor wheel for cleanliness. If only the blade side of the wheel is dirty, dirt and/or moisture is passing through the air filtering system. If oil is found only on the back side of the wheel, there is a possibility of a failed turbocharger oil seal.

The presence of oil may be the result of extended engine operation at low idle. The presence of oil may also be the result of a restriction of the line for the inlet air (plugged air filters), which causes the turbocharger to slobber.

4. Use a dial indicator to check the end clearance on the shaft. If the measured end play is greater than the Service Manual specifications, the turbocharger should be repaired or replaced. An end play measurement that is less than the minimum Service Manual specifications could indicate carbon buildup on the turbine wheel. The turbocharger should be disassembled for cleaning and for inspection if the measured end play is less than the minimum Service Manual specifications.
5. Inspect the bore of the turbine housing for corrosion.
6. Clean the turbocharger housing and clean the backing plate of the cartridge with standard shop solvents and a soft bristle brush.
7. Fasten the air inlet piping and the exhaust outlet piping to the turbocharger housing.

## Walk-Around Inspection

**SMCS Code:** 1000-040

### Inspect the Engine for Leaks and for Loose Connections

A walk-around inspection should only take a few minutes. When the time is taken to perform these checks, costly repairs and accidents can be avoided.

For maximum engine service life, make a thorough inspection of the engine compartment before starting the engine. Look for items such as oil leaks or coolant leaks, loose bolts, worn belts, loose connections and trash buildup. Make repairs, as needed:

- The guards must be in the proper place. Repair damaged guards or replace missing guards.
- Wipe all caps and plugs before the engine is serviced in order to reduce the chance of system contamination.

---

#### NOTICE

For any type of leak (coolant, lube, or fuel) clean up the fluid. If leaking is observed, find the source and correct the leak. If leaking is suspected, check the fluid levels more often than recommended until the leak is found or fixed, or until the suspicion of a leak is proved to be unwarranted.

---



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#### NOTICE

Accumulated grease and/or oil on an engine or deck is a fire hazard. Remove this debris with steam cleaning or high pressure water.

---

- Ensure that cooling lines are properly clamped and tight. Check for leaks. Check the condition of all pipes.
- Inspect the water pump for coolant leaks.

**Note:** The water pump seal is lubricated by coolant in the cooling system. It is normal for a small amount of leakage to occur as the engine cools down and the parts contract.

Excessive coolant leakage may indicate the need to replace the water pump seal. For the removal of water pump and the installation of water pump and/or seals, refer to the Service Manual for the engine or consult your Caterpillar dealer.

- Inspect the lubrication system for leaks at the front crankshaft seal, the rear crankshaft seal, the oil pan, the oil filters and the valve cover.
- Inspect the fuel system for leaks. Look for loose fuel line clamps.
- Inspect the piping for the air inlet system and the elbows for cracks and for loose clamps.
- Inspect the alternator belt and the accessory drive belts for cracks, breaks or other damage.

Belts for multiple groove pulleys must be replaced as matched sets. If only one belt is replaced, the belt will carry more load than the belts that are not replaced. The older belts are stretched. The additional load on the new belt could cause the belt to break.

- Drain the water and the sediment from fuel tanks on a daily basis in order to ensure that only clean fuel enters the fuel system.
- Inspect the wiring and the wiring harnesses for loose connections and for worn wires or frayed wires.
- Inspect the ground strap for a good connection and for good condition.
- Inspect the engine-to-frame ground strap for a good connection and for good condition.
- Disconnect any battery chargers that are not protected against the current drain of the starting motor. Check the condition and the electrolyte level of the batteries, unless the engine is equipped with a maintenance free battery.
- Check the condition of the gauges. Replace any gauges which are cracked or can not be calibrated.

Visually inspect the water pump for leaks. If any leaking is observed, replace the water pump seal or the water pump assembly. Refer to the Service Manual for the disassembly and assembly procedure.

**Note:** Refer to the Service Manual or consult your Caterpillar dealer if any repair is needed or any replacement is needed.

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## Water Pump - Inspect

**SMCS Code:** 1361-040; 1361

A failed water pump might cause severe engine overheating problems that could result in the following conditions:

- Cracks in the cylinder head
- A piston seizure
- Other potential damage to the engine



# Reference Information Section

## Engine Ratings

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### Engine Rating Conditions

**SMCS Code:** 1000

All engine ratings are in compliance with the following standard ambient air conditions of "SAE J1349":

- 99 kPa (29.3 inches of Hg)
- 30 percent relative humidity
- A temperature of 25 °C (77 °F)

Ratings relate to the standard conditions of "ISO8665", of "ISO3046/1", of "DIN6271", and of "BS5514".

The engine ratings are based on the following fuel specifications:

- Low heat value (LHV) of the fuel of 42 780 kJ/kg (18,390 Btu/lb) at 29 °C (84 °F)
- Gravity (API) of 35 degrees at 15 °C (60 °F)
- Specific gravity of .849 at 15 °C (60 °F)
- Density of 850 kg/m<sup>3</sup> (7.085 lb/US gal)

The engine ratings are gross output ratings.

**Gross Output Ratings** – The total output capability of the engine that is equipped with standard accessories.

Standard accessories include the following components:

- Oil pumps
- Fuel pumps
- Water pumps

Subtract the power that is required to drive auxiliary components from the gross output. This will produce the net power that is available for the external load (flywheel).

## Customer Service

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## Customer Assistance

**SMCS Code:** 1000

### USA and Canada

When a problem arises concerning the operation of an engine or concerning the service of an engine, the problem will normally be managed by the dealer in your area.

Your satisfaction is a primary concern to Caterpillar and to Caterpillar dealers. If you have a problem that has not been handled to your complete satisfaction, follow these steps:

1. Discuss your problem with a manager from the dealership.
2. If your problem cannot be resolved at the dealer level without additional assistance, use the phone number that is listed below to talk with a Field Service Coordinator:

1-800-447-4986

The normal hours are from 8:00 to 4:30 Monday through Friday Central Standard Time.

3. If your needs have not been met still, submit the matter in writing to the following address:

Caterpillar Inc.  
Manager, Customer Service, Engine Division  
Mossville Bldg A  
P.O. Box 600  
Peoria, Illinois 61552-0600

Please keep in mind: probably, your problem will ultimately be solved at the dealership, using the dealership's facilities, equipment, and personnel. Therefore, follow the steps in sequence when a problem is experienced.

### Outside of the USA and of Canada

If a problem arises outside the USA and outside Canada, and if the problem cannot be resolved at the dealer level, consult the appropriate Caterpillar office.

Latin America, Mexico, Caribbean  
Caterpillar Americas Co.  
701 Waterford Way, Suite 200  
Miami, FL 33126  
USA  
Phone: 305-476-6876  
Fax: 305-476-6850

Europe, Africa, and Middle East  
Caterpillar Overseas S.A.  
76 Route de Frontenex  
P.O. Box 6000  
1211 Geneva 6  
Switzerland  
Phone: 22-849-4444  
Fax: 22-849-4544

Far East  
Caterpillar Asia Pte. Ltd.  
7 Tractor Road  
Jurong, Singapore 627968  
Republic of Singapore  
Phone: 65-662-8333  
Fax: 65-662-8302

China  
Caterpillar China Ltd.  
37/F, The Lee Gardens  
33 Hysan Avenue  
Causeway Bay, Hong Kong  
China  
Phone: 852-2848-0333  
Fax: 852-2848-0440

Japan  
Shin Caterpillar Mitsubishi Ltd.  
Setagaya Business Square Tower  
10-1, Yoga 4-chome  
Setagaya, Tokyo  
Japan  
Phone: 81-3-5717-1121  
Fax: 81-3-5717-1177

Japan  
Caterpillar Power Systems, Inc.  
Japan Branch Sanno Grand Bldg.  
2-14-2 Nagatacho  
Chiyoda-ku, Tokyo, 100  
Japan  
Phone: 81-335-93-3237  
Fax: 81-335-93-3238

Australia and New Zealand  
Caterpillar of Australia Ltd.  
1 Caterpillar Drive  
Private Mail Bag 4  
Tullamarine, Victoria 3043  
Australia  
Phone: 03-9339-9333  
Fax: 03-9335-3366

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## Ordering Replacement Parts

SMCS Code: 7567

### **WARNING**

**When replacement parts are required for this product Caterpillar recommends using Caterpillar replacement parts or parts with equivalent specifications including, but not limited to, physical dimensions, type, strength and material.**

**Failure to heed this warning can lead to premature failures, product damage, personal injury or death.**

---

Quality Caterpillar replacement parts are available from Caterpillar dealers throughout the world. Caterpillar dealers' parts inventories are up-to-date. The parts stocks include all of the parts that are normally needed to protect your Caterpillar engine investment.

When you order parts, please specify the following information:

- Part number
- Part name
- Quantity

If there is a question concerning the part number, please provide your dealer with a complete description of the needed item.

When a Caterpillar engine requires maintenance and/or repair, provide the dealer with all the information that is stamped on the Information Plate. This information is described in this Operation and Maintenance Manual (Product Information Section).

Discuss the problem with the dealer. Inform the dealer about the conditions of the problem and the nature of the problem. Inform the dealer about when the problem occurs. This will help the dealer in troubleshooting the problem and solving the problem faster.

## Reference Materials

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### Reference Material

SMCS Code: 1000

### Lubricants

- Special Publication, PEHP1026, "Data Sheet - Caterpillar Diesel Engine Oil (DEO) (CF-4) (International only)"
- Special Publication, PEHP0002, "Data Sheet - Multipurpose Lithium Complex Grease with Molybdenum (MPGM)"
- Special Publication, PEHP0017, "Data Sheet - Special Purpose Grease (SPG) Bearing Lubricant"
- Special Publication, SEBD0640, "Oil and Your Engine"
- Operation and Maintenance Manual, SEBU5898, "Cold Weather Recommendations"
- Special Publication, PEDP7036, "S·O·S Fluids Analysis Cornerstone"
- Special Publication, PEHP6001, "How To Take A Good Oil Sample"
- Special Publication, PEHP8038, "Data Sheet - Caterpillar Diesel Engine Oils (DEO) (CH-4, CG-4, CF-4) (North America and Australia)"
- Special Publication, PEHP7041, "Product Data Sheet for Caterpillar Diesel Engine Oils (DEO) CG-4 engine oils (International markets)"
- Special Publication, PEWP3014, "Cat Fluids Selector Dial (International)"
- Special Publication, PEWP9733, "Cat Fluids Selector Dial (North America)"
- Special Publication, NEHP5621, "How To Select The Right Grease For Any Job"
- Special Publication, NEHP6015, "Caterpillar Special Purpose Grease Data Sheet"

### Fuels

- Special Publication, SEBD0717, "Diesel Fuels and Your Engine"

### Coolants

- Special Publication, PEHP4036, "Data Sheet-Caterpillar Coolant"
- Special Publication, PEHP7057, "S·O·S Coolant Analysis"
- Special Publication, SEBD0518, "Knowing Your Cooling System"
- Special Publication, SEBD0970, "Coolant and Your Engine"
- Special Publication, PEEP5027, "Label - ELC Radiator Label"

### Miscellaneous

- Service Manual, SEBU6251, "Caterpillar Commercial Diesel Engine Fluids Recommendations"
- Special Publication, PECP6026, "One Safe Source"
- Special Publication, PECP6027, "One Safe Source (For COSA)"
- Special Publication, PECP6028, "One Safe Source (For non NACD and non COSA)"
- Service Manual, REG1139F, "Service Manual Contents Microfiche"
- Service Manual, SENR3945, "3114, 3116, and 3126 Industrial and Generator Set Engines"
- Specifications, SENR9557, "3114, 3116, and 3126 Industrial, Marine and Generator Set Engines"
- Systems Operation, Testing & Adjusting, SENR9558, "3114, 3116, and 3126 Industrial, Marine and Generator Set Engines"
- Disassembly and Assembly, SENR9518, "3114, 3116, and 3126 Industrial, Marine and Generator Set Engines"
- Specifications, SENR3130, "Torque Specifications"
- Special Instruction, SEHS7654, "Alignment - General Instructions"
- Special Publication, LEBH9324, "Industrial Application and Installation Guide"
- Special Publication, SEBF8029, "Index to Guidelines for Reusable Parts and Salvage Operations"

- Special Publication, SEBF8062, "Guideline for Reusable Parts - Cleaning and Inspection of Air Filters"
- Special Instruction, SEHS9031, "Storage Procedure for Caterpillar Products"
- Special Publication, NEHS0526, "Service Technician Application Guide"
- Special Instruction, SMHS7001, "Assembly of Fan Drive Pulley Assemblies"
- Special Instruction, SEHS7768, "Use of 6V-2150 Starting/Charging Analyzer"
- Special Instruction, SEHS7633, "Battery Test Procedure"
- Label, SEHS7332, "Do Not Operate"

## Emissions Warranty

This engine may be Certified and this engine may be covered by an Emissions Warranty. A detailed explanation of the Emissions Warranty that is applicable to Certified engines is found in Supplement, SEBU7066, "Federal Emissions Control Warranty Information". The Engine is Certified if the engine has a special label that verifies the certification. A Caterpillar dealer can also inform you if the engine is Certified.

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## Additional Reference Material

### SMCS Code: 1000

The "EMA Lubricating Oils Data Book" can be obtained from the following locations: local technological society, local library, and local college. If necessary, consult EMA at the following address:

Engine Manufacturers Association  
401 N. Michigan Ave.  
Chicago, IL, USA 60611  
Telephone: (312) 644-6610 ext. 3626

The "Society of Automotive Engineers (SAE) Specifications" can be found in your SAE handbook. This publication can also be obtained from the following locations: local technological society, local library, and local college. If necessary, consult SAE at the following address:

SAE International  
400 Commonwealth Drive  
Warrendale, PA, USA 15096-0001  
Telephone: (724) 776-4841

The "American Petroleum Institute Publication No. 1509" can be obtained from the following locations: local technological society, local library, and local college. If necessary, consult API at the following address:

American Petroleum Institute  
1220 L St. N.W.  
Washington, DC, USA 20005  
Telephone: (202) 682-8000

The International Organization for Standardization (ISO) offers information and customer service regarding international standards and standardizing activities. ISO can also supply information on the following subjects that are not controlled by ISO: national standards, regional standards, regulations, certification, and related activities. Consult the member of ISO in your country.

International Organization for Standardization (ISO)  
1, rue de Varembe  
Case postale 56  
CH-1211 Genève 20  
Switzerland  
Telephone: +41 22 749 01 11  
Facsimile: +41 22 733 34 30  
E-mail: [central@iso.ch](mailto:central@iso.ch)  
Web site: <http://www.iso.ch>

European classifications are established by the Conseil International Des Machines a Combustion (CIMAC) (International Council on Combustion Engines).

CIMAC Central Secretariat  
Lyoner Strasse 18  
60528 Frankfurt  
Germany  
Telephone: +49 69 6603 1567  
Facsimile: +49 69 6603 1566

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## Maintenance Records

### SMCS Code: 1000

Caterpillar Inc. recommends the retention of accurate maintenance records. Accurate maintenance records can be used for the following purposes:

- Determine operating costs.
- Establish maintenance schedules for other engines that are operated in the same environment.

- Show compliance with the required maintenance practices and maintenance intervals.

Maintenance records can be used for a variety of other business decisions that are related to engine maintenance.

Maintenance records are a key element of a maintenance program that is well managed. Accurate maintenance records can help your Caterpillar dealer to fine tune the recommended maintenance intervals in order to meet the specific operating situation. This should result in a lower engine operating cost.

Records should be kept for the following items:

**Fuel Consumption** – A record of fuel consumption is essential in order to determine when the load sensitive components should be inspected or repaired. Fuel consumption also determines overhaul intervals.

**Service Hours** – A record of service hours is essential to determine when the speed sensitive components should be inspected or repaired.

**Documents** – These items should be easy to obtain, and these items should be kept in the engine history file. All of the documents should show this information: date, service hours, fuel consumption, unit number, and engine serial number. The following types of documents should be kept as proof of maintenance or repair for warranty:

Keep the following types of documents as proof of maintenance for warranty. Also, keep these types of documents as proof of repair for warranty:

- Dealer work orders and itemized bills
- Owner's repair costs
- Owner's receipts
- Maintenance log

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## Maintenance Log

**SMCS Code:** 1000

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# Product and Dealer Information

**Note:** For product identification plate locations, see the section "Product Identification Information" in the Operation and Maintenance Manual.

**Delivery Date:** \_\_\_\_\_

## Product Information

Model: \_\_\_\_\_

Product Identification Number: \_\_\_\_\_

Engine Serial Number: \_\_\_\_\_

Transmission Serial Number: \_\_\_\_\_

Generator Serial Number: \_\_\_\_\_

Attachment Serial Numbers: \_\_\_\_\_

Attachment Information: \_\_\_\_\_

Customer Equipment Number: \_\_\_\_\_

Dealer Equipment Number: \_\_\_\_\_

## Dealer Information

Name: \_\_\_\_\_ Branch: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

	<u>Dealer Contact</u>	<u>Phone Number</u>	<u>Hours</u>
Sales:	_____	_____	_____
Parts:	_____	_____	_____
Service:	_____	_____	_____





PEMEX – PP LUM A  
Project

ImXport Services Corp.

# Vendor Data Book

P.O. # 0018987

Serial # 23407C

Volume: 1

## Nautilus Crane Model 340LA-80

### Section 5.11 Hydraulic System



**SEE MAINTENANCE PRECAUTIONS  
PRIOR TO PERFORMING ANY WORK**

#### Part Repair or Replacement

Any repair of hydraulic parts, particularly pumps, motors and cylinders, requiring complete disassembly of the unit is not recommended to be performed in the field.

Major repairs should only be attempted by experienced, qualified and properly equipped personnel. Only minor repairs and adjustments as described in the manual should be performed in the field.

As always, the prime consideration when working on the hydraulic system is to insure that no contamination is introduced into the system. When replacing a hydraulic part, the following basic outline should be used:

1. Remove damaged part and install new part.
2. If any debris is present in the hoses or tubing, the lines should be flushed clean with a suitable solvent and blown dry before reconnecting.
3. If the hydraulic part is a pump or motor, power is off and disconnects are open, physically hand-fill ports with clean hydraulic oil (provides lubrication for initial start-up).
4. Reconnect all tubing and hoses.
5. If debris from damaged parts are in the system (such as motor which has “gone to pieces”), replace the return line filter element and check the suction strainers.
6. Check all mounting bolts, nuts and/or pins.



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## Nautilus Crane Model 340LA-80

7. Start prime mover and allow it to run at low (idle, 1000 rpm).
8. Operate system at least a few minutes at zero pressure.
9. Operate repaired system without a load on the hook observing operating pressure and general operational characteristics.
10. Operate system with a load observing operating pressures and general operational characteristics.
11. Inspect the system for hydraulic leaks and correct any abnormalities.



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Serial # 23407C

Volume: 1

## Nautilus Crane Model 340LA-80

### Section 5.12 Load Indicator System



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HOUMA, LA 70363  
USA







**Markload Systems Inc.®**  
**DX**  
**Operation, Service and Installation**  
**Manual**

## IMPORTANT NOTES

### SYSTEM INSTALLATION

Installations should be done in dry weather to insure moisture does not penetrate any of the cable connections. If moisture is suspected in any connections they should be cleaned with contact cleaner that is labeled "RESIDUE FREE" only.

### INITIAL SYSTEM SETUP

Upon initial installation or when any system components are replaced, the calibration of all input signals (loads, angle, length...) should be checked and adjusted if necessary. See the calibration pages of this manual for detailed procedures.

### POWER PRECAUTION

On some cranes, when the crane power is turned on or when the engine is started, there are short duration power fluctuations that are severe enough to affect the Markload system memory. It is advisable to **LEAVE THE MARKLOAD POWER OFF UNTIL AFTER THE CRANE ENGINE IS STARTED**. It is also best to turn the Markload system off **before** turning the crane off.

### TEST THE ANTI-TWO-BLOCK DAILY

If your system is so equipped, the Anti-two-block for each hook should be tested daily for proper operation.

### LOAD CALIBRATION

The load accuracy should be checked once a year. This should be done using certified test weights.

- Lift a known load.  
A sufficient load must be lifted in order to calibrate the system correctly.  
The crane should be set up to allow the following load to be picked up safely.  
( $\frac{1}{2}$  of the Max single line pull working load times current parts of line)

(Example: If max working single line pull for the wire rope is 25,000 and four parts of line are in use then  $\frac{1}{2}$  times 25,000 times 4 = 50,000 ... so at least 50,000 lbs. should be lifted for proper calibration)

# Operation Handbook for Markload DX Systems

## Alerts and Alarms

The following are typical Alert and Alarm conditions (special alerts and alarms are programmed at the customer's request):

Alert at load greater than 85% capacity - The **ALERT** light flashes and the audible alarm pulses as the display flashes the Alert message.

Alarm at loads greater than 100% capacity - The **ALARM** light is constantly lit and the audible alarm is constantly on as the display flashes the Alarm message.

Boom angles greater or less than those allowed by the lift charts (NO LIFT ZONE) - The **ALERT** and **ALARM** lights flash and the audible alarm pulses as the display flashes the "**NO LIFT ZONE**" message.

Hardware Failure - The **ALARM** light is constantly lit and the audible alarm is constantly on as the display flashes the appropriate "**TRANSDUCER ERROR**" message on the top line of the display.

As well as describing the above conditions, the display provides the operator with the current load on that hook, the maximum capacity allowable for that hook in the current configuration, and the boom geometry (radius, angle, height, or length). The load and capacity are displayed as a digital number and a bar graph representation of that number.

## Using the Menus

The up (↑) and down (↓) arrows are used to scroll or move the menu selection up and down.

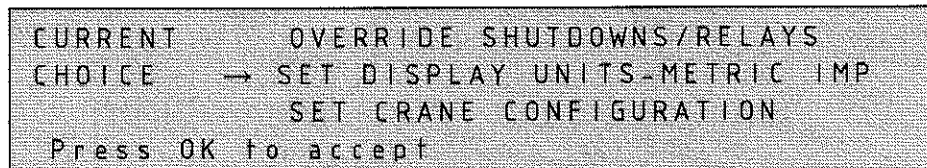
The current selection appears in front of the (→) arrow.

For example, in the picture below the current selection is "**SET DISPLAY UNITS-METRIC IMP**".

To go to the current selection, press the **OK** button.

Example:

To change the units for display press ↓ several times until the screen looks like the following picture:



```
CURRENT      OVERRIDE SHUTDOWNS/RELAYS
CHOICE  → SET DISPLAY UNITS-METRIC IMP
          SET CRANE CONFIGURATION
Press OK to accept
```

Press the **OK** button to go to the units selection menu. Next press the up (↑) or down (↓) arrows until the units of measure you wish to display lines up with the right (→) arrow then press the **OK** button. The correct units of measure will now appear on the display.

## Steps to Follow When the Markload System is Turned On

Start the crane (The Markload power should be off while starting the crane).

Turn the Markload system power on.

Verify that all of the information on the top line of the display matches the current crane setup.

Example:

- 1) Main hook,
- 2) 8 Parts of Line,
- 3) Boom Length = 100,

1	2	3
MAIN	PL 08	100' BOOM
LOAD	: 02.5	Klb
CAP	: 40.0	Klb
RAD	: 205	Ft

### To Change the Hook In Use:

- Press the SET button to enter the setup menu.
- Press ↓ several times to scroll down to the “CHANGE HOOK – MAIN/AUX” selection.
- Press OK to make this selection.
- This will change the hook that is monitored and save this setting. The hook that is monitored will be shown at the left side of the top line of the display.

### To Change the Parts of Line In Use:

- Press the SET button to enter the setup menu.
- Press ↓ several times to scroll down to the “CHANGE PARTS OF LINE” selection.
- Press OK to make this selection
- Press ↑ as many times as needed until the display shows the correct Parts-of-Line.
- Press OK to accept and save this setting.

### To Change the Capacity Display Line:

- Press the SET button to enter the setup menu.
- Press ↓ several times to scroll down to the “SET CAPACITY/%CAPACITY DSPLY” selection.
- Press OK to make this selection.
- This will change and save the capacity display to or from the percent setting.

### To Change Geometry Display:

- Press the SET button to enter the setup menu.
- Press ↓ several times to scroll down to the "DISPLAY RAD-LEN-HGHT
- Press OK to make this selection.
- Press ↑ as many times as needed until the display shows the intended setting.
- Press SET to accept and save this setting.

"RAD" for radius,

"LGTH" for boom length

"HGHT" for boom tip height

"ANG" for main boom angle, This is continuously shown at the bottom left line of the display

### To Change the Crane Configuration

- Press the SET button to enter the setup menu.
- Press ↓ several times to scroll down to the "SET CRANE CONFIGURATION" selection.
- Press OK to make this selection
- Now press the ↑ or ↓ buttons until the required configuration lines up with the right (→) arrow.
- Press OK to accept and save this setting.

### To Override the Relay(s) (for systems with this option)

This menu allows the operator to override the optional relays provided. The description programmed into the system for the relay(s) depends on the customer's specific application.

- Press the SET button to enter the setup menu.
- Press ↓ several times to scroll down to the "OVERRIDE SHUTDOWNS/RELAYS" selection.
- Press OK to make this selection
- Now press the ↑ or ↓ buttons until the relay to be changed lines up with the right (→) arrow.
- Press the SET button to change the override state of the relay shown. The display will show the current status.
- Press OK to accept and save this setting.

This menu can also act as a test for the relays. If the relay was not activated when this menu was entered, the operator can activate the relay by first OVERRIDING the relay, then returning it to normal operation (push the 'SET' button twice). The relay will return to normal operation after the menu is exited or timed out if the operator did not OVERRIDE the relay. The override status of the relays will **not** be saved when power to the system is turned off and will be reset when the condition that activated the relay goes away.

## Set Display Units (Metric / Imperial)

This menu allows the operator to choose the UNITS for display. The load units will be displayed as Klbs for kilo-pounds (1000s of pounds) or KKg for kilo-kilo-grams (1000s of Kilograms - Metric tonnes).

- Press the SET button to enter the setup menu.
- Press ↓ several times to scroll down to the “SET DISPLAY UNITS-METRIC/IMP” selection.
- Press OK to make this selection
- Now press the ↑ or ↓ buttons until the required setting lines up with the right (→) arrow.
- Press OK to accept and save this setting.

## Other Menus

Additional menus are present when more complex crane configurations are required. Other menus are present when options such as the lift recorder or special calibration options are ordered.

## Tare Function

The tare function allows the user to tare the current load, thus zeroing the load displayed. This allows the operator to display any increase above the amount of the tare (useful for weighing the contents of a container).

**NOTE:** Overload Alert and Alarm checking is not effected by the TARE function.

### To use tare do the following:

- Press the SET button to enter the setup menu.
- Press ↓ several times to scroll down to the “SET TARE” selection.
- Press OK to make this selection
- Press SET to accept the current load as the tare value. This will save the value and change the load display to the tare mode. The display will now show “**L D - T :**” for the load display and the value will be the total load minus the tare load.
- Press OK to accept and save this setting.

The system will retain the tare load for use at a later time (even if the power is turned off).

### To cancel tare do the following:

- Press the SET button to enter the setup menu.
- Press ↓ several times to scroll down to the “SET TARE” selection.
- Press OK to make this selection
- Press ↓ button. This will cancel tare and save this setting.

## Test Function

Pressing and holding the **OK** button does a system test on all lights, audible devices and all input channels used. The test continues as long as the OK button is pressed. The last line of the display shows the results of the test done on the input channels. A **FAIL** occurs when the input signal of that channel falls below a specified level, or the preamp is not sending a correct signal indicating an open line or preamp failure. The test function will test the lights, and audible alerts by turning them all on while the switch is pressed. If one of the lights is not lit or the audible alert is not sounding during test, the system must be repaired. While the OK button is pressed, the system serial number and other system information is also displayed.

## Passwords

System Password = 7030

In order to change any of the system calibration settings, a password must be entered.

Follow the steps below to enter the password:

- When the password screen appears the current digit to be changed will flash.
- The value of the flashing digit can be set by pressing the ↓ or ↑ arrows.
- To select another digit press the SET button.
- When the correct password shows on the display, press the OK button.

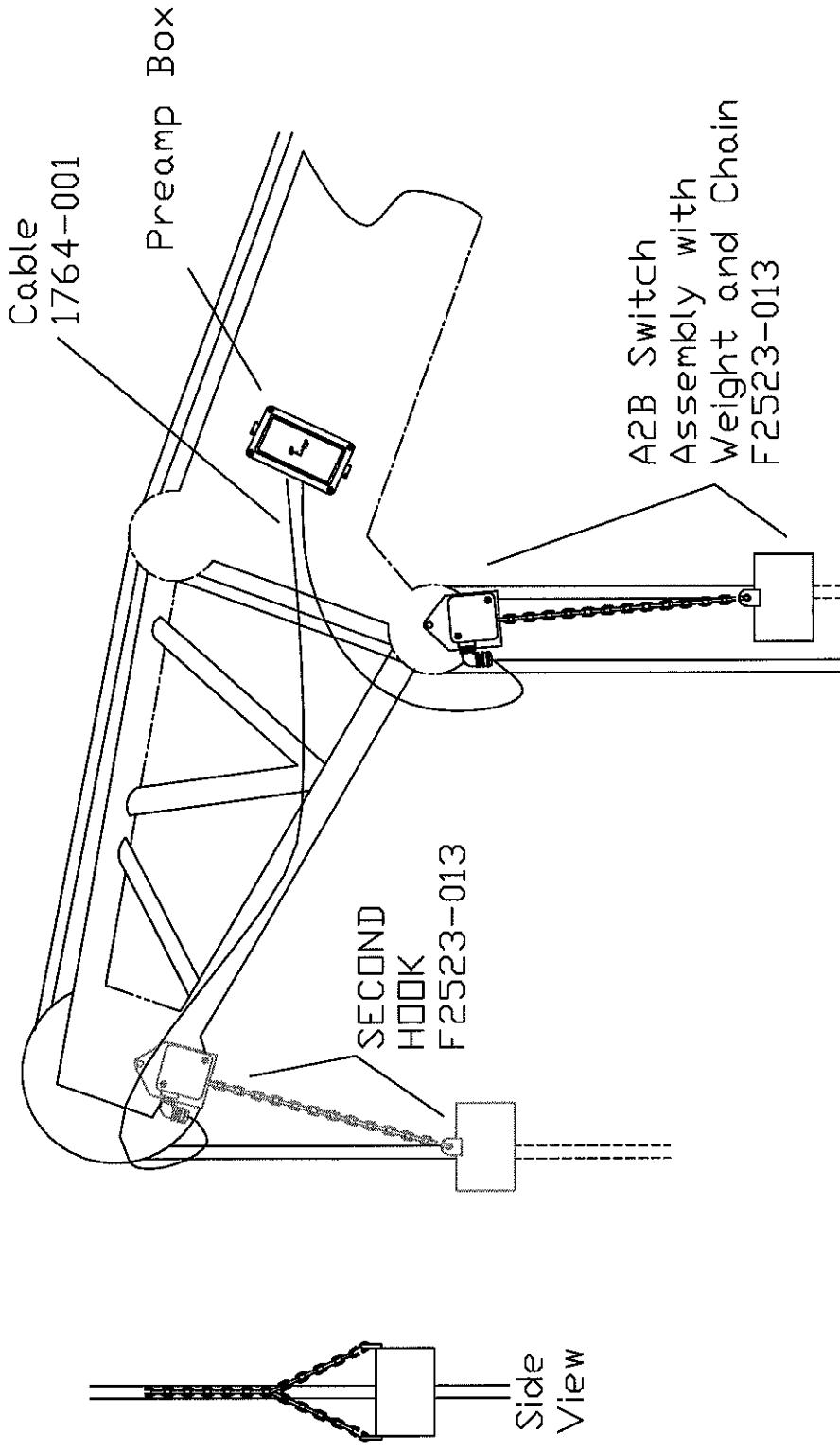


## **ANTI-TWO-BLOCK ENABLE / DISABLE**

(for systems with this option)

If one or both of the anti-two-block switches are not used they can be disabled. This prevents the system from monitoring the disabled switch.

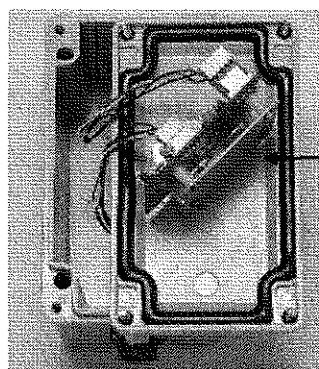
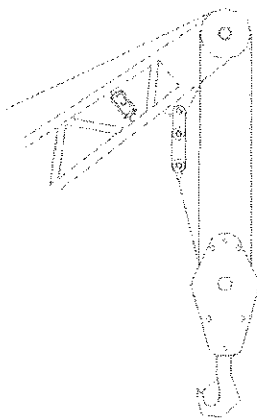
- Press the **SET** button to enter the setup menu.
- Press **↓** several times to scroll down to the “ADVANCED MENU” selection.
- Press **OK** to make this selection
- Enter password then press **OK**. The value of the flashing digit can be changed by pressing the **↓** or **↑** arrows. To select another digit press the **SET** button.
- Press **↓** if needed so the right arrow points to “SETUP ANTI-TWO-BLOCK” then press **OK**.
- Press **↓** if needed so the **→** (right arrow) points to the main or aux hook to enable/disable that function.
- Press the **SET** button to change the status. The display will show the current status.
- Press **OK** to accept and save this setting.



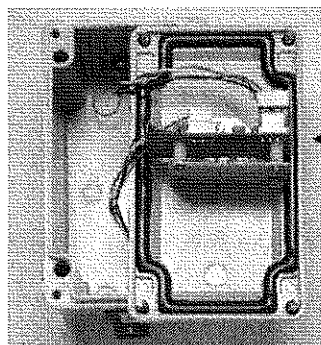
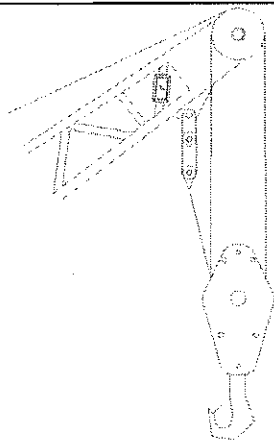
DWN M. R. I. DATE 9/30/93	CK'D DATE	ENG DATE	APPR DATE	MARKLOAD SYSTEMS INC. 1115 N. MAIN PEARLAND, TEXAS 77581 (713)485-8608 FAX (713)485-3007	REVISION
UNLESS OTHERWISE NOTED BREAK SHARP EDGES 45° X .005 MAX FILLET 0.005 RADIUS				A- / - / - /	
TOLERANCES FRAC. + 1/64 DEC. XX = +.010 ANGLES + 30° X = +.015				- / - / - /	
SCALE: NONE				- / - / - /	
NEXT ASS'Y: FINAL				SHT OF	
TITLE: ANTI-TWO-BLOCK OPTION DUAL HOOK					

## ANGLE SENDER INSTALLATION

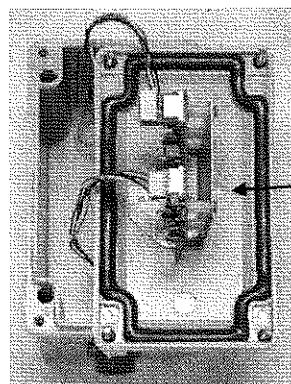
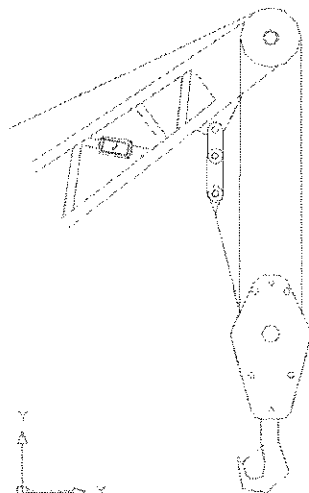
- The angle sender unit should be mounted vertically (when the boom is horizontal) if possible on the inside of the boom for protection. The cover of the box should face the right side of the boom when facing the boom tip. The sensor inside the angle sender is shipped from the factory for vertical mounting. If the angle sender is mounted vertically, no adjustments to the sensor board are needed.
- If the angle sender is mounted to a diagonal boom lacing, the sensor board inside the angle enclosure must be reoriented.
- The drawings below show the orientation of the sensor board when the housing is mounted at different angles while the boom is horizontal.
- To adjust the sensor board, remove the four screws holding the sensor board standoffs to the bracket. Next remove the two screws holding the bracket to the cover. Orient the sensor board on the housing cover as shown below. Reinstall the bracket to the housing cover using the seal screws. Finally mount the sensor board to the bracket. Be sure to use seal screw provided to seal unused holes.
- After the angle sender unit is installed follow the "ANGLE CALIBRATION" procedure.



Circuit Board  
orientation  
(Factory setting)



Circuit Board  
orientation  
For -45deg diagonal



Circuit Board  
orientation  
For +45deg diagonal

## **BOOM ANGLE CALIBRATION**

### **Low Boom Angle Setting**

- Move the boom to 0.0 degrees or as low as possible.
- Press SET button to enter the setup menu.
- Press ↓ several times to scroll down to the “ADVANCED MENU”.
- Press OK to select the advanced menu.
- Enter password then press OK. The value of the flashing digit can be changed by pressing the ↓ or ↑ arrows. To select another digit press SET.
- Press ↓ if needed so the right arrow points to “SET ANGLE ZERO” then press OK.
- Enter the actual boom angle. The value of the flashing digit can be changed by pressing the ↓ or ↑ arrows. To select another digit press the SET button.
- Press OK to accept and save the value.

### **High Boom Angle Setting**

***The following steps should not be necessary for new installations since the angle sender is calibrated at the factory.***

- Now move the crane boom to the maximum angle allowed by the crane lift chart.
- Press SET button to enter the setup menu.
- Press ↓ several times to scroll down to the “ADVANCED MENU”.
- Press OK to select the advanced menu.
- Enter password then press OK. The value of the flashing digit can be changed by pressing the ↓ or ↑ arrows. To select another digit press SET.
- Press ↓ several times until the right arrow (→) points to “SET HIGH ANGLE” then press OK.
- Enter the actual boom angle. The value of the flashing digit can be changed by pressing the ↓ or ↑ arrows. To select another digit press the SET button.
- Press OK to accept and save the value.

## LOAD CALIBRATION

The following instructions give steps to set the zero and gain for the load lines.

### NO LOAD CALIBRATION

- Put the hook in the no load condition with the block on the ground or with the block in the air. The crane manufacturer's lift chart will identify if the block weight is considered part of the load.
- Verify that the 'parts of line' for the current hook shown on the display is set correctly.
- Press **SET** button to enter the setup menu.
- Press **↓** several times to scroll down to the **ADVANCED MENU**.
- Press **OK** to select **ADVANCED MENU**.
- Enter password then press **OK**.
- Press **↓** if needed so the right arrow (**→**) points to "MAIN (or AUX) LOAD ZERO WITH NO LOAD".
- Press **OK** to accept the new 'no load' value.

### LOAD CALIBRATION WITH TEST LOAD

- Verify that the 'parts of line' for the current hook shown on the display is set correctly.
- Lift a known load.  
A sufficient load must be lifted in order to calibrate the system correctly.  
The crane should be set up to allow the following load to be picked up safely.  
( $\frac{1}{2}$  of the Max single line pull working load times current parts of line)

(Example: If max working single line pull for the wire rope is 25,000 and four parts of line are in use then  $\frac{1}{2}$  times 25,000 times 4 = 50,000 ... so at least 50,000 lbs. should be lifted for proper calibration)

- Press **SET** button.
- Press **↓** several times to scroll down to the **ADVANCED MENU**.
- Press **OK** to select **ADVANCED MENU**.
- Enter password then press **OK**.
- Press **↓** as needed so the right arrow (**→**) points to "MAIN (or AUX) LOAD GAIN WITH LOAD" then press **OK**.
- Enter the actual load. The value of the flashing digit can be changed by pressing the **↓** or **↑** arrows. To select another digit press the **SET** button.
- Press **OK** to accept the new value.

## ERROR MESSAGES

### BOOM ANGLE IN A NO LIFT ZONE

The measured boom angle is beyond the allowed angle according to the crane lift charts for the current configuration.

### ALERT-LOAD WITHIN ALERT ZONE

The measured load on hook specified on the top line of the display is beyond the 'Alert' limit according to the crane lift charts for the current configuration.

### ALARM-LOAD EXCEEDS CAPACITY

The measured load on hook specified on the top line of the display is beyond the allowed capacity calculated from the crane lift charts for the current configuration.

### ANGLE TRANSDUCER ERROR

The measured angle is beyond any normal measurements for the system.

Possible problems may be:

The Angle Sender assembly may be damaged or installed incorrectly.

The angle reading may need to be recalibrated.

### MAIN (or AUX) LOAD CELL ERROR

The signal measured from the main load cell is out of range.

Possible problems may be:

Cable from the preamp to the load cell may be damaged.

Connections from the preamp to the load cell may be loose or damaged.

The preamp may be damaged.

The load cell may be damaged.

### LENGTH TRANSDUCER ERROR

The length sensor (option), or connection to it, may be damaged.

### MAIN (or AUX) ANTI-2-BLOCK

The system has sensed an anti-two block error condition. If there is not an anti-two-block condition: Check the cable, all connections, and the switch assembly for damage. The preamp that monitors the switch(s) may also be damaged.

### ANGLE SIGNAL ERROR

The display unit is unable to communicate with the angle sender assembly.

Possible problems may be:

Cable from the display to the angle sender may be damaged.

Follow the "Check Preamp Input Voltage" procedure above.

The angle sender enclosure or connectors may be damaged.

The angle sender circuit board may be damaged.

### MAIN (or AUX) PREAMP SIGNAL ERROR

The display unit is unable to communicate with the load preamp assembly.

Possible problems may be:

Cable from the display to the load preamp may be damaged.

Follow the "Check Preamp Input Voltage" procedure above.

The preamp enclosure or connectors may be damaged.

The preamp circuit board may be damaged.

# SYSTEM TROUBLESHOOTING GUIDE

## OVERALL SYSTEM CHECK - TROUBLESHOOTING

The first step should be to visually inspect all equipment:

Inspect all cables and connections for tightness, damage and water leakage.

Open the display unit and any other enclosures and check for bad connections, loose screws, and water leakage.

*Important: Inspect all gaskets and replace if needed.*

Turn power switch ON.

Check lights ('OK', 'ALERT', 'ALARM'), Display, and Beeper.

Are all missing? ----- yes -----> See 'CHECK INPUT VOLTAGES' page.

no

Are any missing or dim? ----- yes -----> See 'CHECK SYSTEM VOLTAGES' page.

no

Are displayed loads O.K. ? ----- no -----> See 'CHECK LOAD SENSORS' page.

## CHECK SYSTEM SUPPLY VOLTAGE - TROUBLESHOOTING

*Note: If there are any voltage problems DO NOT change Display contrast, Gain, or Zero adjustments until all voltages are at normal levels.*

**IMPORTANT:** Only qualified personnel should open the cover of the system. Dangerous voltages may exist.

Turn power switch OFF.

Disconnect all boom sensor cables  
from the front panel. (MAIN, AUX, ANGLE, LENGTH)

Turn power switch ON.

Measure the 'System Supply Voltage' as shown in the picture.

Power O.K. now? ----- yes -----> See 'CHECK SYSTEM VOLTAGES' PAGE  
| no

Turn power switch OFF.

Disconnect the POWER cable connector from front of display enclosure.

Inspect inside of connector contacts.

Check voltages at cable connector.

Set volt meter to appropriate voltage.

+ meter lead to pin-A

(com) meter lead to pin-B

for 12 VDC system, +10 to +14 VDC allowed

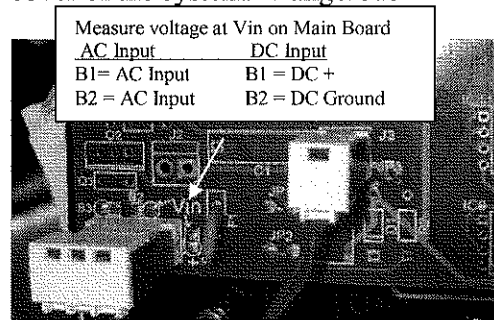
for 24 VDC system, +20 to +28 VDC allowed

for AC system, 105 to 260 VAC 50/60Hz

Power O.K. ? ----- no -----> Verify power cable source connections.  
| yes

Reconnect POWER cable connector to front of Display Unit.

Turn power switch OFF.





## CHECK SYSTEM VOLTAGES - TROUBLESHOOTING

*Note: If there are any voltage problems DO NOT change Display contrast, Gain, or Zero adjustments until all voltages are at normal levels.*

**IMPORTANT:** Only qualified personnel should open the cover of the system. Dangerous voltages may exist.

Turn power switch OFF.

Disconnect the boom sensor cables from the front of the enclosure.

Turn power switch ON.

Measure the input voltage across B1 and B2 on the main board. --- if bad readings-----> Check external power connections

Measure +5 VDC at D5 on the main board --- if bad readings-----> Check for short circuits on the main board.

Turn power switch OFF.

Reconnect boom sensor cable on the front of the enclosure.

Turn power switch ON.

Measure +5 volts at system board.----- if bad readings ----->See 'CHECK PREAMP' page.

## CHECK PREAMP INPUT VOLTAGE - TROUBLESHOOTING

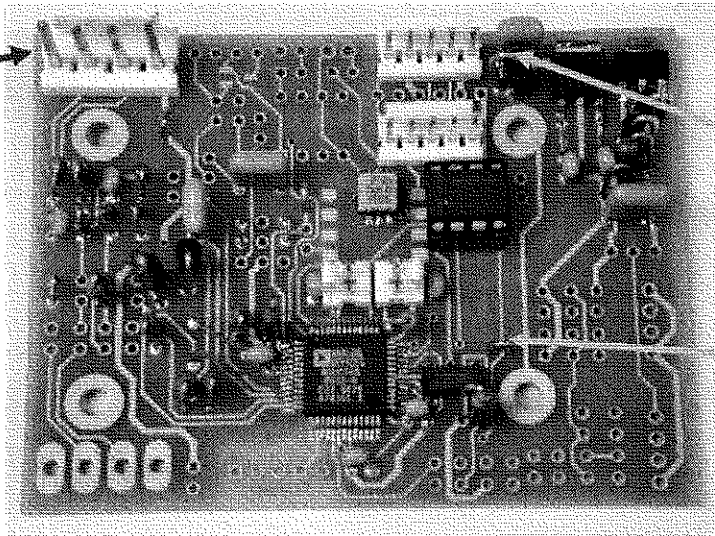
Check the preamp input voltage (see pictures below).

The preamp input voltage should be between 11 VDC and 26 VDC.

If the voltage is not present do the following:

1. Follow the 'Check System Supply Voltage' procedure listed above.
2. Follow the 'Check System Voltages' procedure listed above.
3. Inspect the cable from the display unit to the preamp enclosure.
4. Inspect the connectors on each end of the cable.
5. Verify that all connections inside of the preamp enclosure are tight.

Load Cell  
input  
connector



Volt Meter  
Positive Lead -  
+12-24 VDC

Volt Meter  
Common  
Lead

## CHECK LOAD SENSORS - TROUBLESHOOTING

Verify voltages (see 'CHECK SYSTEM VOLTAGES' page).

Turn power switch OFF.

Disconnect the 'Load Cell Input' connector on the preamp board.

Check resistance between each of the four wires on the connector that plugs into the preamp board and metal of the case of the load cell.

There should be a *minimum* of 1.0 MegaOhm resistance between each wire and the case.

Note: Take care not to touch the metal part of the meter leads when making these measurements since it will affect the readings.

O.K. ----- no -----> Replace load cell.

yes

Check the load cell resistances at the disconnected 'Load Cell Input' connector.

-- For a Dead End load cell only:

Check resistance between the following pairs of wires:

GREEN wire to WHITE wire resistance 350 +/- 2 Ohms

RED wire to BLACK wire resistance 430 +/- 40 Ohms

-- For a 3-sheave compression load cell only:

Check resistance between the following pairs of wires:

GREEN wire to WHITE wire resistance 350 +/- 2 Ohms

RED wire to BLACK wire resistance 365 +/- 20 Ohms

Bad resistance -----> Replace the load cell

Inspect connector for corrosion or loose wires.

O.K. ----- no -----> Replace preamp box or cable/jumper assemblies.

Plug *all* connectors back into correct locations.  
(internal and external).

Open Display unit.

Inspect all connections.

Calibrate for NO LOAD.

O.K. ----- no -----> Replace System Board.

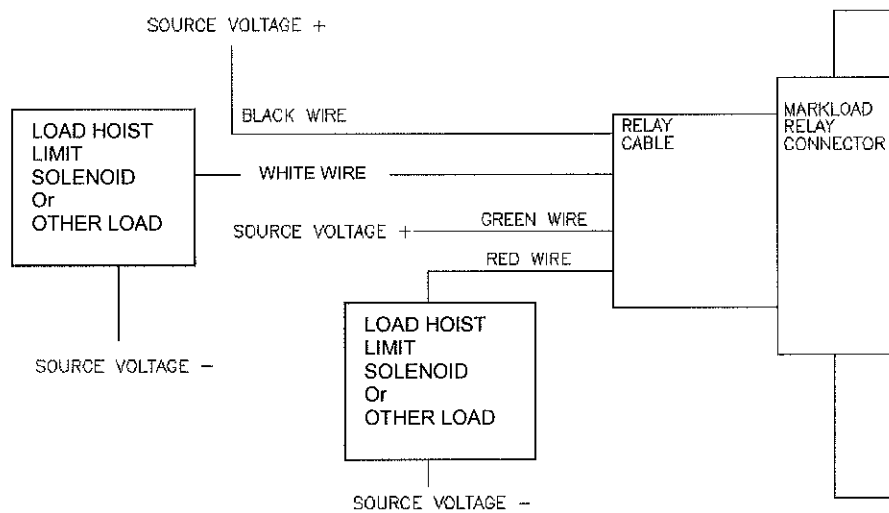
Calibrate with LOAD.

O.K. ----- no -----> Replace System Board.

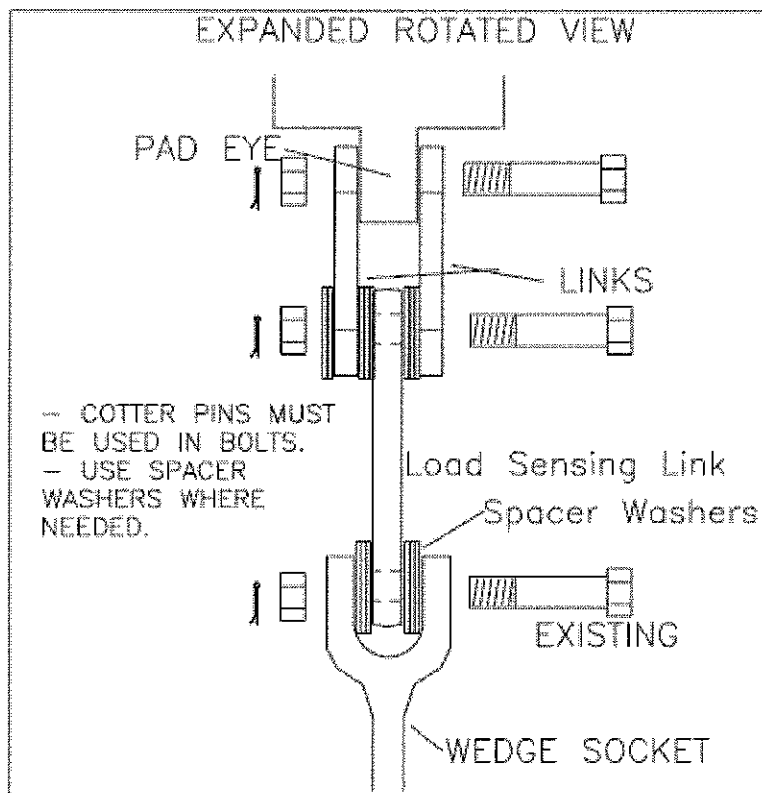
### SOLID STATE RELAY NOTES

Two internal solid-state relays are installed in the Mariner display unit. These relays are open during normal operation. These relays are rated for 3 Amps maximum.

- Relay-1 closes when an anti-two-block condition exists.
- Relay-2 closes when the lifted load exceeds 110%.

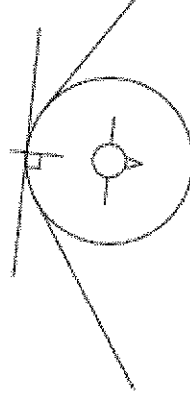
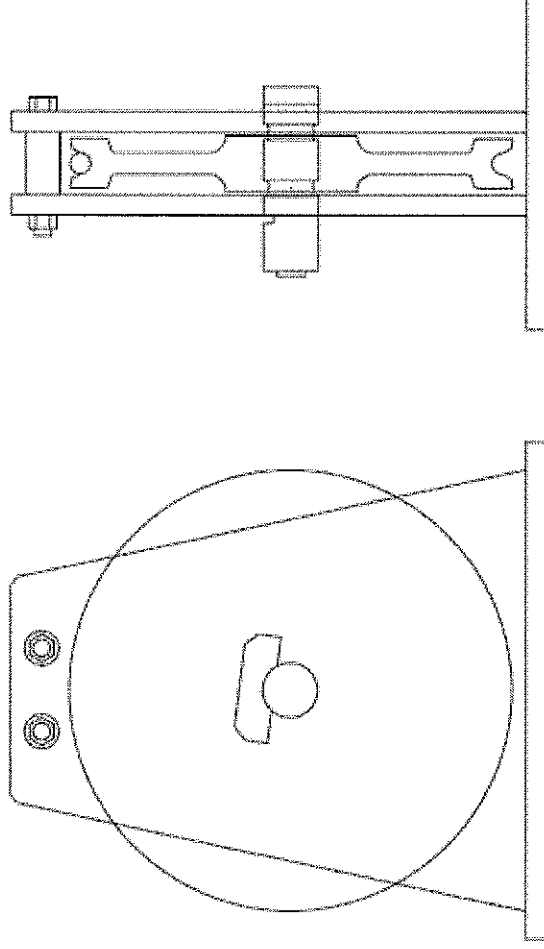


# DEAD END LOAD CELL MOUNTING DIAGRAM



LINKINS3C.DWG

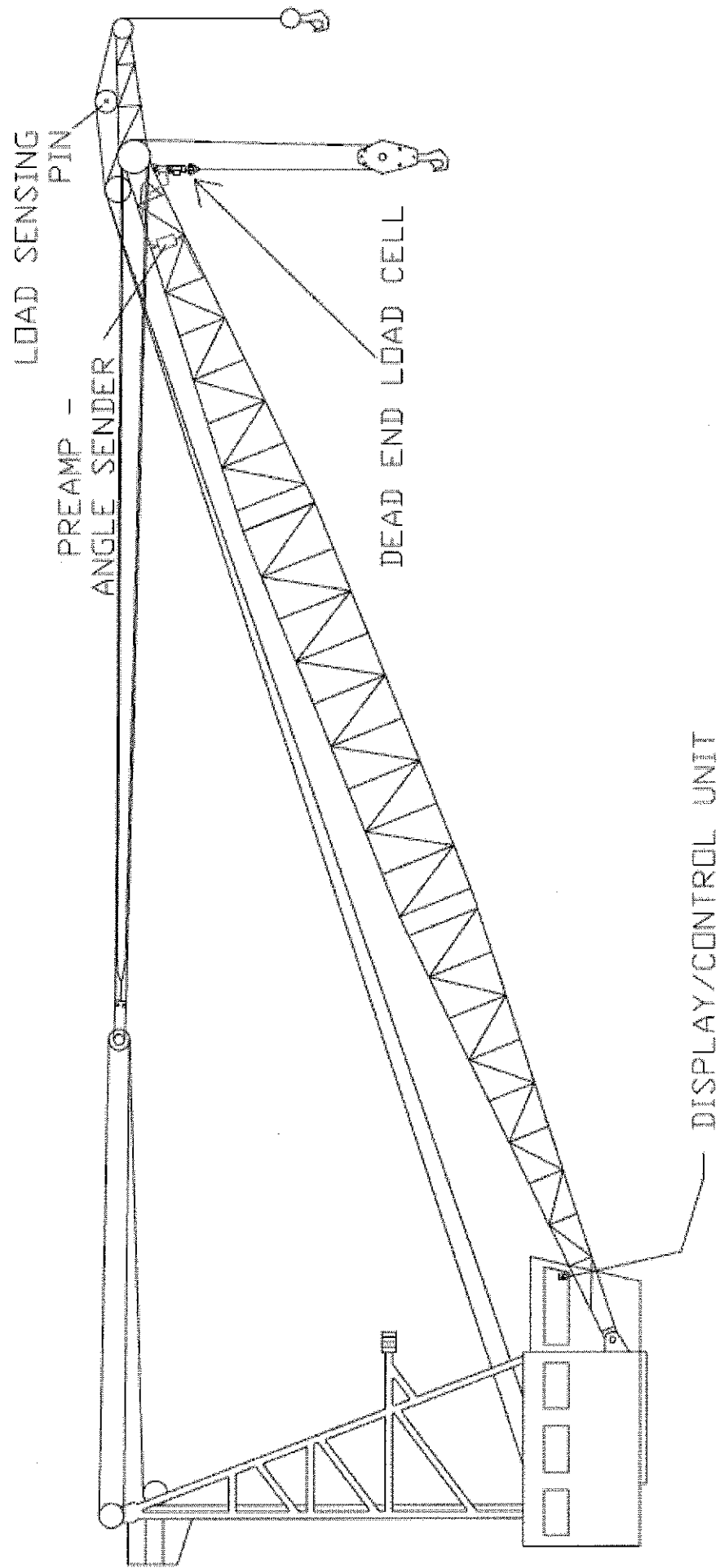
LOAD ARROW ON PIN MUST BE  
PERPENDICULAR WITH CENTER  
OF WIRE ROPE CONTACT WITH  
SHEAVE.



DWN DATE	M.I. DATE	CK'D DATE	ENG DATE	APPR DATE	MARKLOAD SYSTEMS INC. 1318 N. MAIN PEARLAND, TEXAS 77661 (713) 485-8800 Fax (713) 485-5007	REVISION
UNLESS OTHERWISE NOTED BREAK SHARP EDGES 45° x .005 MAX FILLET 0.005 RADIUS			MATERIAL		REV. DATE	
TOLERANCES FRAC. + 1/64 DEC. .005 ANGLES + 30° .010 X = ±.015			FINISH OR TREATMENT		REV. DATE	
SCALE: NEXT ASSY:			TITLE: LOAD SENSING PIN INSTALLATION DETAILS		REV. DATE	
SHT			OF		REV. DATE	



# MARKLOAD SYSTEMS, INC. COMPONENT PLACEMENT





# 7230

# Certificate of Conformance

For

Markload System DX Serial No. 7020-DX

For

OILSTATES SKAGIT SMATCO

1180 MULBERRY ROAD

HOUMA, LOUISIANA 70363



This instrument has been calibrated in terms of standards maintained at this factory, and was found to be within specifications.

THIS EQUIPMENT IS DESIGNED AND MANUFACTURED IN ACCORDANCE WITH UNITED STATES NEC CLASSIFICATION: CLASS 1, DIVISION 2, GROUP D.

The following standards were used as references for this calibration. Their calibration is traceable to the National Reference Standards maintained by the National Bureau of Standards.

NBS TRACEABLE NUMBERS: SST01/10152; SAE J159, J375, J376

Calibration date: 10/17/7

By

Approved



**MARKLOAD SYSTEMS, INC.**

1118 North Main  
Pearland, Texas 77581  
(281) 485-8600

WARRANTY PROVISIONS SHOWN ON BACK.

## MARKLOAD SYSTEMS, INC. WARRANTY

Markload components, of Markload Systems, Inc. manufacture, are warranted for one year against defects in material and workmanship. Purchased parts are covered only in accordance with Markload Systems, Inc. supplier's warranty. This warranty covers repair or replacement (at Markload's option) of all components in a system including labor, at Markload Systems, Inc. factory in Pearland, Texas. This does not include freight and forwarding charges on the returned components, and does not include a service technician's labor and travel expenses for field repairs. The above warranty does not extend to any product which has been subjected to misuse, neglect, accident, improper installation, or use in violation of Markload's instructions, or to any product repaired or altered by persons not expressly approved by Markload. Markload Crane Weight, Angle, and Load Moment Computer Systems are sold as an aid to proper crane operation. No further claim is made as to installed system accuracy nor will this equipment necessarily prevent crane damage due to overloading and related causes. No other warranty is expressed or implied, nor will Markload Systems, Inc. be responsible for damages or losses incidental to the use, installation, or removal of this equipment.



PEMEX – PP LUM A  
Project

ImXport Services Corp.

# Vendor Data Book

P.O. # 0018987

Serial # 23407C

Volume: 1

## Nautilus Crane Model 340LA-80

### Section 5.13 Sentinel Engine Shutdown System



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA







# SENTINEL

## DIESEL ENGINE PROTECTION SYSTEMS



### INSTALLATION GUIDE

BE SURE the Master Control (Oil Sentinel) has the proper oil pressure setting for your application - this is determined by knowing engine oil pressure at hot-low idle. Use a setting under the hot-low idle oil pressure to avoid false shut-down at idle speed. The Master Control (Oil Sentinel) can be ordered with 5, 10, 15, 20 or 25 p.s.i. primary settings.

ALL MASTER CONTROLS HAVE EXCLUSIVE, BUILT-IN VARIABLE SHUT-OFF POINT. IT AUTOMATICALLY PROVIDES A HIGHER OIL PRESSURE SHUT-OFF POINT FOR ENGINE OPERATING UNDER LOAD AT HIGH SPEED. A unique advantage, particularly for engines that have low idling oil pressure. Engine fuel pressure is inherently used as a force to assist in automatically raising the oil pressure point at which the fuel valve closes. Fuel pressure values correspondingly increase and decrease with RPM, particularly on Detroit Diesel and Cummins Engine. The chart below shows the effect of fuel pressures on the oil pressure shut-off point:

APPROXIMATE CORRESPONDING OIL PRESSURE SHUT-OFF POINT OF SENTINEL

PRESSURE P.S.I	MODEL D-25 PRIMARY SETTING	MODEL D-20 PRIMARY SETTING	MODEL D-15 PRIMARY SETTING	MODEL D-10 PRIMARY SETTING	MODEL D5Y PRIMARY SETTING	MODEL D-5** PRIMARY SETTING
0	25	20	15	10	5	---
10	26	21	16	12	7	---
20	27	22	17	13	9	5
30	29	24	19	15	11	7
40	31	26	20	16	12	8
60	33	28	22	19	15	12
80	36	31	26	23	18	15
100	40	35	30	25	21	17
125	44	39	34	29	25	
150	49	44	39	33	29	
175	53	48	43	37	32	

\*\*FOR N SERIES OR OTHER DETROIT DIESELS WITH LOW IDLE OIL PRESSURE WITH 15 TO 20 P.S.I. FUEL PRESSURE AT IDLE.

By consulting chart, the approximate shut-off point can be determined, both at idle and accelerated speeds - i.e., a Sentinel Master Control with 10 p.s.i. primary oil pressure setting operating on an engine that is idling with 20 p.s.i. fuel pressure will actually shut-off at 13 p.s.i. oil pressure. When engine is accelerated and fuel pressure escalates to 80 p.s.i. the Sentinel will automatically compensate and produce a shut-off point at 23 p.s.i. oil pressure.

## RACOR®

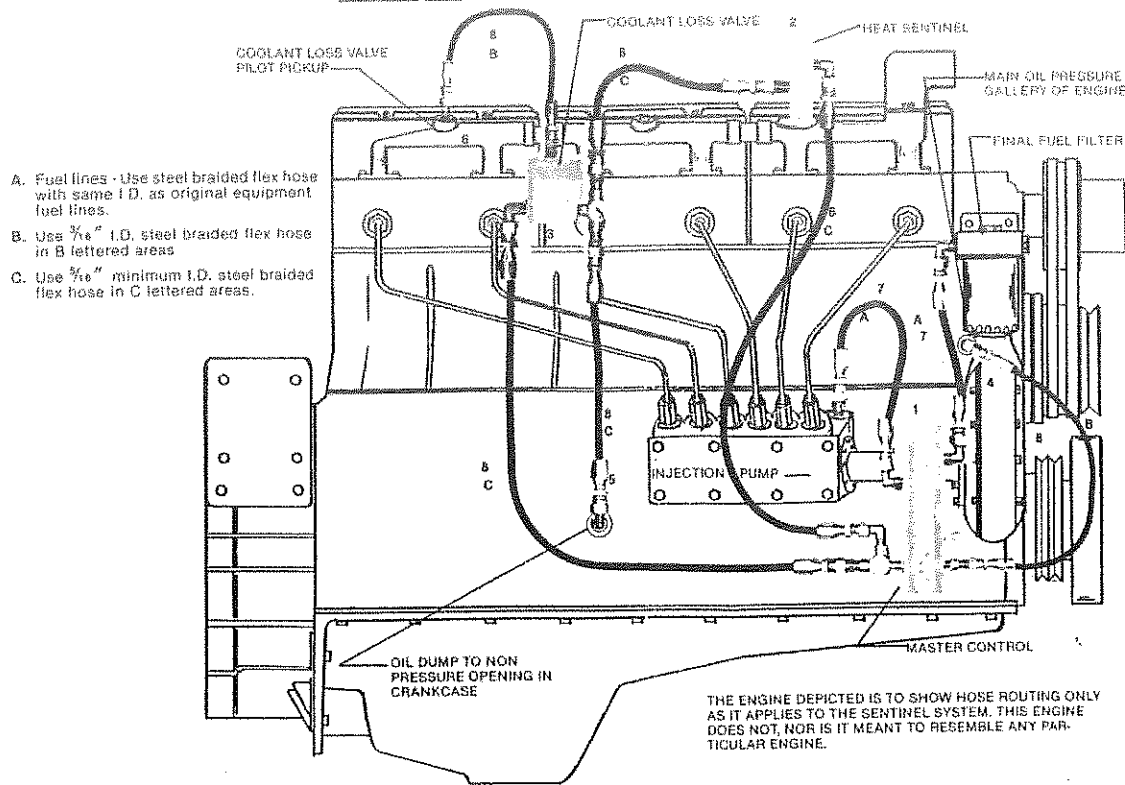
Parker Hannifin Corporation  
Racor Division  
P.O. Box 3208  
Modesto, CA 95353 USA  
800/344-3286, 209/521-7860  
Telex 359-408 RACOR MSTO

Parker Hannifin N.M.F. GmbH  
Racor Division Europe  
Geestemunder Strasse 42  
D5 Koln 60, West Germany  
(0021) 71720  
Telex 8885219



Filtration

# INJECTION FUEL SYSTEMS THAT HAVE HIGH PRESSURE LINES TO EACH INJECTOR



## GENERAL INSTALLATION INSTRUCTION GUIDE FOR ENGINES WITH INJECTION PUMPS THAT HAVE HIGH PRESSURE LINES TO EACH INJECTOR

Some of the pumps that fall into this category are Bosch, CAV, Caterpillar and Roosa Master. The engine shown in this illustration is for hose routing only and does not resemble any particular engine. It is drawn in this configuration to simplify drawing.

1. Mount the Master Control at a location near the injection pump and in a position to allow the fuel lines to be plumbed at the final fuel filter and injection pump as shown.  
**NOTE:** On some Caterpillar Engines the final fuel filter is mounted on the injection pump or so near it that a fuel adapter is required to break into fuel system. (See Caterpillar specification sheet for details.)
2. The Heat Sentinel should be installed in the hottest part of the coolant flow. This is usually the thermostat housing or water manifold just prior to the thermostat housing. On some older engines or on engines where no openings are available, it will be necessary to drill and tap the water manifold or a plate attached to the engine head to install the Heat Sentinel. Heat Sentinels are available with  $\frac{1}{2}$ " N.P.T.F. or  $\frac{3}{8}$ " N.P.T.F. installation threads. Thermowell Reducer Bushings are also available.
3. Using the MB-79 (Mounting Bracket for Coolant Loss Valve) or the four holes in the MB-1 Mounting Bracket, mount the Coolant Loss Valve at approximately the same height as the engine head.
4. Select an oil pressure opening from the main oil pressure gallery of the engine and install a suitable fitting that will accept a #4 Hose End. **DO NOT** tee into an oil supply line that feeds an engine accessory, such as an air compressor.
5. Locate a suitable opening in the non-pressure section of the oil crankcase. There are usually pipe plug openings in the engine block just above the oil pan. In some cases a gear plate or other plate on the engine may have to be removed and a hole be drilled and tapped  $\frac{1}{4}$ " N.P.T. for the oil dump. Install a fitting to accept the oil dump line.
6. Locate an opening in the coolant system between the discharge side of the water pump and the engine side of the thermostat. Most engines have numerous openings in the block, water manifold and thermostat housing. Install a suitable fitting in one of the openings that will accept a #4 Hose End. This is the Coolant Loss Valve pickup.  
**NOTE:** To make certain the opening that is selected is in the main coolant flow, it is recommended a pressure gage that reads in one pound increments be installed to monitor the coolant pressure at the opening. The engine should idle with at least one p.s.i. of coolant pressure and as the engine R.P.M. increases the coolant flow pressure should also increase to at least 5 p.s.i. over idle. If coolant pressure does not increase, select another opening for Coolant Loss Valve pilot pickup.
7. Locate the main fuel supply line that runs from the final fuel filter to the injection pump and remove it. Make up two new fuel lines and plumb Master Control into fuel system as shown. On Caterpillar engines that do not have fuel lines from the final fuel filter to the injection pump a fuel adaptor is required. (See Caterpillar specification sheet.)
8. Using the drawing as a plumbing guide, makeup the remaining hoses and install as shown. The plumbing does not have to be the exact configuration as shown, but the Heat Sentinel and Coolant Loss Valve must have an oil pressure line from the Master Control to the "IN" Port of each and a route from the "OUT" port of each back to the crankcase.
9. On some applications where the fuel tank is located higher than the injection pump it may be necessary to install a one-way Check Valve in the fuel return line to prevent fuel from being supplied by gravity to the injection pump when Master Control closes. During self-test if shutdown time is excessive and fuel tank is above injection pump, the check valve is necessary.

Applied Hydraulic Systems Inc.  
204 Industrial Ave. C  
Homa, LA 70363  
Attn: Mr. Gary Bondillain

Subject: Sentinel Heat Units

Dear Gary,

Our Sentinel heat unit bodies are made of leaded brass. The heat sensor unit is from Verna in France. It has a copper and wax fill and has been found to be extremely accurate over the past 35 years with great repeatability.

In manufacturing we test all units 100% before shipping. This is due to the fact that we use the same verna on two units. The travel of the pin caused by the expansion of the copper and wax fill in the verna lifts the ball in the heat unit and the travel of the pin determines the setting. All verna are put in the unit with sealer or lock-tite so that the settings can not change. All units are plus or minus 3 degree.

There is an unintentional safety built into the heat units. The internal spring in the heat unit can loose tension over the years from the constant heat. When this happens it allows the heat sentinel to open earlier than it's original setting. This has happened in a few cases over the years allowing the engine to shut down early rather than later.

When testing the units we use a mixture of 50-50 water and Prestone. We have a constant flow of the mixture across the heat element.

If you test the units in the field you need to have a moving or agitated mixture of water and Prestone. There can be a big difference in standing water nearest the heat source and in the middle of the water.

I hope that this answers some of your questions and feel free to contact me at any time.

Sincerely,  
Chub Burgess, Sentinel Product Manager  
Parker Hannifin Corporation  
Racor Division

## ACTUAL ENGINE OVERHEAT TEST

Although not recommended, the Heat Sentinel can be field tested by heating the engine up to the shutdown point. Care should be taken not to overheat and damage engine.

The Heat Sentinel is factory checked for defects prior to shipping. The unit is designed to give years of accurate maintenance-free service.

If testing becomes necessary, observe the following precautions.

## CHASSIS OR STATIONARY APPLICATION

1. Simulate a coolant loss or oil pressure loss as described earlier in this guide. This will ensure the system has been correctly installed.
2. Install an accurate mechanical heat gauge in the water manifold as close as possible to the Heat Sentinel.
3. Locate the #6 Dump Line that runs from the Heat Sentinel "OUT" port to the oil dump point on the engine.
4. Disconnect this line at the dump point on the engine. Place the end of this hose in the oil filler neck, or a five-gallon bucket or other suitable container. Position the hose end so as to be able to visually observe when oil is running out of the hose. Care must be taken to prevent oil from touching person.
5. Note the heat setting stamped on the Heat Sentinel (200° F, 212° F, etc.). This figure indicates the temperature at which the Heat Sentinel will open.
6. Restrict the air flow through the radiator by blocking about ¾" of the frontal area of the radiator with cardboard or some other material.
7. Start engine and ensure the manual override is turned to the run position (counterclockwise).
8. Run engine at a high idle and monitor the heat gauge.
9. When engine coolant temperature approaches figure stamped on Heat Sentinel, the valve will open and oil will be dumped out of the oil dump line. Engine shutdown will occur momentarily.

## DYNAMOMETER TEST

If an engine dynamometer is available, this test can be more easily performed due to closer control of coolant flow and power imposed upon the engine.





**ImXport Services Corp**  
**Pemex-PP LUM A Project**  
**Appendix**  
**for the**  
**Nautilus Model**  
**340LA-80**  
**Marine Crane**

**Serial Number:23407C**

Purchase Order No.: 0018987				OSI Doc. No: SS4Q-00-301		
Rev. No.	Submittal Date	Revision	Prep By	OSI Checked	OSI Approved	Client Approval
A	12 Dec 07	Official Release	C. Modrynski	D. Bourgeois		



**ImXport Services  
Corp.**

**Pemex-PP LUM A  
Project**

# **Vendor Data Book**

**P.O. # 0018987**

**Serial # 23407**

**Volume 1**

## **Nautilus Crane Model 340LA-80**

### **INDEX**

- 1.0 Material Certificates and NDE Reports**
- 2.0 Pin Certificates**
- 3.0 Ballring Certificates**
- 4.0 Ballring Clearance Reports**
- 5.0 Bolt Certificates**
- 6.0 Wire Rope Certificates**
- 7.0 Load Block Certificates**
- 8.0 Overhaul Balls Certificates**
- 9.0 Backlash Report**
- 10.0 Miscellaneous**



*SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA*





ImXport Services  
Corp.

Pemex-PP LUM A  
Project

## Vendor Data Book

P.O. # 0018987

Serial # 23407

Volume 1

### Nautilus Crane Model 340LA-80

#### Section 1.0 Material Certificates and NDE Reports

- Pedestal Weldment
- Turret Weldment
- Boom Base Weldment
- Boom Insert Mid 1
- Boom Insert Mid 2
- Boom Point Weldment
- Bridle Weldment
- Gantry Weldment
- Jib Weldment
- Maintenance Jib Weldment



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA



# Material Traceability Log

CRANE WO. NO.: 23407

**CUSTOMER:** PEMEX

**WELDMENT PART NO.:** N2005SK1-132

WELDMENT S/N: C07171-01

**DESCRIPTION:** Pedestal Weldment

**MODEL:** 340LA-100

**CHECKED BY:**

DATE:

[illegible]

07/02/2007 From: AMERICAN ALLOY STEEL

P.O.# : 4061700

S.O.# : 297040

To: OIL STATES-SKAGIT-SMATCO

AA PL#: 8032605

Item : 1 (2 PC) 1" X 144" X 96"

TAG: P/N N00149-003

## Mittal Steel USA Burns Harbor Plate

QUALITY ASSURANCE  
REPORT OF TEST AND ANALYSES

SHIPMENT NO. 804-31902		DATE SHIPPED 09-24-06	CAR OR VEHICLE NO. EJE-WCHGO-UP		BNSF 545163	PAGE 8
AMERICAN ALLOY STEEL INC PO BOX 40469 HOUSTON TX 77040-0469			AMERICAN ALLOY STEEL INC C/O B&R MARINE SVS PORT OF GREATER BATON ROUGE TRACK #791 PORT ALLEN LA 70767			
S H I P T O	NO. PCS.		THICKNESS		WIDTH OR DIA.	LENGTH
N O T E	SERIAL NUMBER	PAT NO.	HEAT NUMBER	WEIGHT	YIELD POINT	TENSILE STRENGTH
				ELONG.	RED	

QUALITY STEEL MELTED &amp; MANUFACTURED IN THE U. S. A.

TEST PERFORMED AT A MITTAL APPROVE LABORATORY

PLATES - API -2H GR 50 INTEGRA 1999 EDITION

MOD C.15 MAX S1,S3,S4,S5,S12

CE=.43X PER IIW FORMULA, ASTM

A633-95 GR C, ABS GRD DH/EH36 REV 2001, ASME SA537-95 PVQ MOD CB

.04MAX CL 1, MIL-S-22698C GR DH36, CH-V A20S5 PLT T 30/25 FTLBS

AT -40F, THRU THK PER API-2H S4, NDT E208 HT NO BRK AT -30F THK

PER HEAT, UT A578 LEVEL 2 100%, PROD ANAL EA HEAT-PLT NORMALIZED

&amp; COOLED IN STILL AIR - TEST CERTS PREPARED IN ACCORDANCE WITH

PROCEDURE OUTLINED IN EN10204:2004 PARA 3.1

NO WELD REPAIR WAS PERFORMED ON BELOW PLATE(S)

----PLATE PASSED NDT E208 NO BREAK AT -30F THK PER HEAT----

CO# 67462-LA GH 361-5131

CH754163

PLATES HEAT TREATED - TEST SPECIMENS ATTACHED &amp; YIELD STRENGTH @ .5% EUL

PLATES ULTRASONICALLY TESTED PER ATTACHMENT

OUTSIDE INSPECTION BY AMERICAN BUREAU OF SHIPPING

S330599 601D20610 1 1 144 480 19602 56100 76800 8 25

66

68

N 1650 DEG F - 49 MIN

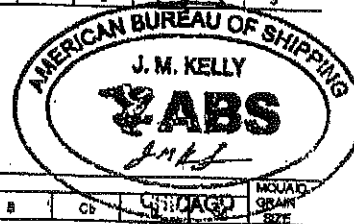
Q-QUENCH TEMPERATURE

T-TEMPERATURE

N-NORMALIZE TEMPERATURE

WE HEREBY CERTIFY THAT THE MATERIAL DESCRIBED HEREIN HAS BEEN MADE BY THE  
MITTAL BRN HRB PLT . TO THE APPLICABLE SPECIFICATION BY AN APPROVED PROCESS  
AND HAS BEEN TESTED IN ACCORDANCE WITH THE REQUIREMENTS OF THE AMERICAN  
BUREAU OF SHIPPING RULES FOR THE INSPECTION AND TESTING OF MATERIALS TO THE  
SATISFACTION OF THE SURVEYORS.

SERIAL NUMBER	PAT NO.	HEAT NUMBER	HARD	BEND	THICKNESS INCHES	TYPE	SIZE	DIR	TEST TEMP F	ENERGY FT LBS			SHEAR (N)			LAT. EXP MILS		
										1	2	3	1	2	3	1	2	3
S330599		601D20610			1.000	V	FULL T	-40		126	149	130						



HEAT NUMBER	CHEMICAL ANALYSIS													CHICKEN	INQUAD	GRAN	SITE	
	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Ti	Al	B					Co
601D20610	.14	1.43	.010	.003	.280	.120	.05	.13	.010	.001	.003	.033	.0009	.030	.006	.006		
	IIW	PCM																
	.42	.24																

Certified a true copy of the  
original, retained in our file.  
AMERICAN ALLOY STEEL, INC

Sept 11-19-07

I certify that the above results are a true and correct copy of actual results contained in records maintained by Mittal Steel Inc. and are in full compliance with the  
requirements of the specification cited above. This test report cannot be altered and must be transmitted intact with any subsequent third party test reports, if required.  
PRODUCED UNDER A CERTIFIED QMS COMPLYING WITH ISO 9002 ABS-QE CERT. #30477

SHPLTRPT.TIF

SUPV. QUALITY ASSURANCE

D. W. ELWOOD PER WNK

AMERICAN ALLOY  
PLATE # 8032605OST  
15  
INSPECTED

7-3-07

07/02/2007 From: AMERICAN ALLOY STEEL

To: OIL STATES-SKAGIT-SMATCO

P.O.# : 4061700

S.O.# : 297040

AA PL#: 8032605

Item : 1 (2 PC) 1" X 144" X 96"

:TAG: P/N N00149-003

# MITTAL

**MITTAL STEEL USA, INC.  
BURNS HARBOR PLATE  
250 WEST US HIGHWAY 12  
BURNS HARBOR, INDIANA 46304 - 1273**

September 25, 2006

American Alloy Steel Inc.  
P.O. Box 40469  
Houston, TX 77040-0469

GENTLEMEN:

The following plates have been 100 percent ultrasonically inspected and found acceptable to A578 Level 2.

Equipment: Epoch IV-0213, UTSYS1  
& USN50-0088CL  
Surface: As Rolled  
Test Method: Contact  
Couplant: Water  
Transducer: 2.25 MHz., 1" Diameter  
Manifest Number: 804-31902

Cust. Order #	Item No.	Serial Number	Heat Number	Plate Size	Recordable Indications
67372-LA	01	S 330395-01	821U00890	1.2500 x 120.000 x 480.0	None
66973-LA	01	P 332038-01	811T10430	1.2500 x 120.000 x 480.0	None
66973-LA	01	P 332039-01	811T10430	1.2500 x 120.000 x 480.0	None
66973-LA	01	P 332031-01	812T40510	1.2500 x 120.000 x 480.0	None
66973-LA	01	P 332028-01	821T10430	1.2500 x 120.000 x 480.0	None
67462-LA	01	S 330596-01	601D20410	1.0000 x 144.000 x 480.0	None
67462-LA	01	S 330597-01	601D20410	1.0000 x 144.000 x 480.0	None
67462-LA	01	S 330599-01	601D20610	1.0000 x 144.000 x 480.0	None

Very truly yours,  
MITTAL STEEL USA, INC.

*Daniel W. Elwood*

Daniel W. Elwood,  
Quality Manager  
Burns Harbor Plate



*JP* 7-3-07

## CERTIFICATION OF TEST

CERTIFICATION NO. 144181D08091



ThyssenKrupp

Customer Order No.	Rotek Order No.	SPECIFICATION	Date
4014366	MD08091	ASTM A694-GR.50-03	11/30/05

S O L D  
OILSTATES SKAGIT SMATCO  
APPLIED HYDRAULIC SYSTEMS DIV  
1180 MULBERRY ROAD  
HOUMA LA 70360

S  
H  
I  
P

Part No.	PCS	Rotek Heat Code
MACHINED RING B123078S ( 90.000 76.000 X 3.000)	1	A433
Heat No. N0167	Material Vendor ELLWOOD QUALITY STEELS	

### CHEMICAL ANALYSIS

C	MN	P	S	SI	NI	CR	MO	CU	V	CB
.170	1.290	.017	.008	.240	.060	.060	.010	.150	.087	.000

Per EPCRA section 313 chemical notice, this Rotek product contains the above chemical mixture by weight to facilitate your Form A and / or R reporting if so required.

### MECHANICAL PROPERTIES OF TEST RING

BHN	TENSILE STRENGTH PSI	YIELD STRENGTH PSI	ELONG % in 4D	% RED. OF AREA	GRAIN SIZE	
000	76,100	54,100	30	65	5	TANG = .500

### CLEANLINESS RATING PER E-45

A	B	C	D
T H	T H	T H	T H

### CHARPY IMPACT TEST RESULTS (FT. LBS.)

TEMP.°F.	#1	#2	#3
-40F	60.0	77.0	70.0

ULTRASONIC INSPECTED

U.T. OK PER ASTM A388

HEAT TREATMENT

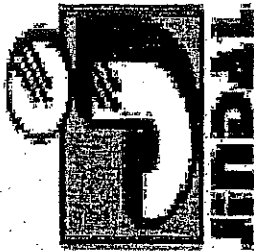
NORMALIZED 1700° F. 3.25 HOURS AIR COOL

NOTES: N47073-008

WE HEREBY CERTIFY THE ABOVE RESULTS ARE CORRECT AS REPORTED AND CONTAINED WITHIN COMPANY RECORDS.  
Testing, inspection and documentation iaw EN10204-3.1 B

*Terry Hart*  
AUTHORIZED SIGNATURE

*gpc*  
12-27-05



# Jindal United Steel Corporation

5200 E. McKinney Road  
Baytown, TX 77520

## METALLURGICAL TEST REPORT

MET-04  
TC No.: BR101994-6170-02

Sold To: CITAPEL STEEL CO. 590 NORTH BETHLEHEM PIKE P.O. BOX 1000 SPRING HOUSE, PA 19477-1000		Ship To: CHAPEL STEEL CO. 6605 N. HOUSTON ROSSLYN RD. HOUSTON, TX 77091		This is to certify that the product described herein was manufactured, sampled, and tested in accordance with the specifications and requirements in such specifications. Fine Grain, Si-AL Fully Killed Steel		Bulletin Num. 101994
Order No: JUS2639-07		Approved By: <i>Helen Green</i>				
Plates Manufactured in the USA		Date 5/2/2007		Shipping Mode: DIRECT TRUCK		
Certified by ISO 9001:2000		P.O. Number HOU-3248		DIN 50049 3.1.B / EN 10204:2004 3.1		

**Specifications:**  
HOT ROLLED PLATE CUT EDGE ASTM/ASME A36 -05 / ABSGR A / B & A709 - 05 GR  
36 STRUCTURAL QUALITY

Insp.

\* We hereby certify that the material described herein has been made to the application by the B.O.S. process and tested in accordance with the requirements of American Bureau of Shipping Rules with satisfactory results.

Item No.	Material Description		Bulletin		Heat No.	Gauge Tested	Test/Plate Identity	Test Cond	Yield Point (KSI)	Tensile Strength (KSI)	Elongation (%)		Yield Strength Determined at	LCVN
	Gauge	Width	Length	Qty							in 8"	in 2"		
07	1.0000	96.0000	480.0000	1		1.125 1.125	08A 08B	ABS ARS	47 55	71 71	24 24		0.2% 0.2%	120 - 112 - 118 FULLmm @ 32°F 105 - 92 - 109 FULLmm @ 32°F
MAY - 3 2007														
HS8023764AX														



15  
INSPECT

Heat No.:S06170		CE:0.38														
Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Cb
LADLE	0.17	1.14	0.015	0.004	0.25	0.04	0.03	0.04	0.010	0.001	0.033	0.005	0.005	0.0005	0.005	0.010





Metallurgical Chemistry and Testing Laboratory

3204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
metallab@an-tech.com

May 16, 2007

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No 10647/31768  
Report No. 07-1153-2

IDENTIFICATION: 1" x 4" x 6", HT# S06170, SL# 7BA  
MATERIAL: ASTM A36, Mfg. JUS  
REFERENCE: HOU-31768

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
103.0	91	60
112.0	94	60
90.0	77	50



JP 5-22-07

Donald Derrick  
Mechanical Testing Supervisor

Sc

Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.



Jindal United Steel Corporation

5200 E. McKinney Road  
Baytown, TX 77520

# METALLURGICAL TEST REPORT

**MEF-04**

TC No.: BR102012-6409-01

[illegible]

HEM No. 506409	CE: 0.30
----------------	----------

HCL No.2060409			CE.9.30													
Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Cb
LADLE	0.12	1.03	0.011	0.009	0.23	0.02	0.02	0.03	0.010	0.001	0.038	0.005	0.005	0.0005	0.005	0.010

15

5-15-0



*Metallurgical Chemistry and Testing Laboratory*

3204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2285  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
[metallab@an.com](mailto:metallab@an.com)

May 11, 2007

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/31692  
Report No. 07-1128

IDENTIFICATION: 1" x 4" x 6", HT# S06409, SL# 07BA  
MATERIAL: ASTM A36, Mfg. Jin  
REFERENCE: HOU-31646

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
115.0	92	70
111.0	96	70
107.0	94	70



5-15-07

Donald Derrick  
Mechanical Testing Supervisor

Sc

Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.

Oilfield Products, LLC

Order-Line - 2022776-2

Heat - C702326

Klickner & Co

Full metal distribution 2990

NAMASCO

→ MILL CERT

001

Page 3 of 5

C-506586

Chemical and Physical Test Report

MADE IN UNITED STATES

**GERDAU AMERISTEEL**

CHARLOTTE STEEL MILL  
6601 LAKEVIEW ROAD  
CHARLOTTE NC 28269 USA  
(704) 596-0361

PRODUCED IN: CHARLOTTE

SHIP TO NAMASCO CORP 14806 W. RIDGE LANE 563-588-0501 (CHRS) DUBUQUE, IA 52003		INVOICE TO NAMASCO CORP(DES) STEEL WAREHOUSE ***ACCT PAYABLE* 500 COLONIAL CENTER PKWY S-500 ROSWELL, GA 30076		SHIP DATE 05/04/07  CUST. ACCOUNT NO 40212110	
SHAPE + SIZE S1		GRADE A36		SPECIFICATION A36 A36 ASTM A36-03A	
HEAT I.D. C701801		C Mn P S Si Cu Ni Cr Mo V Nb Sn Al C Eqv		.16 .70 .005 .026 .20 .42 .11 .14 .040 .003 <.008 .011 .000 .352	
Mechanical Test: Yield 46986 PSI, 323.96 MPA Tensile: 88771 PSI, 474.16 MPA %El: 27.08in, 27.0200MM Bend: OK Sid Dev:0 Idl Diam: .571					
Customer Requirements CASTING: STRAND CAST					
CUST ITEM NUMBER: MB1SQ20A36					
SHAPE + SIZE S34		GRADE A36		SPECIFICATION A36 A36 ASTM A36-05	
HEAT I.D. C702325		C Mn P S Si Cu Ni Cr Mo V Nb Sn Al C Eqv		.16 .68 .007 .039 .19 .43 .10 .12 .020 .002 <.008 .014 .000 .333	
Mechanical Test: Yield 48559 PSI, 337.56 MPA Tensile: 72135 PSI, 497.35 MPA %El: 26.09in, 26.0200MM Bend: OK Sid Dev:0 Idl Diam: .509					
Customer Requirements CASTING: STRAND CAST					
CUST ITEM NUMBER: MB34SQ20A36					

This material, including the billets, was produced and manufactured in the United States of America

Bhaskar Yalamanchilli  
Quality Director  
Gerdau Ameristeel

THE ABOVE FIGURES ARE CERTIFIED EXTRACTS FROM THE ORIGINAL CHEMICAL AND PHYSICAL TEST RECORDS AS CONTAINED IN THE PERMANENT RECORDS OF COMPANY.

Mgr. Metallurg. Svcs.  
CHARLOTTE STEEL MILL

05/15/07

10-12-07



# Test Certificate

Form TCI: Revision 1; Date 31 Oct 2000

Customer: NAMASCO - ATTN ACCOUNTS PAYABL 500 COLONIAL CENTER PKWY SUITE 500 ROSWELL GA 30076		Customer P.O. No.: 6042046		Mill Order No.: 41-133376-05		Shipping Manifest : AR020150	
Product Description: ABS (2003) GR A ASTM A36(00A)/A709(01A)GR36/SA-36(98ED)				Ship Date: 26 Mar 06 Cert Date: 26 Mar 06		Cert No: 081030966 (Page 1 of 1)	
Size: 0.250 X 96.00 X 480.0 (IN)							

Tested Pieces		Tensiles				Charpy Impact Tests								
Heat Id	Piece Id	Dimensions	YS (PSI)	UTS (PSI)	%RA (Z)	Elong % (Z)	Bend Test	Average Hardness	Abs. Energy(FTLB)	% Shear	Test Temp	Test Dir	Test Size (mm)	BDWTT
E6C223 W6C726	B84	0.246 X 96.00 (DISCRT)	49000	64000		42				1	2	3		
	B85	0.184 X 96.00 (DISCRT)	53000	70000		37								
	B81	0.250 X 96.00 (DISCRT)	52000	67000		41								

Chemical Analysis												ORGN			
Heat Id	C	Mn	P	S	Si	Tot Al	Cu	Ni	Cr	Mo	Ch	V	Ti	CEV	USA
E6C223	.05	1.08	.019	.006	.22	.026	.42	.15	.20	.06	.004	.005	.020	.232	USA
W6C726	.06	1.07	.015	.005	.22	.027	.45	.15	.18	.06	.004	.005	.022	.244	USA

MERCURY IS NOT A METALLURGICAL COMPONENT OF THE STEEL AND NO MERCURY WAS INTENTIONALLY ADDED DURING THE MANUFACTURE OF THIS PRODUCT

WE HEREBY CERTIFY THAT MATERIAL DESCRIBED HEREIN HAS BEEN MADE BY IPSCO STEEL BY THE ELECTRIC FURNACE / STRAND CAST PROCESS AND TESTED IN ACCORDANCE WITH THE REQUIREMENTS OF THE AMERICAN BUREAU OF SHIPPING RULES WITH SATISFACTORY RESULTS

CEV = C + MN/6

100% MELTED AND MANUFACTURED IN THE USA. MTR DIN EN10204 TYPE 3.1 COMPLIANT.


W6C726 B81 PCS: 4, WGT: 13095 B82

E6C223 B83 PCS: 16, WGT: 52361

PCS: 16, WGT: 52341

ABS AMERICAS  
PRINCIPAL SURVEYOR  
(SIGNED) S.E. RYAN  
MOBILE, ALABAMA



M 6 9 7 2 5 4 F

MAR 31 2006

(u) Cust Part # :	WE HEREBY CERTIFY THAT THIS MATERIAL WAS TESTED IN ACCORDANCE WITH THE APPROPRIATE SPECIFICATION	Jason Thomas CHECKED BY <i>John S. [Signature]</i>
-------------------	--	---

ID: 671761

44-18-07

# OCEANEERING<sup>®</sup>

## INSPECTION

REPORT NO. 417273

Houma, LA  
(985) 868-5097  
New Iberia, LA  
(337) 365-7102  
Ingleside, TX  
(361) 776-7251

MAILING ADDRESS  
Sta. 1 Box 10267  
Houma, LA 70363

(985) 868-5097  
**DAILY WORK REPORT**  
ISO 9002 Certified

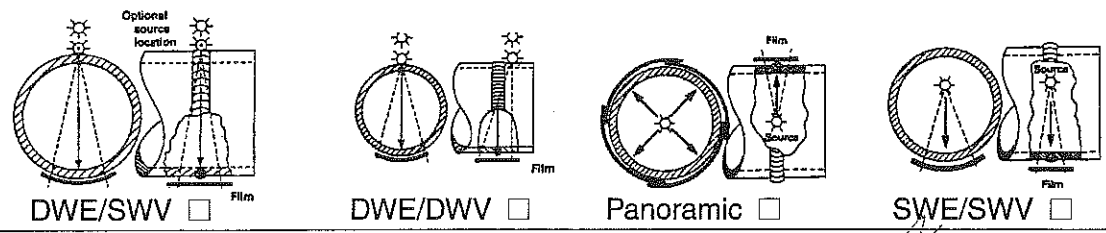
Customer <b>OIL STATES</b>	Job Location <b>Houma LA</b>	Inspection Date / Time <b>8-1-07</b>
Billing Address	Project <b>23407.10</b>	OII Job Number <b>57348</b>
	P.O. #	PKG / AFE #
	S.S. Procedure # <b>API 650 Rev 1</b>	Acceptance Criteria <b>ASTM-A578</b>

AD = Accumulations of Discontinuities    ESI = Elongated Slag Inclusion    IFD = Incomplete Fusion Due to Cold Lap    LC = Low Crown  
BT = Burn Through    EU = External Undercut    IP = Inadequate Penetration    NW = Narrow Weld  
BTA = Burn Through Area    HB = Hollow Bead    IPD = Inadequate Penetration Due to High Low    P = Porosity  
C = Crack/Cracks    IC = Internal Concavity    ISI = Isolated Slag Inclusions  
CP = Cluster Porosity    IF = Incomplete Fusion    IU = Internal Undercut

Job Description: **ULTRASONIC Exam OF:**

WELD NO.		PIPE SIZE		RECOMMENDATION		WELD NO.		PIPE SIZE		RECOMMENDATION			
				✓ X	ACCEPT REJECT	REMARKS					✓ X	ACCEPT REJECT	REMARKS
1							31						
2	Pedestal		340L				32						
3							33						
4	N 20075E1-132						34						
5							35						
6							36						
7							37						
8	10020 LAM- 5cm of 3" Flange.						38						
9							39						
10							40						
11	(After welding)						41						
12							42						
13							43						
14							44						
15							45						
16			✓ Acc				46						
17							47						
18							48						
19							49						
20							50						
21							51						
22							52						
23							53						
24							54						
25							55						
26							56						
27							57						
28							58						
29							59						
30							60						

Technique: check exposure setup    SFD \_\_\_\_\_    Thickness \_\_\_\_\_



Film Delivered to: SS Manager: \_\_\_\_\_ Client: \_\_\_\_\_ Customer Representative: **AL Carlos**

X-Ray: \_\_\_\_\_ MAK V: \_\_\_\_\_ Gamma Ray: \_\_\_\_\_ Curies: \_\_\_\_\_ Date: **8-1-07** Technician: **AL Carlos**

No. of Welds Checked: \_\_\_\_\_ Focal Size: \_\_\_\_\_ Ug: \_\_\_\_\_ Assistant: \_\_\_\_\_ Assistant: \_\_\_\_\_

Linear Ft. Film: \_\_\_\_\_ Type: \_\_\_\_\_ Instrument: **Site Scan**

Penetrant-A \_\_\_\_\_ B \_\_\_\_\_ C \_\_\_\_\_ Required wire: \_\_\_\_\_ Angles Used: **0 0**

Dye Penetrant: \_\_\_\_\_ Ultrasonic: ☒ \_\_\_\_\_ Magnetic Particle: \_\_\_\_\_ Freq: **225** Cal Bloc: **ASE**

Hours Worked: **2** Travel Time: \_\_\_\_\_ Mileage: \_\_\_\_\_ Couplant: **celley**

Sheet # **1** of **1** Subsistence (check if applicable): \_\_\_\_\_ Consumables: \_\_\_\_\_ Specifications: \_\_\_\_\_

Oceaneering Inspection has furnished this Examination Report of weldments as a good faith interpretation. Acceptance or rejection of welding discontinuities to the clients specific codes and/or standards shall not infer any warranty or liability on the part of Oceaneering inspection as to the fitness for service of such weldments and their intended use by the client.

# OCEANEERING<sup>®</sup>

## INSPECTION

REPORT NO. 417272

Houma, LA  
(985) 868-5097  
New Iberia, LA  
(337) 365-7102  
Ingleside, TX  
(361) 776-7251

MAILING ADDRESS  
Sta. 1 Box 10267  
Houma, LA 70363

(985) 868-5097  
**DAILY WORK REPORT**  
ISO 9002 Certified

Customer <b>OIL STATES</b>	Job Location <b>Houma LA</b>	Inspection Date / Time <b>8-1-07</b>
Billing Address	Project <b>23407.10</b>	Oil Job Number <b>57348</b>
	P.O. #	PKC / AFE #
	S.S. Procedure # <b>AMS UT-02 Rev 1</b>	Acceptance Criteria <b>AMS 21.1</b>

AD = Accumulations of Discontinuities BT = Burn Through BTA = Burn Through Area C = Crack/Cracks CP = Cluster Porosity	ESI = Elongated Slag Inclusion EU = External Undercut HB = Hollow Bead IC = Internal Concavity IF = Incomplete Fusion	IFD = Incomplete Fusion Due to Cold Lap IP = Inadequate Penetration IPD = Inadequate Penetration Due to High Low ISI = Isolated Slag Inclusions IU = Internal Undercut	LC = Low Crown NW = Narrow Weld P = Porosity
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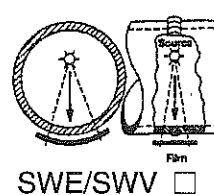
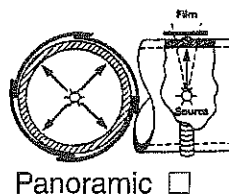
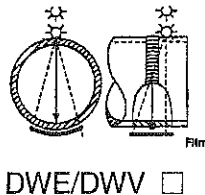
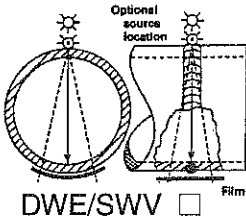
Job Description: **ULTRASONIC EXAM OF:**

WELD NO.	PIPE SIZE	RECOMMENDATION		REMARKS	WELD NO.	PIPE SIZE	RECOMMENDATION		REMARKS
		✓ X	ACCEPT REJECT				✓ X	ACCEPT REJECT	
1					31				
2	<b>pedestal 340 L</b>				32				
3					33				
4	<b>N 2007 SKI-132</b>				34				
5					35				
6					36				
7					37				
8	<b>100% UT of Flange Weld</b>				38				
9					39				
10					40				
11					41				
12					42				
13	<b>1" P4 ✓ ACC</b>				43				
14					44				
15					45				
16					46				
17					47				
18					48				
19					49				
20					50				
21					51				
22					52				
23					53				
24					54				
25					55				
26					56				
27					57				
28					58				
29					59				
30					60				

Technique: check exposure setup

SFD \_\_\_\_\_

Thickness \_\_\_\_\_



Film Delivered to: SS Manager: \_\_\_\_\_ Client: \_\_\_\_\_

X-Ray: \_\_\_\_\_ MAK V: \_\_\_\_\_ Gamma Ray: \_\_\_\_\_ Curies: \_\_\_\_\_

No. of Welds Checked: \_\_\_\_\_ Focal Size: \_\_\_\_\_ Ug: \_\_\_\_\_

Linear Ft. Film: \_\_\_\_\_ Type: \_\_\_\_\_

Penetrant-A \_\_\_\_\_ B \_\_\_\_\_ C \_\_\_\_\_ Required wire: \_\_\_\_\_

Dye Penetrant: \_\_\_\_\_ Ultrasonic: \_\_\_\_\_ Magnetic Particle: \_\_\_\_\_

Hours Worked: **2** Travel Time: \_\_\_\_\_ Mileage: \_\_\_\_\_

Sheet # **1** of **1** Subsistence (check if applicable): \_\_\_\_\_

Customer Representative: **AL Carlos**

Date: **8-1-07** Technician: **AL Carlos**

Assistant: \_\_\_\_\_ Assistant: \_\_\_\_\_

Instrument: **Site Scan**

Angles Used: **8 045 060 070**

Freq: **2.25** Cal Bloc: **ASC**

Couplant: **celley**

Consumables: \_\_\_\_\_

Specifications: \_\_\_\_\_

Oceaneering Inspection has furnished this Examination Report of weldments as a good faith interpretation. Acceptance or rejection of welding discontinuities to the clients specific codes and/or standards shall not infer any warranty or liability on the part of Oceaneering Inspection as to the fitness for service of such weldments and their intended use by the client.



REPORT NO. 417271

(985) 868-5097

## DAILY WORK REPORT

ISO 9002 Certified

Houma, LA  
(985) 868-5097  
New Iberia, LA  
(337) 365-7102  
Ingleside, TX  
(361) 776-7251

MAILING ADDRESS  
Sta. 1 Box 10267  
Houma, LA 70363

Customer <b>OIL STATES</b>	Job Location <b>Houma LA</b>	Inspection Date / Time <b>8-1-07</b>
Billing Address	Project <b>23407.10</b>	Oil Job Number <b>57348</b>
	P.O. #	PKC / AFE # <b>LATEST EDITION</b>
	S.S. Procedure # <b>AWS MTO2 Rev1</b>	Acceptance Criteria <b>AWS D1.1 G.1</b>

AD = Accumulations of Discontinuities  
BT = Burn Through  
BTA = Burn Through Area  
C = Crack/Cracks  
CP = Cluster Porosity

ESI = Elongated Slag Inclusion  
EU = External Undercut  
HB = Hollow Bead  
IC = Internal Concavity  
IF = Incomplete Fusion

IFD = Incomplete Fusion Due to Cold Lap  
IP = Inadequate Penetration  
IPD = Inadequate Penetration Due to High Low  
ISI = Isolated Slag Inclusions  
IU = Internal Undercut

LC = Low Crown  
NW = Narrow Weld  
P = Porosity

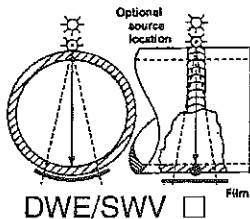
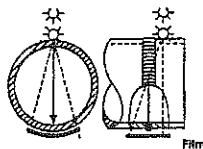
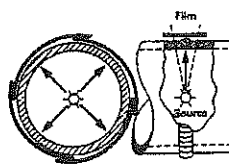
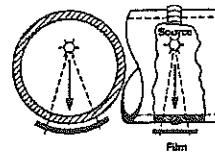
Job Description: **WET MAG EXAM OF:**

WELD NO.	PIPE SIZE	RECOMMENDATION			WELD NO.	PIPE SIZE	RECOMMENDATION		
		✓	ACCEPT	REMARKS			✓	ACCEPT	REMARKS
1					31				
2	<b>PEDESTAL 340L</b>				32				
3					33				
4	<b>N200TSK1-132</b>				34				
5					35				
6					36				
7					37				
8	<b>100% M.T. OF ALL WELDS.</b>				38				
9					39				
10					40				
11					41				
12					42				
13					43				
14					44				
15					45				
16					46				
17					47				
18					48				
19					49				
20					50				
21					51				
22					52				
23					53				
24					54				
25					55				
26					56				
27					57				
28					58				
29					59				
30					60				

Technique: check exposure setup

SFD

Thickness

DWE/SWV ☐DWE/DWV ☐Panoramic ☐SWE/SWV ☐

Film Delivered to: SS Manager: \_\_\_\_\_ Client: \_\_\_\_\_

Customer Representative: AL CARLOS

X-Ray: \_\_\_\_\_ MAK V: \_\_\_\_\_ Gamma Ray: \_\_\_\_\_ Curies: \_\_\_\_\_

Date: **8-1-07** Technician: **AL CARLOS**

No. of Welds Checked: \_\_\_\_\_ Focal Size: \_\_\_\_\_ Ug: \_\_\_\_\_

Assistant: \_\_\_\_\_ Assistant: \_\_\_\_\_

Linear Ft. Film: \_\_\_\_\_ Type: \_\_\_\_\_

Instrument: **ESX 115**

Penetrometer-A \_\_\_\_\_ B \_\_\_\_\_ C \_\_\_\_\_

Angles Used: **3 to 6" space**Dye Penetrant: \_\_\_\_\_ Ultrasonic: \_\_\_\_\_ Magnetic Particle: ☒Freq: **110AC** Cal Bloc: **100B**Hours Worked: **3** Travel Time: \_\_\_\_\_ Mileage: \_\_\_\_\_

Couplant: \_\_\_\_\_

Sheet # **1** of **1** Subsistence (check if applicable): \_\_\_\_\_Consumables: **1 paint**

Specifications: \_\_\_\_\_

Oceaneering Inspection has furnished this Examination Report of weldments as a good faith interpretation. Acceptance or rejection of welding discontinuities to the clients specific codes and/or standards shall not infer any warranty or liability on the part of Oceaneering Inspection as to the fitness for service of such weldments and their intended use by the client.



# OCEANEERING<sup>®</sup>

## INSPECTION

REPORT NO. 417291

Houma, LA  
(985) 868-5097  
New Iberia, LA  
(337) 365-7102  
Ingleside, TX  
(361) 776-7251

**MAILING ADDRESS**

Sta. 1 Box 10267  
Houma, LA 70363

(985) 868-5097  
**DAILY WORK REPORT**  
ISO 9002 Certified

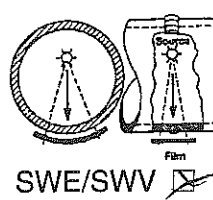
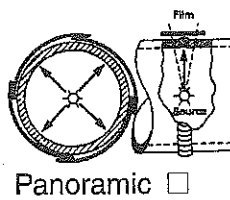
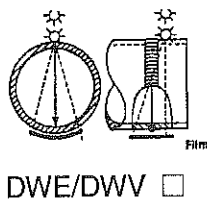
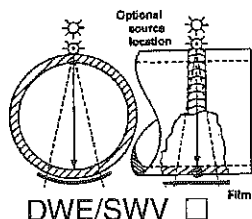
Customer <i>Oil States</i>	Job Location <i>Houma, LA</i>	Inspection Date / Time
	Project <i>23407</i>	Oil Job Number <i>57342</i>
Billing Address	P.O. #	PKC / AFE #
	S.S. Procedure # <i>AWS-KT-02</i>	Acceptance Criteria <i>AWS D1.1</i>

AD = Accumulations of Discontinuities    ESI = Elongated Slag Inclusion    IFD = Incomplete Fusion Due to Cold Lap    LC = Low Crown  
BT = Burn Through    EU = External Undercut    IP = Inadequate Penetration    NW = Narrow Weld  
BTA = Burn Through Area    HB = Hollow Bead    IPD = Inadequate Penetration Due to High Low    P = Porosity  
C = Crack/Cracks    IC = Internal Concavity    ISI = Isolated Slag Inclusions  
CP = Cluster Porosity    IF = Incomplete Fusion    IU = Internal Undercut

**Job Description:**

WELD NO.	PIPE SIZE	RECOMMENDATION		REMARKS	WELD NO.	PIPE SIZE	RECOMMENDATION		REMARKS
		✓	X				✓	X	
1 <i>LS1</i>	<i>76x1</i>			<i>23407</i>	31				
2 <i>0-1</i>					32				
3 <i>1-2</i>					33				
4 <i>2-3</i>					34				
5 <i>3-4</i>					35				
6 <i>4-5</i>					36				
7					37				
8 <i>LS2</i>					38				
9 <i>0-1</i>					39				
10 <i>1-2</i>					40				
11 <i>2-3</i>					41				
12 <i>3-4</i>					42				
13 <i>4-5</i>					43				
14					44				
15					45				
16					46				
17					47				
18					48				
19					49				
20					50				
21					51				
22					52				
23					53				
24					54				
25					55				
26					56				
27					57				
28					58				
29					59				
30					60				

Technique: check exposure setup    SFD 18"    Thickness 1"

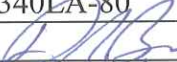


Film Delivered to: SS Manager: _____ Client: _____ X-Ray: _____ MAK V: _____ Gamma Ray: <u>1R</u> Curies: <u>80</u> No. of Welds Checked: _____ Focal Size: <u>172</u> Ug: <u>01</u> Linear Ft. Film: <u>6pc 7.5x17</u> Type: <u>D5</u> Penetrator-A <input type="checkbox"/> B <input type="checkbox"/> C <input checked="" type="checkbox"/> Required wire: <u>.016</u> Dye Penetrant: _____ Ultrasonic: _____ Magnetic Particle: _____ Hours Worked: <u>4</u> Travel Time: _____ Mileage: _____ Sheet # <u>1</u> of <u>1</u> Subsistence (check if applicable): _____	Customer Representative: <u>Cory Ford</u> Date: <u>07/18/07</u> Technician: <u>D. Carlos</u> Assistant: _____ Assistant: <u>R. Pirell</u> Instrument: _____ Angles Used: _____ Freq: _____ Cal Bloc: _____ Couplant: _____ Consumables: _____ Specifications: _____	Oceaneering Inspection has furnished this Examination Report of weldments as a good faith interpretation. Acceptance of or rejection of welding discontinuities to the clients specific codes and/or standards shall not infer any warranty or liability on the part of Oceaneering Inspection as to the fitness for service of such weldments and their intended use by the client.
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# Material Traceability Log

CRANE WO. NO.:	23407
CUSTOMER:	PEMEX
WELDMENT PART NO.:	N61584-001
WELDMENT S/N:	08240-01
DESCRIPTION:	Upperstructure Weldment
MODEL:	340LA-80
CHECKED BY:	
DATE:	7/13/07

[illegible]

# Certificate of Mill Test Results

SO HOU-027973-001 4Aug06  
Pg 1/2

API 2H GR.50 NORM. DUAL TO ABS EH 36  
3" X 120.0000" X 360.0000"  
PART NO.

API 2H50-D 3" Attn:

ISG PLATE INC.

## TEST CERTIFICATE

### SHIP TO:

Loughlin Steel & Plate Co., Inc.  
Northwood Industrial Park East  
11921 FM 529  
Houston TX, 77041

PAGE NO: 01 OF 02  
FILE NO: 1507-01-13  
MILL ORDER NO: 54684-002  
MELT NO: D0833  
SLAB NO: 5  
DATE: 07/22/06

### SOLD TO:

Loughlin Steel & Plate Co., Inc.  
Northwood Industrial Park East  
11921 FM 529  
Houston TX, 77041

### SEND TO:

Loughlin Steel & Plate Co., Inc.  
Northwood Industrial Park East  
11921 FM 529  
Houston TX, 77041

02-C

## PLATE DIMENSIONS / DESCRIPTION

TOTAL QTY	GAUGE	WIDTH	LENGTH	DESCRIPTION	PIECE WEIGHT
1	3"	120"	360"	RECTANGLE	36755#

Tag#  
28246

## CUSTOMER INFORMATION

CUSTOMER PO: HOU-2804

## SPECIFICATION(S)

THIS MATERIAL HAS BEEN MANUFACTURED AND TESTED IN ACCORDANCE WITH PURCHASE ORDER REQUIREMENTS AND SPECIFICATION(S).

API 2H-8TH-EDITION YR 99 GR 50 S1 S3 S4  
SUPPL. PARA. S5 APPLIES. SUPPLEMENTAL PARA. S12  
APPLIES SPEC MOD FOR CHEMISTRY SPEC MOD FOR CARBON  
SPEC MOD FOR PHYSICALS ABS PART-2-SECT-3 05 GRADES  
DH36 AND EH36 AND MIL S-22698C-AM#2 94 GR DH36  
CLASS U NOTE 2 & ASTM A633 01 GRADE C  
MATERIAL PRODUCED UNDER A CERTIFIED QUALITY MGMT SYSTEM COMPLYING WITH  
ISO 9001 ABS-QE CERT. NO. 30130

ABS CERTIFICATION IS  
LIMITED TO ONLY ABS GRADES

## CHEMICAL COMPOSITION

MELT:D0833	C	MN	P	S	CU	SI	NI	CR	MO
	.14	1.53	.011	.001	.14	.35	.16	.10	.02

MELT:D0833	V	TI	B	AL	CB	N	CEF
	.002	.004	.0004	.040	.028	.0065	.44

CARBON EQUIVALENT FORMULA (CEF)  
CEF = C + (MN \* .1667) + ((CR + MO + V) \* .2000) + ((CU + NI) \* .0667)

## MANUFACTURE

FINELINE - VACUUM DEGAISED - FINE GRAIN PRACTICE

## HEAT TREAT CONDITION

MATL OR TEST	HEAT TREAT DESCRIPTION	NOM TEMP	HOLD MINS	COOL MTHD
PL/TEST	NORMALIZE	1650F	76	AIR COOL



PA735724

WE HEREBY CERTIFY THE ABOVE INFORMATION IS CORRECT:

QUALITY ASSURANCE LABORATORY  
COATESVILLE, PA 19320

SUPERVISOR - TEST REPORTING  
ELINORE ZAPLITNY

4-27-07

# Certificate of Mill Test Results

SO HOU-027973-001 4Aug06

Pg 2/2

API-2H GR.50 NORM. DUAL TO ABS EH 36

1" X 120.0000" X 360.0000"

PART NO.

Attn:

ISG PLATE INC.

## TEST CERTIFICATE

PAGE NO: 02 OF 02  
FILE NO: 1507-01-13  
MILL ORDER NO: 54684-002  
MELT NO: D0833  
SLAB NO: 5  
DATE: 07/22/06

### TENSILE PROPERTIES

SLAB NO.	LOC	DIR	YIELD STRENGTH PSI X 100	TENSILE STRENGTH PSI X 100	ELONGATION GAGE LGTH	%	%R.A.
5	BOT.	THRU GA.					65.8
5	TOP	THRU GA.					64.1
5	BOT.	TRANS.	543	810	2.00"	30.0	

### CHARPY V-NOTCH IMPACT RESULTS

SLAB	LOC	DIR	TEMP	SIZE	FT. LBS.
5	BOT.	TRANS.	-40F	FULL	162 164 200

### DROP WEIGHT TESTING

LOC	DIR	SIZE	DEPTH	TEMP	RSLT	TEMP	RSLT
BOT.	LONG.	P3	SURF	-30F	NB	-30F	NB

### GENERAL INFORMATION

ALL STEEL HAS BEEN MELTED AND MANUFACTURED IN THE U.S.A.  
A.B.S. Q.A. CERTIFICATE 04-MMPQA-263.  
MATERIAL HAS BEEN VACUUM DEGAISED AND CALCIUM TREATED  
FOR SULFIDE SHAPE CONTROL.  
FINELINE MOD FOR SULPHUR  
TEST CERTS. ARE PREPARED IN ACCORD. WITH PROCEDURES  
OUTLINED IN EN 10204:2004 PARA 3.1

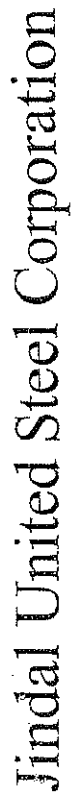
B/L #40807 BVRY 62061

WE HEREBY CERTIFY THE ABOVE  
INFORMATION IS CORRECT:

QUALITY ASSURANCE LABORATORY  
COATESVILLE, PA 19320

SUPERVISOR - TEST REPORTING  
ELINORE ZAPLITNY

KAC  
087  
11  
4-27-07



5200 E. McKinney Road  
Baytown, TX 77520

# METALLURGICAL TEST REPORT

TC No.: BR101680-6170-01  
MET-04

Sold To: CHAPEL STEEL CO. 590 NORTH BETHLEHEM PIKE P.O. BOX 1000 SPRING HOUSE, PA 19477-1000										Ship To: CHAPEL STEEL CO. 6605 N. HOUSTON ROSSLYN RD. HOUSTON, TX 77091										This is to certify that the product described herein was manufactured, sampled, and tested in accordance with the specifications and requirements in such specifications. Fine Grain, Si-AL Fully Killed Steel										Bulletin Num. 101680									
Plates Manufactured in the USA Certified by ISO 9001:2000										Order No: JUS2620-07										Approved By: <i>J. Jaguella</i>																			
										Date 4/16/2007					P.O. Number HOU-3243					Shipping Mode: DIRECT TRUCK DIN 50049 3.1.B / EN 10204 3.1.B																			
Specifications: HOT ROLLED PLATE CUT EDGE ASTM/ASME A36-05 / ABSGR A / B & A709 - 05 GR 36 STRUCTURAL QUALITY																														Insp. " We hereby certify that the material described herein has been made to the application by the B.O.S. process and tested in accordance with the requirements of American Bureau of Shipping Rules with satisfactory results."									
Item No.		Material Description			Bulletin		Heat No.	Gauge Tested	Test/Plate Identity	Test Cond	Yield Point (KSI)	Tensile Strength (KSI)	Elongation (%)		Yield Strength Determined at	LCVN	<div>AMERICAN BUREAU OF SHIPPING A.B.S. HOUSTON, TEXAS</div> <div>H2822764X</div> <div>APR 17 2007</div>																						
		Gauge	Width	Length	Qty	Wgt							in 8"	in 2"																									
07	2.0000	96.0000	480.0000	1	26,137	S06170	2.000	04A	AR	44	72	34	0.2%	108 - 70 - 81 FULL mm @ 32°F																									
Heat No. S06170 CE: 0.38																																							
Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Cb																							
LADLE	0.17	1.14	0.015	0.004	0.25	0.04	0.03	0.04	0.010	0.001	0.033	0.005	0.005	0.0005	0.005	0.010																							



Metallurgical Chemistry and Testing Laboratory

3204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7801  
FAX: (713) 644-1400  
metallab@an-tech.com

Page 1 of 1

April 24, 2007

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/31453  
Report No. 07-0994

IDENTIFICATION: 2" x 4" x 6", HT# S06170, SL# 04A-A  
MATERIAL: ASTM A36, Mfg. Jin

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
56.0	54	30
45.0	43	20
55.0	52	30

Donald Derrick  
Mechanical Testing Supervisor

Sc



Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.



**JINDAL**

# Jindal United Steel Corporation

5200 E. McKinney Road  
Baytown, TX 77520

## METALLURGICAL TEST REPORT

MET-04

TC No.: BR102012-6409-01

<b>Sold To:</b> CHAPEL STEEL CO. 590 NORTH DETLEHEM PIKE P.O. BOX 1000 SPRING HOUSE, PA 19477-1000		<b>Ship To:</b> CHAPEL STEEL CO. 6605 N. HOUSTON ROSSLYN RD. HOUSTON, TX 77091		<b>This is to certify that the product described herein was manufactured, sampled, and tested in accordance with the specifications and requirements in such specifications: Fine Grain, Si-AL Fully Killed Steel</b>		<b>Bulletin Num.</b> 102012		
<b>Order No:</b> JUS2639-07		<b>Date:</b> 5/2/2007		<b>Approved By:</b> <i>Helen Green</i>				
<b>Plates Manufactured in the USA</b>		<b>P.O. Number:</b> HOU-3248		<b>Shipping Mode:</b> DIRECT TRUCK				
<b>Certified by ISO 9001:2000</b>				<b>DIN 50049 3.1.1.B / EN 10204:2004 3.1</b>				
<b>Specifications:</b> HOT ROLLED PLATE CUT EDGE ASTM/ASME A36-05 / ABSGR A / B & A709 - 05 GR 36 STRUCTURAL QUALITY				<b>Insp.</b> " We hereby certify that the material described herein has been made to the application by the B.O.S. process and tested in accordance with the requirements of American Bureau of Shipping Rules with satisfactory results."				
<b>Item No.</b>	<b>Material Description</b>	<b>Bulletin</b>	<b>Test/Plate Identity</b>	<b>Yield Point (KSI)</b>	<b>Tensile Strength (KSI)</b>	<b>Elongation (%)</b>	<b>Yield Strength Determined at</b>	<b>LCVN</b>
07	Gauge 1.0000 Length 480.0000 Qty 3 Wgt 39.204	Heat No. S06409	Gauge Tested 1.000 07A 07B	45 46	64 64	in 8" 27 26	0.2% 0.2%	FULL mm @ 32DEG F 25 FT/LBS 97 - 95 - 97 FULLmm @ 32°F 95 - 90 - 90 FULLmm @ 32°F

Heat No.: S06409 CE: 0.30

Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Cb
LADLE	0.12	1.03	0.011	0.009	0.23	0.02	0.02	0.03	0.010	0.001	0.038	0.005	0.005	0.0005	0.005	0.010

15  
2007  
15-15-07





*Metallurgical Chemistry and Testing Laboratory*

3204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2285  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
[metallab@an.com](mailto:metallab@an.com)

May 11, 2007

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/31692  
Report No. 07-1128

IDENTIFICATION: 1" x 4" x 6", HT# S06409, SL# 07BA  
MATERIAL: ASTM A36, Mfg. Jin  
REFERENCE: HOU-31646

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
115.0	92	70
111.0	96	70
107.0	94	70



5-15-07

Donald Derrick  
Mechanical Testing Supervisor

Sc

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Jindal United Steel Corporation  
5200 E. McKinney Road  
Baytown, TX 77520

# METALLURGICAL TEST REPORT

Sold To: CHAPEL STEEL CO. 590 NORTH BETHLEHEM PIKE P.O. BOX 1000 SPRING HOUSE, PA 19477-1000				Ship To: CHAPEL STEEL CO. 6605 N. HOUSTON ROSSLYN RD. HOUSTON, TX 77091				This is to certify that the product described herein was manufactured, sampled, and tested in accordance with the specifications and requirements in such specifications. Fine Grain, Si-AL Fully Killed Steel				Bulletin Num. 43280											
Order No: JUS2190-08				P.O. Number HOU-2987				Approved By: <i>J. Laguarda / Analyst</i>				Shipping Mode: DIRECT TRUCK											
Date 10/19/2006				Plates Manufactured in the USA				DIN 50049 3.1 B / EN 10204 3.1 B				Insp.											
Specifications: HUT ROLLED PLATE CUT EDGE ASTM/ASME A36-05 / ABS GR. A / B-06 & A709 - 05 GR 36 STRUCTURAL QUALITY												"We hereby certify that the material described herein has been made to the application by the B.O.S. process and tested in accordance with the requirements of American Bureau of Shipping Rules with satisfactory results."											
Material Description		Bulletin		Heat No.		Test/Plat Identity		Test Cond		Yield Point (KSI)		Tensile Strength (KSI)		Elongation (%)		Yield Strength Determined at		LCVN					
Item No.	Gauge	Width	Length	Qty	Wgt																		
08	1.0000	120.0000	480.0000	1	16,335	S04385	1.000	05C	ABS	43	66	32	0.2%	101 - 176 - 229	FULL mm @ 32°F								
AMERICAN BUREAU OF SHIPPING ABS HOUSTON, TEXAS												OCT 19 2006 HS7569194X											

Heat No. S04385 CE:0.33

Heat No. S04385		CE-0.33														
Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Cb
LADLE	0.15	1.02	0.012	0.0066	0.24	0.04	0.02	0.03	0.010	0.001	0.036	0.007	0.005	0.0003	0.005	0.010

3-19-0



Metallurgical Chemistry and Testing Laboratory

3204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
[metalltesters@msn.com](mailto:metalltesters@msn.com)

March 8, 2007

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/30925  
Report No. 07-0571-1

IDENTIFICATION: 1" x 4" x 6", HT# S04385, SL# 10AA  
MATERIAL: ASTM A36, Mfg. CS  
REFERENCE: HOU30925

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
112.0	94	70
101.0	82	60
118.0	94	70

Donald Derrick  
Mechanical Testing Supervisor

Sc

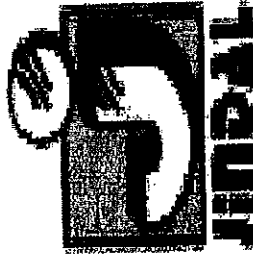
Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.

gpc  
8  
INSPECTED  
3-19-07

PO/Rel 4057853- ROBERT

## Atéris

TC No: BR43324-5190-01  
MET-04



Jindal United Steel Corporation  
5200 E. McKinney Road  
Baytown, TX 77520

# METALLURGICAL TEST REPORT

<b>JUNE</b>						<b>METALLURGICAL TEST REPORT</b>						<b>Bulletin Num. 43324</b>											
<b>Sold To:</b> CHAPEL STEEL CO. 590 NORTH BETHLEHEM PIKE P.O. BOX 1000 SPRING HOUSE, PA 19477-1000						<b>Ship To:</b> CHAPEL STEEL CO. 6605 NHOUSTON ROSSLYN RD. HOUSTON, TX 77091						This is to certify that the product described herein was manufactured, sampled, and tested in accordance with the specifications and requirements in such specifications. Fine Grain, Si-AL Fully Killed Steel											
Order No: JUS2190-08						P.O. Number HOU-2907						Approved By: [Signature]											
Plates Manufactured in the USA						Date 10/28/2006						Shipping Mode: DIRECT TRUCK											
Specifications: HOT ROLLED PLATE CUT EDGE ASTM/AISME A36 -05 / ABSGR A / B-06 & A709 - 05 GR 36 STRUCTURAL QUALITY						Insp.						We hereby certify that the material described herein has been made to the application by the B.O.S. process and tested in accordance with the requirements of American Bureau of Shipping Rules with satisfactory results."											
Material Description				Bulletin		Heat No.	Gauge Tested	Test/Plate Identity	Test Cond	Yield Point (KSI)	Tensile Strength (KSI)	Elongation (%)		Yield Strength Determined at	LCVN FULL mm @ 32DEGF 25 FT/LBS								
Item	Gauge	Width	Length	Qty	Wgt							in 8"	in 2"										
No. 08	1.0000	120.0000	480.0000	2	32.670	S05190	1.000	08A	ABS	47	67	29		0.2%	45 - 40 - 40 FULLmm @ 32°F								
HS756919CX																							
Heat No. S05190 CE-0.34																							
Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Cb							
LADLE	0.14	1.09	0.016	0.014	0.23	0.04	0.03	0.05	0.010	0	0.032	0.005	0.005	0.0005	0.005	0.010							

3-19-60  
U.S. DEPT. OF JUSTICE  
RECEIVED



Metallurgical Chemistry and Testing Laboratory

3204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
[metalltesters@an.com](mailto:metalltesters@an.com)

March 8, 2007

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091


P.O. No. 10647/30925  
Report No. 07-0571-2

IDENTIFICATION: 1" x 4" x 6", PLT# H21185, HT# S05190, SL# 08BA  
MATERIAL: ASTM A36, Mfg. CS  
REFERENCE: HOU30925

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
59.0	60	40
58.0	52	40
61.0	61	40

  
Donald Derrick  
Mechanical Testing Supervisor

Sc

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3-14-07

**BAYOU STEEL CORPORATION**

RIVER ROAD P.O. BOX 5000  
LA PLACE, LOUISIANA 70069-1156  
Telephone (985) 652-4900

**MATERIAL CERTIFICATION REPORT**

SABEL STEEL SERVICES INC.  
P.O. DRAWER 4747  
MONTGOMERY, AL 36103-4747

SABEL STEEL SERVICES  
1500 CHIPPEWA DRIVE  
BATON ROUGE, LA 70892

TESTED IN **ASTM A6**

INVOICE NO.

ACCORDANCE  
WITH

PRODUCT FLATS  
HEAT NO. 41943 69 PCS  
Length 20'0"

DATE 03/06/07

PO: 50985

Cust S-0050 -0021

GRADE A3652950 -

SIZE F 4 X 1/4 X 3.404

05/01/2007 From: SABEL STEEL

FAX #:  
ATTN: :  
PO #:

To:

CHEMICAL ANALYSIS	
C	.10
Mn	1.00
P	.015
S	.033
Si	.19
Cu	.27
Ni	.20
Cr	.15
Mo	.072
Co	.013
V	.000
B	
Al	
Sn	.006
N	
Ti	

MECHANICAL PROPERTIES	TEST 1		TEST 2		TEST 3	
	IMPERIAL	METRIC	IMPERIAL	METRIC	IMPERIAL	METRIC
YIELD STRENGTH	55,814 PSI	385 MPa	56,231 PSI	388 MPa	PSI	MPa
TENSILE STRENGTH	74,673 PSI	515 MPa	74,330 PSI	513 MPa	PSI	MPa
ELONGATION	31.0 %	31.0 %	29.0 %	29.0 %	%	%
GAUGE LENGTH	8 in	203 mm	8 in	203 mm	in	mm
BEND TEST DIAMETER	d	d	d	d	d	d
BEND TEST RESULTS						
SPECIMEN AREA	sq in	sq mm	sq in	sq mm	sq in	sq mm
REDUCTION OF AREA	%	%	%	%	%	%
IMPACT STRENGTH	ft-lbs	J	ft-lbs	J	ft-lbs	J

IMPACT STRENGTH	IMPERIAL	METRIC	INTERNAL CLEANLINESS		GRAIN SIZE	
			ft-lbs	SEVERITY FREQUENCY RATING	HARDNESS	REDUCTION RATIO
AVERAGE TEST TEMP	F	J C				
ORIENTATION						

Customer Grade & Specs: A36-04  
44W, CSA50W, A70936  
ASME SA36

A529-04 GRADE 50

I HEREBY CERTIFY THAT THE MATERIAL TEST RESULTS PRESENTED HERE ARE FROM THE REPORTED HEAT AND ARE CORRECT. ALL TESTS WERE PERFORMED IN ACCORDANCE TO THE SPECIFICATIONS REPORTED ABOVE. ALL STEEL IS ELECTRIC FURNACE MELTED, MANUFACTURED, PROCESSED, AND TESTED IN THE U.S.A WITH SATISFACTORY RESULTS, AND IS FREE OF MERCURY CONTAMINATION IN THE PROCESS.

NOTARIZED UPON REQUEST:

SWORN TO AND SUBSCRIBED BEFORE ME IN AND FOR ST. JOHN

PARISH ON THIS \_\_\_\_\_ DAY OF \_\_\_\_\_, 20\_\_\_\_

SIGNED

MARK EDWARDS, QUALITY ASSURANCE SUPERVISOR

DIRECT ANY QUESTIONS OR NECESSARY CLARIFICATIONS CONCERNING  
THIS REPORT TO THE SALES DEPARTMENT.

Michael E. Soileau, # 81887, Notary Public

1-800-535-7692 (USA)



W 5-2-07

# OCEANEERING<sup>®</sup> INSPECTION

REPORT NO. 386946

MAILING ADDRESS  
Sta. 1 Box 10267  
Houma, LA 70363

(985) 868-5097  
**DAILY WORK REPORT**  
ISO 9002 Certified

Houma, LA  
(985) 868-5097  
New Iberia, LA  
(337) 365-7102  
Ingleside, TX  
(361) 776-7251

Customer <b>OIL STATES</b>	Job Location <b>Houma LA</b>	Inspection Date / Time <b>5-1-07</b>
Billing Address	Project <b>23407.01</b>	Oil Job Number <b>57788</b>
	P.O. #	PKC / AFE #
	S.S. Procedure # <b>API UT-03 Rev-1</b>	Acceptance Criteria <b>ASME-A578</b>

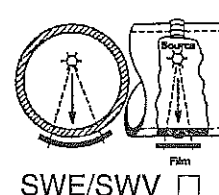
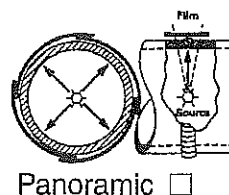
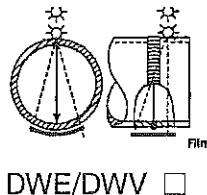
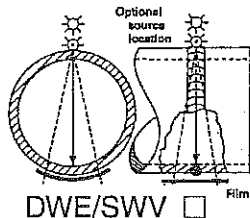
AD = Accumulations of Discontinuities	ESI = Elongated Slag Inclusion	IFD = Incomplete Fusion Due to Cold Lap	LC = Low Crown
BT = Burn Through	EU = External Undercut	IP = Inadequate Penetration	NW = Narrow Weld
BTA = Burn Through Area	HB = Hollow Bead	IPD = Inadequate Penetration Due to High Low	P = Porosity
C = Crack/Cracks	IC = Internal Concavity	ISI = Isolated Slag Inclusions	
CP = Cluster Porosity	IF = Incomplete Fusion	IU = Internal Undercut	

Job Description: **ULTRASONIC EXAM OF:**

RECOMMENDATION				RECOMMENDATION					
WELD NO.	PIPE SIZE	✓ X	ACCEPT REJECT	REMARKS	WELD NO.	PIPE SIZE	✓ X	ACCEPT REJECT	REMARKS
1					31				
2	UPPER STRUCTURE 340 L				32				
3					33				
4	N 61992-010				34				
5					35				
6					36				
7					37				
8	100% LAM-SCAN OF 3"				38				
9					39				
10	BASE PLATE				40				
11					41				
12	(Before welding)				42				
13					43				
14					44				
15					45				
16					46				
17					47				
18					48				
19					49				
20					50				
21					51				
22					52				
23					53				
24					54				
25					55				
26					56				
27					57				
28					58				
29					59				
30					60				

Technique: check exposure setup

SFD \_\_\_\_\_ Thickness \_\_\_\_\_



Film Delivered to: SS Manager: _____	Client: _____	Customer Representative: <u>AL CARLOS</u>
X-Ray: _____ MAK V: _____ Gamma Ray: _____	Curies: _____	Date: <u>5-1-07</u> Technician: <u>AL CARLOS</u>
No. of Welds Checked: _____ Focal Size: _____ Ug: _____		Assistant: _____ Assistant: _____
Linear Ft. Film: _____ Type: _____		Instrument: <u>SITE SCAN</u>
Penetrameter-A _____ B _____ C _____	Required wire: _____	Angles Used: <u>00</u>
	Achieved wire: _____	Freq: <u>225</u> Cal Bloc: <u>DSC</u>
Dye Penetrant: _____ Ultrasonic: <input checked="" type="checkbox"/> Magnetic Particle: _____		Couplant: <u>cellex</u>
Hours Worked: <u>2</u> Travel Time: _____ Mileage: _____		Consumables: _____
Sheet # <u>1</u> of <u>1</u> Subsistence (check if applicable): _____		Specifications: _____

Oceaneering Inspection has furnished this Examination Report of weldments as a good faith interpretation. Acceptance or rejection of welding discontinuities to the clients specific codes and/or standards shall not infer any warranty or liability on the part of Oceaneering Inspection as to the fitness for service of such weldments and their intended use by the client.

# OCEANEERING<sup>®</sup> INSPECTION

REPORT NO. 414354

Houma, LA  
(985) 868-5097  
New Iberia, LA  
(337) 365-7102  
Ingleside, TX  
(361) 776-7251

(985) 868-5097  
**DAILY WORK REPORT**  
ISO 9002 Certified

MAILING ADDRESS  
Sta. 1 Box 10267  
Houma, LA 70363

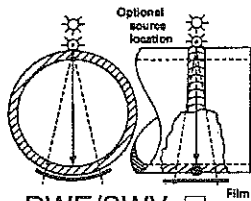
Customer <b>OIL STATES</b>	Job Location <b>Houma LA</b>	Inspection Date / Time <b>7-11-07</b>
Billing Address	Project <b>23407.01</b>	Oil Job Number <b>57348</b>
	P.O. #	PKC / AFE # <b>LATEST EDITION</b>
	S.S. Procedure # <b>AW3 mF-02 Rev1</b>	Acceptance Criteria <b>AW3 D.I. 6.1</b>

AD = Accumulations of Discontinuities BT = Burn Through BTA = Burn Through Area C = Crack/Cracks CP = Cluster Porosity	ESI = Elongated Slag Inclusion EU = External Undercut HB = Hollow Bead IC = Internal Concavity IF = Incomplete Fusion	IFD = Incomplete Fusion Due to Cold Lap IP = Inadequate Penetration IPD = Inadequate Penetration Due to High Low ISI = Isolated Slag Inclusions IU = Internal Undercut	LC = Low Crown NW = Narrow Weld P = Porosity
--	---	--	--

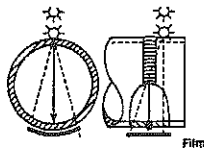
Job Description: **WET MAG EXTM OF:**

RECOMMENDATION					RECOMMENDATION				
WELD NO.	PIPE SIZE	✓ X	ACCEPT REJECT	REMARKS	WELD NO.	PIPE SIZE	✓ X	ACCEPT REJECT	REMARKS
1					31				
2	Upper Structure			340 L	32				
3					33				
4	N 61584-001				34				
5					35				
6					36				
7					37				
8					38				
9	100% m.t. of All welds.				39				
10					40				
11					41				
12					42				
13					43				
14		✓	Acc		44				
15					45				
16					46				
17					47				
18					48				
19					49				
20					50				
21					51				
22					52				
23					53				
24					54				
25					55				
26					56				
27					57				
28					58				
29					59				
30					60				

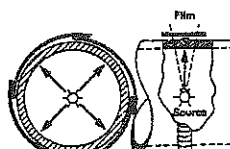
Technique: check exposure setup      SFD \_\_\_\_\_      Thickness \_\_\_\_\_



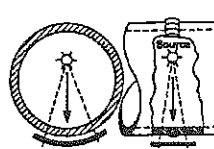
DWE/SWV ☐ Film



DWE/DWV ☐ Film



Panoramic ☐ Film



SWE/SWV ☐ Film

Film Delivered to: SS Manager: _____	Client: _____	Customer Representative: <b>Conny Fied</b>
X-Ray: _____ MAK V: _____ Gamma Ray: _____ Curies: _____	Date: <b>7-11-07</b>	Technician: <b>AL CARLOS</b>
No. of Welds Checked: _____ Focal Size: _____ Ug: _____	Assistant: _____	Assistant: _____
Linear Ft. Film: _____ Type: _____	Instrument: <b>ESX 115</b>	Oceaneering Inspection has furnished this Examination Report of weldments as a good faith interpretation. Acceptance or rejection of welding discontinuities to the clients specific codes and/or standards shall not infer any warranties or liability on the part of Oceaneering Inspection as to the fitness for service of such weldments and their intended use by the client.
Penetrant-A _____ B _____ C _____	Angles Used: <b>370 6" SPACE</b>	
Required wire: _____	Freq: <b>110AC</b> Cal Bloc: <b>10LB</b>	
Ultrasonic: _____ Magnetic Particle: <input checked="" type="checkbox"/>	Couplant: _____	
Achieved wire: _____	Consumables: <b>2 paints</b>	
Dye Penetrant: <b>4</b>	Hours Worked: _____ Travel Time: _____ Mileage: _____	Specifications: _____
Sheet # <b>1</b> of <b>1</b>	Subsistence (check if applicable): _____	



# OCEANEERING<sup>®</sup> INSPECTION

REPORT NO. 414338

Houma, LA  
(985) 868-5097  
New Iberia, LA  
(337) 365-7102  
Ingleside, TX  
(361) 776-7251

(985) 868-5097

## DAILY WORK REPORT

ISO 9002 Certified

### MAILING ADDRESS

Sta. 1 Box 10267  
Houma, LA 70363

Customer <b>OIL STATES</b>	Job Location <b>Houma LA</b>	Inspection Date / Time <b>7-9-07</b>
Billing Address	Project <b>23407.01</b>	Oil Job Number <b>57348</b>
	P.O. #	PKC / AFE #
	S.S. Procedure # <b>APL UT-03 Rev 1</b>	Acceptance Criteria <b>ASTM-A578</b>

AD = Accumulations of Discontinuities  
BT = Burn Through  
BTA = Burn Through Area  
C = Crack/Cracks  
CP = Cluster Porosity

ESI = Elongated Slag Inclusion  
EU = External Undercut  
HB = Hollow Bead  
IC = Internal Concavity  
IF = Incomplete Fusion

IFD = Incomplete Fusion Due to Cold Lap  
IP = Inadequate Penetration  
IPD = Inadequate Penetration Due to High Low  
ISI = Isolated Slag Inclusions  
IU = Internal Undercut

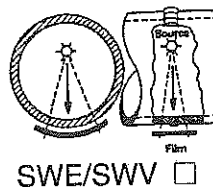
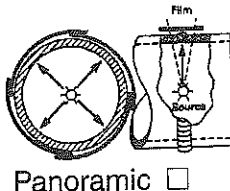
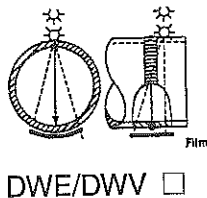
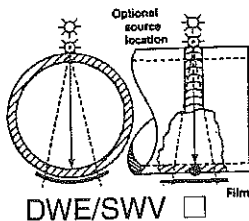
LC = Low Crown  
NW = Narrow Weld  
P = Porosity

Job Description: **ULTRASONIC Exam of**

WELD NO.	PIPE SIZE	RECOMMENDATION			WELD NO.	PIPE SIZE	RECOMMENDATION		
		✓ X	ACCEPT REJECT	REMARKS			✓ X	ACCEPT REJECT	REMARKS
1					31				
2	Upper structure 340L				32				
3					33				
4	N 61584-001				34				
5					35				
6					36				
7					37				
8					38				
9	100% LAM-SCAN of 5" Base				39				
10					40				
11	PLATE				41				
12					42				
13					43				
14					44				
15	(After welding)				45				
16					46				
17					47				
18					48				
19					49				
20		✓	Acc		50				
21					51				
22					52				
23					53				
24					54				
25					55				
26					56				
27					57				
28					58				
29					59				
30					60				

Technique: check exposure setup

SFD \_\_\_\_\_ Thickness \_\_\_\_\_



Film Delivered to: SS Manager: _____	Client: _____	Customer Representative: <b>Al Carlos</b>
X-Ray: _____ MAK V: _____ Gamma Ray: _____ Curies: _____	Date: <b>7-9-07</b>	Technician: <b>AL CARLOS</b>
No. of Welds Checked: _____ Focal Size: _____ Ug: _____	Assistant: _____	Assistant: _____
Linear Ft. Film: _____ Type: _____	Instrument: <b>Site-Scan</b>	
Penetrometer-A _____ B _____ C _____	Angles Used: <b>90</b>	
Dye Penetrant: _____ Ultrasonic: <input checked="" type="checkbox"/> Magnetic Particle: _____	Freq: <b>2.25</b> Cal Bloc: <b>05C</b>	
Hours Worked: <b>2</b> Travel Time: _____ Mileage: _____	Couplant: <b>celucp</b>	
Sheet # <b>1</b> of <b>1</b> Subsistence (check if applicable): _____	Consumables: _____	
	Specifications: _____	

Oceaneering Inspection has furnished this Examination Report of weldments as a good faith interpretation. Acceptance or rejection of welding discontinuities to the clients specific codes and/or standards shall not infer any warranty or liability on the part of Oceaneering Inspection as to the fitness for service of such weldments and their intended use by the client.

# OCEANEERING<sup>®</sup>

## INSPECTION

REPORT NO. 409032

Houma, LA  
(985) 868-5097  
New Iberia, LA  
(337) 365-7102  
Ingleside, TX  
(361) 776-7251

MAILING ADDRESS  
Sta. 1 Box 10267  
Houma, LA 70363

(985) 868-5097  
DAILY WORK REPORT  
ISO 9002 Certified

Customer <b>OIL STATES</b>	Job Location <b>Houma LA</b>	Inspection Date / Time <b>10-5-07</b>
Billing Address	Project <b>2340701</b>	Oil Job Number <b>57348</b>
	P.O. #	PKC / AFE # <b>LATEST EDITION</b>
	S.S. Procedure # <b>AWS M202 Rev1</b>	Acceptance Criteria <b>AWS 2.1.1 6.1</b>

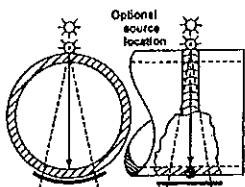
AD = Accumulations of Discontinuities  
BT = Burn Through  
BTA = Burn Through Area  
C = Crack/Cracks  
CP = Cluster Porosity  
ESI = Elongated Slag Inclusion  
EU = External Undercut  
HB = Hollow Bead  
IC = Internal Concavity  
IF = Incomplete Fusion  
IFD = Incomplete Fusion Due to Cold Lap  
IP = Inadequate Penetration  
IPD = Inadequate Penetration Due to High Low  
ISI = Isolated Slag Inclusions  
IU = Internal Undercut  
LC = Low Crown  
NW = Narrow Weld  
P = Porosity

Job Description: **Wet M202 Exam of:**

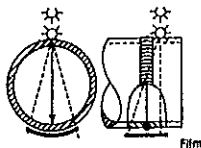
WELD NO.	PIPE SIZE	RECOMMENDATION			WELD NO.	PIPE SIZE	RECOMMENDATION		
		✓ X	ACCEPT REJECT	REMARKS			✓ X	ACCEPT REJECT	REMARKS
1					31				
2					32				
3					33				
4					34				
5					35				
6					36				
7					37				
8					38				
9					39				
10					40				
11					41				
12					42				
13					43				
14					44				
15					45				
16					46				
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18					48				
19					49				
20					50				
21					51				
22					52				
23					53				
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27					57				
28					58				
29					59				
30					60				

Technique: check exposure setup

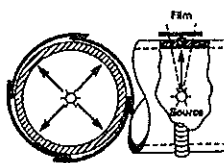
SFD \_\_\_\_\_ Thickness \_\_\_\_\_



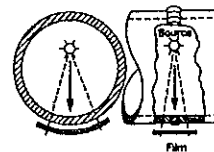
DWE/SWV ☐



DWE/DWV ☐



Panoramic ☐



SWE/SWV ☐

Film Delivered to: SS Manager: \_\_\_\_\_ Client: \_\_\_\_\_ Customer Representative: **Camy Fard**

X-Ray: \_\_\_\_\_ MAK V: \_\_\_\_\_ Gamma Ray: \_\_\_\_\_ Curies: \_\_\_\_\_ Date: **10-5-07** Technician: **AL CARLOS**

No. of Welds Checked: \_\_\_\_\_ Focal Size: \_\_\_\_\_ Ug: \_\_\_\_\_ Assistant: \_\_\_\_\_ Assistant: \_\_\_\_\_

Linear Ft. Film: \_\_\_\_\_ Type: \_\_\_\_\_ Instrument: **ESX 115**

Penetrameter-A \_\_\_\_\_ B \_\_\_\_\_ C \_\_\_\_\_ Required wire: \_\_\_\_\_ Angles Used: **3106 5/8" x 1/2"**

Dye Penetrant: \_\_\_\_\_ Ultrasonic: \_\_\_\_\_ Magnetic Particle: ☒ Freq: **160K** Cal Bloc: **1005**

Hours Worked: **3** Travel Time: \_\_\_\_\_ Mileage: \_\_\_\_\_ Couplant: \_\_\_\_\_

Sheet # **1** of \_\_\_\_\_ Consumables: **1 paint**

Subsistence (check if applicable): \_\_\_\_\_ Specifications: \_\_\_\_\_

Oceaneering Inspection has furnished this Examination Report of weldments as a good faith interpretation. Acceptance or rejection of welding discontinuities to the clients specific codes and/or standards shall not infer any warranty or liability on the part of Oceaneering Inspection as to the fitness for service of such weldments and their intended use by the client.



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# Material Traceability Log

CRANE WO. NO.:	23407
CUSTOMER:	PEMEX
WELDMENT PART NO.:	N61586-001
WELDMENT S/N:	C07101-02
DESCRIPTION:	Boom Base Weldment
MODEL:	340LA-100
CHECKED BY:	
DATE:	9-5-07

[illegible]

Atlas ABC Corp (Atlas Tube Chicago)  
1855 East 122nd Street  
Chicago, Illinois, USA  
60633  
Tel: 773-646-4500  
Fax: 773-646-6128



Ref.B/L: 80207438  
Date: 12.13.2006  
Customer: 193

**Sold to**

Tubular Steel  
1031 Executive Parkway  
ST. LOUIS MO 63141  
USA

# **ATLAS TUBE INC.** **MATERIAL TEST REPORT**

**Shipped to**

Tubular Steel  
27700 Highway Blvd.  
KATY TX 77493  
USA

Material: 4.0x4.0x500x40"0(4x2)NMHROPS1  
Sales order: 222099

Material No: 40040500

Made in: USA

Purchase Order: 4116 HOT NEXT TRUCK!

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V
Y28079	0.080	0.810	0.014	0.006	0.044	0.044	0.030	0.018	0.004	0.010	0.040	0.001

Bundle No	Yield	Tensile	Eln.2in
M900034653	069230 Psi	078140 Psi	33 %

Certification

ATLAS ROPS 1

Material Note:

Sales Or.Note: ALSO MEETS ASTM A500-03A GRADE C &amp; B

Material: 4.0x4.0x500x32"0(4x2)NMHROPS1  
Sales order: 222099

Material No: 40040500

Made in: USA

Purchase Order: 4116 HOT NEXT TRUCK!

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V
Y28080	0.070	0.820	0.015	0.005	0.047	0.032	0.020	0.015	0.005	0.010	0.030	0.001

Bundle No	Yield	Tensile	Eln.2in
M800034686	072230 Psi	078320 Psi	32 %

Certification

ATLAS ROPS 1

Material Note:

Sales Or.Note: ALSO MEETS ASTM A500-03A GRADE C &amp; B

Material: 4.0x4.0x500x32"0(4x2)NMHROPS1  
Sales order: 222099

Material No: 40040500

Made in: USA

Purchase Order: 4116 HOT NEXT TRUCK!

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V
Y28080	0.070	0.820	0.015	0.005	0.047	0.032	0.020	0.015	0.005	0.010	0.030	0.001

Bundle No	Yield	Tensile	Eln.2in
M900034695	072230 Psi	078320 Psi	32 %

Certification

ATLAS ROPS 1

Material Note:

Sales Or.Note: ALSO MEETS ASTM A500-03A GRADE C &amp; B

Material: 4.0x4.0x500x32"0(4x2)NMHROPS1  
Sales order: 222099

Material No: 40040500

Made in: USA

Purchase Order: 4116 HOT NEXT TRUCK!

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V
Y28080	0.070	0.820	0.015	0.005	0.047	0.032	0.020	0.015	0.005	0.010	0.030	0.001

Bundle No	Yield	Tensile	Eln.2in
M900034694	072230 Psi	078320 Psi	32 %

Certification

ATLAS ROPS 1

Material Note:

Sales Or.Note: ALSO MEETS ASTM A500-03A GRADE C &amp; B

Authorized by Quality Assurance:

Page: 1 Of 2

081  
76  
11-11-07



Atlas ABC Corp (Atlas Tube Chicago)  
1855 East 122nd Street  
Chicago, Illinois, USA  
80633  
Tel: 773-648-4500  
Fax: 773-648-6128



Ref.B/L: 80207438  
Date: 12.13.2006  
Customer: 193

**Sold to**

Tubular Steel  
1031 Executive Parkway  
ST. LOUIS MO 63141  
USA

**MATERIAL TEST REPORT****Shipped to**

Tubular Steel  
27700 Highway Blvd.  
KATY TX 77493  
USA

Material: 4.0x4.0x500x40"0(4x2)NMHROPS1  
Sales order: 222099

Material No: 40040500

Made in: USA

Purchase Order: 4116 HOT NEXT TRUCKI

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V
Y28079	0.080	0.810	0.014	0.006	0.044	0.044	0.030	0.018	0.004	0.010	0.040	0.001

Bundle No	Yield	Tensile	Eln.2in
M900034852	069230 Psi	078140 Psi	33 %

Certification

ATLAS ROPS 1

Material Note:

Sales Or.Note: ALSO MEETS ASTM A500-03A GRADE C &amp; B

Material: 4.0x4.0x500x32"0(4x2)NMHROPS1  
Sales order: 222099

Material No: 40040500

Made in: USA

Purchase Order: 4116 HOT NEXT TRUCKI

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V
Y28080	0.070	0.820	0.015	0.005	0.047	0.032	0.020	0.015	0.005	0.010	0.030	0.001

Bundle No	Yield	Tensile	Eln.2in
M900034693	072230 Psi	078320 Psi	32 %

Certification

ATLAS ROPS 1

Material Note:

Sales Or.Note: ALSO MEETS ASTM A500-03A GRADE C &amp; B

Material: 4.0x4.0x500x30"0(5x3)NMHROPS1  
Sales order: 222098

Material No: 40040500

Made in: USA

Purchase Order: 4116 HOT NEXT TRUCKI

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V
Y28080	0.070	0.820	0.015	0.005	0.047	0.032	0.020	0.015	0.005	0.010	0.030	0.001

Bundle No	Yield	Tensile	Eln.2in
M900034697	072230 Psi	078320 Psi	32 %

Certification

ATLAS ROPS 1

Material Note:

Sales Or.Note: ALSO MEETS ASTM A500-03A GRADE C &amp; B

Authorized by Quality Assurance:

Page : 2 Of 2

Atlas ABC Corp (Atlas Tube Chicago)  
1855 East 122nd Street  
Chicago, Illinois, USA  
60633  
Tel: 773-646-4500  
Fax: 773-646-6128



AUG 21 2006

## MATERIAL TEST REPORT

Heat No	C	Mn	P	S	Si	Al	Cu	Cl	Mo	Ni	Cr	V
Y28079	0.080	0.810	0.014	0.006	0.044	0.044	0.030	0.018	0.004	0.010	0.040	0.001

Material	Yield	Tensile	Elo. 2in	Certification
4 X 4 X .500	069230 Psi	078140 Psi	33 %	

Impact Values Req.	Sample Size	Absorbed Energy1 FT-LBS	CHARTY Test Results Absorbed Energy2 FT-LBS	Absorbed Energy3 FT-LBS	Avg FT-LBS	ATLAS ROPS I
TEST @ -22F 10x10 mm	14	174	10	66		

Authorized by Quality Assurance:

*Carrie Lauritzen*

Page : 1 Of 1



DATE: 01/01/07  
TIME: 04:16:44  
SERIAL NO: L0014862

TUBULAR PRODUCTS  
CERTIFIED TEST REPORT  
(IN ACCORDANCE WITH ISO 10474/EN10204/DIN50049 3.1.b)

UNITED STATES STEEL



MILL ORDER ITEM NO DR37884 01	SHIPPER NO. R70811	P.O. NUMBER 06-19103	VEHICLE ID LT8138
SOLD TO ADDRESS PIPE DISTRIBUTORS LTD P O BOX 23237 HOUSTON TX 77228-3237		MAIL TO ADDRESS PIPE DISTRIBUTORS LTD P O BOX 23237 HOUSTON TX 77228-3237	
VENDOR USS TUBULAR PRODUCTS 2199 EAST 28TH ST. LORAIN, OH 44055			

## SPECIFICATION AND GRADE

PIPE CARBON SMLS STD PIPE API 5L-43RD EDITION DATED 3/04 PSL-1 GRADE B ASTM A53-\*05 GRADE B ASME  
SA53-\*2004 EDITION GRADE B ASTM A106-\*04B GRADE B/C ASME SA106-\*2004 EDITION GRADE B/C BLK REG MILL  
COAT PE BEV 30 DEG MEETING ALL THE APPLICABLE REQUIREMENTS OF NACE STANDARD MR-01-75 \*2002

MATERIAL COND: AS ROLLED										O.D.: 1.900 ( 48.260 )		I.D.: 0.145 ( 3.683 )		WALL: 0.145 ( 3.683 )		In (mm)		ft (mm)	
PRODUCT IDENTIFICATION	TENSILE TEST TYPE/ ORIENTATION	TEST COND.	GAUGE WIDTH IN	YIELD		TENSILE		Y/T	ELONG % (IN 2" )	HARDNESS		MIN HYDRO PSI	DWELL (SEC)						
				PSI	EXT %	PSI	SCALE: HRB												
							MIN:			MAX:	MIN:			MAX:					
B27156	STRIP/L/B	AR	0.750	40000	52500	50	76000	0.69	33.0	B 70.7	2500	5							
B27447	STRIP/L/B	AR	0.750	40000	51500	50	75500	0.68	34.0	B 78.7	2500	5							
			** END OF DATA THIS SHEET **																
LEGEND:		L - LONGITUDINAL U - UPSET		T - TRANSVERSE NM - NORMALIZED		QT - QUENCH & TEMPERED SR - STRESS RELIEVED		AR - AS ROLLED		B - BODY		W - WELD							
PRODUCT IDENTIFICATION	TYPE	C	MIN	P	S	SI	CU	NI	CR	MO	AL	N	V	B	TI	CB	CO	CE*	
																		MAX	
B27156	HEAT	19	106	009	002	18	03	04	09	03	034		00	0001	002	001		0.40	
B27156	PROD	20	106	009	003	18	03	04	09	03	031		00	0001	001	001		0.41	
B27156	PROD	18	105	008	003	18	03	04	09	03	031		00	0000	001	001		0.39	
B27447	HEAT	19	105	009	004	18	04	02	07	02	035		00	0002	001	001		0.39	
B27447	PROD	20	108	009	004	19	03	02	07	02	034		00	0000	001	001		0.41	
B27447	PROD	20	108	009	005	19	03	02	07	02	033		00	0001	001	001		0.40	
		** END OF DATA THIS SHEET **																	
*C.E. IS BASED ON THE FOLLOWING EQUATION(S): CE=C+(MN/6)+(CR+MO+V)/5+(NI+CU)/15																			

\*C.E. IS BASED ON THE FOLLOWING EQUATION(S):  $CE = C + (MN/6) + (CR+MO+V)/5 + (NI+CU)/15$

DECIMAL POSITIONS FOR ELEMENTS ARE INDICATED BY THE LEFT MARGIN, VERTICAL DOTTED LINE OR DECIMAL POINT.

1/1/2007 4:19 AM  
USS Tubular QA -> MURRY HAMILTON  
Page 2 of 3



DATE: 01/01/07  
TIME: 04:16:44  
SERIAL NO: 10014862

**UNITED STATES STEEL**  
**TUBULAR PRODUCTS**  
**CERTIFIED TEST REPORT**  
**(IN ACCORDANCE WITH ISO 10474/EN10204/DIN50049 3.1.b)**



MILL ORDER ITEM NO DR37884 01		SHIPPER'S NO. R70811		P.O. NUMBER 06-19103		Q.D. 1.900 ( 48.260 )		WALL THICKNESS 0.145 ( 3.683 )		P.O. NUMBER 0024707	
MATERIAL COND: AS ROLLED		MIN COLLAPSE		DIR		TEST LOC		TEMP		SIZE	
PRODUCT IDENTIFICATION		BEND		FLAT		CHARTER V-NOTCH IMPACT TESTING		TEST COND.		% SHEAR	
B27156		OK		OK		1		2		3	
B27447		OK		OK		1		2		3	
T - TRANSVERSE		B - BODY		W - WELD		HAZ - HEAT AFFECTED ZONE					
LEGEND		L - LONGITUDINAL		T - TRANSVERSE		B - BODY		W - WELD		HAZ - HEAT AFFECTED ZONE	
TEST / INSPECTION		YES		RESULTS / COMMENTS							
FULL LENGTH VISUAL		X		OD		OD/ID		L		L/T	
FULL LENGTH EMI				ID		OD/ID		L		L/T	
FULL LENGTH MPI				MPI		UT					
FULL LENGTH UT				MPI		UT					
END AREA INSPECTION (PLAIN END)				DRIFT MANDREL SIZE:							
SPECIAL END AREA (SEA) INSP											
FULL LENGTH DRIFT											
ADDITIONAL NOTES/COMMENTS											
MELTED AND MANUFACTURED IN THE USA. NO REPAIRS BY WELDING. NO MERCURY OR MERCURY COMPOUNDS ARE ADDED TO THE STEEL AND ALL MERCURY BEARING EQUIPMENT IS PROTECTED BY A DOUBLE BOUNDARY OF CONTAINMENT.											

THIS IS TO CERTIFY THAT THE PRODUCT DESCRIBED HEREIN WAS MANUFACTURED, SAMPLED, TESTED AND/OR INSPECTED IN ACCORDANCE WITH THE SPECIFICATION AND FULFILLS THE REQUIREMENTS IN SUCH RESPECTS.

PREPARED BY THE OFFICE OF: J. MAJERZAK - MANAGER, Q.A.

DATE 01/01/07

PAGE 2 OF 2

\*\*

2-19-07

Page 2 of 4

IN ACCORDANCE WITH EEO 10474/EH 10204/DH 50049 3.1.b)

C.E. IS BASED ON THE FOLLOWING EQUATIONS):

$$CE = C_4 \left( \frac{MN}{S} \right) + \left( \frac{CR + MD + V}{S} \right) / 5 + \left( \frac{RI + CO}{S} \right) / 15$$

DECIMAL POSITIONS FOR ELEMENTS ARE INDICATED BY THE LEFT MARGIN, VERTICAL DOTTED LINE OR DECIMAL POINT.

Page 1 of 1

150

2

202: 442

USS Tubular QA -> MAIRA ZARATE

Page 3 of 3

Q1M ACCO BOARDANCE WITH (80 10474/ENH204/DUN5049 2.15)  
 CERN-127 7.150 TEST AREA

MILL IDENTIFICATION NO.		P.O. NUMBER		ENTRANCE NO.		DATE		WALL		DIP	
DE 34950 01		06-18864		06-18864		06-18864		06-18864		06-18864	
MATERIAL CODE:		AS ROLLED		Q.D.		1.900 { 48.260 }		0.145 { 3.682 }		0.145 { 3.682 }	
PRODUCT IDENTIFICATION		FLAT		RND		ORIGIN SIZE		MIN. COMPOSE		TEST LOC	
R20857		OR		OR		OR		OR		OR	
FULL LENGTH VISUAL		X		X		X		X		X	
FULL LENGTH EM											
FULL LENGTH MP											
FULL LENGTH UT											
END AREA INSPECTION (PLAIN END)											
SPECIAL END AREA (SEAM SP)											
FULL LENGTH DRIFT											

TEST/INSPECTION

TEST

RESULTS/COMMENTS

TEST/INSPECTION INFORMATION

TEST

RESULTS/COMMENTS

ADDITIONAL NOTES/COMMENTS

MELTED AND MANUFACTURED IN THE USA. NO REPAIRS BY WELDING. NO MERCURY OR MERCURY COMPOUNDS ARE ADDED TO THE STEEL AND ALL MERCURY BEARING EQUIPMENT IS PROTECTED BY A DOUBLE BOUNDARY OF CONTAINMENT.

THIS IS TO CERTIFY THAT THE PRODUCT DESCRIBED HEREIN WAS MANUFACTURED, SAMPLED, TESTED AND NOW INSPECTED IN ACCORDANCE WITH THE SPECIFICATION AND FULFILLS THE REQUIREMENTS OF SUCH INSPECTS.

PREPARED BY THE OFFICE OF J. KALTREK - MANAGER, Q. A.

DATE 05/13/06

PAGE 2 OF 2

15  
INSPECTED  
J.S.O.

MAY-17-2007(THU) 19:40

ATLAS TUBE

P. 003/003

Atlas Tube Inc.  
8039N County Road 1018  
Blytheville, Arkansas, USA  
72314  
Tel: 870-838-2000  
Fax: 870-752-6630



Ref. B/L: 80239499  
Date: 05.17.2007  
Customer: 193

Sold to

Tubular Steel  
1031 Executive Parkway  
ST. LOUIS MO 63141  
USA

**MATERIAL TEST REPORT**Shipped to

Tubular Steel  
27700 Highway Blvd.  
KATY TX 77493  
USA

Material: 4.0x3.0x188x40"0"0(5x4).

Material No: 400301884000

Made in: USA

Melted &amp; Manufactured in USA

Sales order: 303326

Purchase Order: 1725 HOT NEXT TRUCK

Heat No	C	Mn	P	S	Si	Al	Cu	Cr	Mo	Ni	Co	V
870565	0.190	0.770	0.015	0.008	0.012	0.043	0.070	0.000	0.010	0.020	0.050	0.000

Bundle No

Yield

Tensile

Elm. 2In

Certification

M400005312

061980 Psi

073100 Psi

33 %

ASTM A600-03A GRADE C &amp; B

Material Note:  
Sales Or. Note:

Material: 4.0x3.0x250x40"0"0(5x3).

Material No: 400302504000

Made in: USA

Melted &amp; Manufactured in USA

Sales order: 303326

Purchase Order: 1725 HOT NEXT TRUCK

Heat No	C	Mn	P	S	Si	Al	Cu	Cr	Mo	Ni	Co	V
272484	0.210	0.750	0.008	0.000	0.029	0.033	0.060	0.000	0.005	0.020	0.020	0.002

Bundle No

Yield

Tensile

Elm. 2In

Certification

M400005282

063200 Psi

071700 Psi

29 %

ASTM A600-03A GRADE C &amp; B

Material Note:  
Sales Or. Note:

Material: 5.0x4.0x250x40"0"0(3x3).

Material No: 800402504000

Made in: USA

Purchase Order: 1725 HOT NEXT TRUCK

Sales order: 303326

Heat No	C	Mn	P	S	Si	Al	Cu	Cr	Mo	Ni	Co	V
188043	0.210	0.770	0.011	0.002	0.026	0.025	0.070	0.000	0.005	0.030	0.040	0.002

Bundle No

Yield

Tensile

Elm. 2In

Certification

M400005365

065100 Psi

076700 Psi

28 %

ASTM A600-03A GRADE C &amp; B

Material Note:  
Sales Or. Note:

Authorized by Quality Assurance:

Page : 2 Of 2



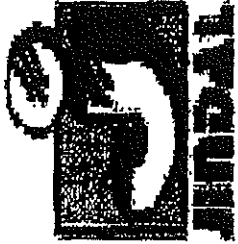
KAC  
057  
11  
INSPECTED  
7-17-07

CHAPEL STEEL CO.  
OIL STATES-SKAGIT-SMAICO  
ASTM A36 PER SPEC "M-36-PL-C" ATTACHED  
1/2" X 96.0000" X 120.0000"  
PART NO.

PO/Ref: 1058488

ROBERT HUDSON

Certificate of Mill Test Results  
SO HOU-031146-002  
28 Mar 07  
Pg 1/1



Jindal United Steel Corporation  
5200 E. McKinney Road  
Baytown, TX 77520

TC No.: BR10J027-6179-01

METALLURGICAL TEST REPORT

Sold To: CHAPEL STEEL CO. 590 NORTH WETHELEHAM PKWY P.O. BOX 1600 SPRING HOUSE, PA 19477-1000		Ship To: CHAPEL STEEL CO. 6605 N HOUSTON ROSSLYN RD. HOUSTON, TX 77091		This is to certify that the product described herein was manufactured, sampled, and tested in accordance with the specifications and requirements in such specifications: Fine Grain, Si-AL Fully Killed Steel		Rolled Numr. 101027	
Order No: JUS2561-02		Date: 2/28/2007		P.O. Number: HOU-3188		Approved By: <i>Helen Green</i>	
Plates Manufactured in the USA		Certified by ISO 9001:2008		Shipping Mode: DIRECT TRUCK		DIN 50049 3.1 B / EN 10204 3.1 B	

Specifications:  
HOT ROLLED PLATE CUT HINGE ASTM/A516-01 / ABSGR A / R & A709 - 45 GR  
36 STRUCTURAL QUALITY

Item	Material Description			Bulletin		Heat No.	Gage Tested	Test/Plate Identity	Test Coual	Yield Point (KSI)	Tensile Strength (KSI)	Elongation (%)		Yield Strength Determined at
	Gauge	Width	Length	Qty	Wgt							In 8"	In 2"	
02	0.5000	96.0000	480.0000	3	19,602	S06179	0.500 0.500	01D 01C	ABS ABS	48 48	66 66	26 25		0.2% 0.2%
HIS-805513-A														

Heat No. S06179 CE-0.31														
Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Me	Sn	Al	N	V	Ch
LADLE	0.12	1.07	0.013	0.009	0.22	0.03	0.02	0.04	0.010	0.001	0.031	0.004	0.0025	0.005

103-30-07

*Metallurgical Chemistry and Testing Laboratory*

3204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
[metall@an-tech.com](mailto:metall@an-tech.com)

March 27, 2007

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/31146  
Report No. 07-739-3

IDENTIFICATION: 1/2" x 4" x 6", HT# S06179, SL# 08BC  
MATERIAL: ASTM A 36

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

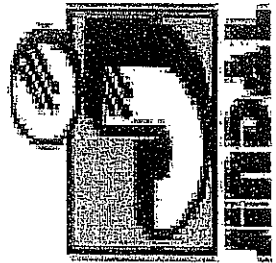
<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
118.0	95	70
118.0	81	60
115.0	92	60

mm

Donald Derrick  
Mechanical Testing Supervisor

JP 3-30-07





# Jindal United Steel Corporation

5200 E. McKinney Road  
Baytown, TX 77520

## METALLURGICAL TEST REPORT

MET-04  
TC No.: BR101680-6170-01

<b>Sold To:</b> CHAPEL STEEL CO. 590 NORTH BETHLEHEM PIKE P.O. BOX 1000 SPRING HOUSE, PA 19477-1000		<b>Ship To:</b> CHAPEL STEEL CO. 6605 N. HOUSTON ROSSLYN RD. HOUSTON, TX 77091		This is to certify that the product described herein was manufactured, sampled, and tested in accordance with the specifications and requirements in such specifications. Fine Grain, Si-AL Fully Killed Steel		Bulletin Num. 101680																									
<b>Order No:</b> JUS2620-07		<b>Date:</b> 4/16/2007		<b>Approved By:</b> <i>J. Aguilera / Amargo</i>																											
<b>Plates Manufactured in the USA</b>		<b>P.O. Number:</b> HOU-3243		<b>Shipping Mode:</b> DIRECT TRUCK																											
<b>Certified by ISO 9001:2000</b>		<b>Date:</b> 4/16/2007		<b>DN:</b> 50049 3.1.B / EN 10204 3.1.B																											
<b>Specifications:</b> HOT ROLLED PLATE CUT EDGE ASTM/ASME A36-05 / ABSGR A / B & A709 - 05 GR 36 STRUCTURAL QUALITY				<b>Insp.</b>		"We hereby certify that the material described herein has been made to the application by the B.O.S. process and tested in accordance with the requirements of American Bureau of Shipping Rules with satisfactory results."																									
<b>Material Description</b>		<b>Bulletin</b>		<b>Test/Plate Identity</b>		<b>Yield Point (KSD)</b>		<b>Tensile Strength (KSD)</b>		<b>Elongation (%)</b>		<b>Yield Strength Determined at</b>		<b>LCVN</b>																	
<b>Item No.</b>	<b>Gauge</b>	<b>Width</b>	<b>Length</b>	<b>Qty</b>	<b>Wgt</b>	<b>Heat No.</b>	<b>Gauge Tested</b>	<b>Test/Plate Identity</b>	<b>Gauge Tested</b>	<b>Heat No.</b>	<b>Yield Point (KSD)</b>	<b>Tensile Strength (KSD)</b>	<b>Elongation (%)</b>	<b>Yield Strength Determined at</b>	<b>LCVN</b>																
07	2.0000	96.0000	480.0000	1	26,137	S06170	2.000	04A	AR	44	72	34	0.2%	108 - 70 - 81 FULL min @ 32°F	25 FT/LBS																
<div style="text-align: center;"></div>																															
																APR 17 2007															
																H3822764A X															
<b>Heat No. S06170 CE-0.38</b>																															
<b>Test Type</b>		<b>C</b>	<b>Mn</b>	<b>P</b>	<b>S</b>	<b>Si</b>	<b>Cu</b>	<b>Ni</b>	<b>Cr</b>	<b>Mo</b>	<b>Sn</b>	<b>Al</b>	<b>N</b>	<b>V</b>	<b>B</b>	<b>Ti</b>	<b>Cb</b>														
LADLE		0.17	1.14	0.015	0.004	0.25	0.04	0.03	0.04	0.010	0.001	0.033	0.005	0.005	0.0005	0.005	0.010														





Metallurgical Chemistry and Testing Laboratory

3204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7801  
FAX: (713) 644-1400  
metallab@an-tech.com

Page 1 of 1

April 24, 2007

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/31453  
Report No. 07-0994

IDENTIFICATION: 2" x 4" x 6", HT# S06170, SL# 04A-A  
MATERIAL: ASTM A36, Mfg. Jin

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
56.0	54	30
45.0	43	20
55.0	52	30

Donald Derrick  
Mechanical Testing Supervisor

Sc



Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.

C-505115

**Chemical and Physical Test Report**  
MADE IN UNITED STATES

**GERDAU AMERISTEEL**  
CHARLOTTE STEEL MILL  
6601 LAKEVIEW ROAD  
CHARLOTTE NC 28269 USA  
(704) 596-0361

**PRODUCED IN: CHARLOTTE**

<b>SHIP TO</b> SABEL INDUSTRIES 1500 CHIPPEWA ST. 877-797-8335 BATON ROUGE, LA 70805	<b>INVOICE TO</b> SABEL STEEL SERVICE INC PO DRAWER 4747 MONTGOMERY, AL 36103-4747	<b>SHIP DATE</b> 03/27/07	<b>CUST. ACCOUNT NO</b> 37835923
--	---	------------------------------	-------------------------------------

SHAPE + SIZE	GRADE	SPECIFICATION	SALES ORDER	CUST P.O. NUMBER
A1 1/4 X 1 1/4 X 1/4	A36	A36 ASTM A36-05	7038017-04	51246-04
HEAT I.D.	C	Mn .63 P .014 S .033 Si .22 Cu .43 Ni .12 Cr .17 Mo .020 V .002 Nb .008 Sn .012 Al .000 C Eqv .345		
C701353				
Mechanical Test: Yield 50339 PSI, 347.08 MPA Tensile: 72730 PSI, 501.46 MPA %EL: 24.08in, 24.0/200MM Bend: OK Std Dev: 0 Idl Diam: .539				

SHAPE + SIZE	GRADE	SPECIFICATION	SALES ORDER	CUST P.O. NUMBER
A2 X 2 X 1/4	A36	A36 ASTM A36-05	7038017-05	51246-05
HEAT I.D.	C	Mn .68 P .005 S .037 Si .17 Cu .47 Ni .12 Cr .14 Mo .030 V .003 Nb .008 Sn .016 Al .000 C Eqv .364		
C607814				
Mechanical Test: Yield 50402 PSI, 347.51 MPA Tensile: 73208 PSI, 504.75 MPA %EL: 25.08in, 25.0/200MM Bend: OK Std Dev: 0 Idl Diam: .615				

SHAPE + SIZE	GRADE	SPECIFICATION	SALES ORDER	CUST P.O. NUMBER
F1/4 X 1 1/2	A36	A36 ASTM A36-05	7038017-03	51246-03
HEAT I.D.	C	Mn .69 P .006 S .038 Si .18 Cu .34 Ni .10 Cr .06 Mo .030 V .002 Nb .008 Sn .012 Al .000 C Eqv .357		
C608050				
Mechanical Test: Yield 50765 PSI, 350.01 MPA Tensile: 70800 PSI, 488.15 MPA %EL: 24.08in, 24.0/200MM Bend: OK Std Dev: 0 Idl Diam: .547				

Customer Requirements CASTING: STRAND CAST

This material, including the billets, was produced and manufactured in the United States of America

Bhaskar Yalamanchili  
Quality Director  
Gerdaul Ameristeel

*For Clayton*

Mgt. Metallurg. Svcs.  
CHARLOTTE STEEL MILL



*5-11-07*

05/09/2007 From: SABEL STEEL  
ATTN: PO #:

To:

B/L# 438574

000000  
NAMASCO  
P. O. BOX 450463

HOUSTON TX 77245-0469

SIZE GRADE HEAT #

2 X 2 X 3/16  
ASTM A36-05/A529-05 GR 50  
PO# - 60943441/4 X 3  
A36-05/A709-04AEL/SA36-98  
PO# - 60943443 X 2 X 3/16  
A36-05/A709-04AEL/SA36-98  
PO# - 60943443 X 2 X 1/4  
A36-05/A709-04AEL/SA36-98  
PO# - 60943443 X 3 X 3/8  
ASTM A36-05/A529-05 GR 50  
PO# - 60941643 X 3 X 3/8  
ASTM A36-05/A529-05 GR 50  
PO# - 60941645 X 3 X 1/4  
ASTM A36-05/A529-05 GR 50  
PO# - 6094344ELONGATION IN 8 INCH SCALE  
MELTED AND MANUFACTURED IN U.S.A.NUCOR STEEL  
A Division of Nucor Corporation  
JEVETT, TEXAS 75846 PH (903) 626-4461

## CERTIFIED MILL TEST REPORT

43877  
NAMASCO  
14200 ALMEDA RD  
HOUSTON

SIZE	GRADE	HEAT #	C	Mn	Si	S	P	V	Nb	Cu	Cr	Ni	Mo	Sn	Bend Test
2 X 2 X 3/16	ASTM A36-05/A529-05 GR 50	402-9524	.111	.887	.200	.033	.008	.004	.011	.340	.100	.230	.066	.014	
			Tensile 1:	72700	Yield 1:	51800	Elong% 1:	27							
			Tensile 2:	72700	Yield 2:	51700	Elong% 2:	28							
1/4 X 3	A36-05/A709-04AEL/SA36-98	403-0864	.106	.794	.200	.034	.007	.004	.002	.380	.120	.130	.037	.014	
			Tensile 1:	61200	Yield 1:	46700	Elong% 1:	28							
			Tensile 2:	59300	Yield 2:	45500	Elong% 2:	22							
3 X 2 X 3/16	A36-05/A709-04AEL/SA36-98	403-0605	.096	.806	.180	.038	.007	.003	.001	.410	.210	.160	.041	.014	
			Tensile 1:	68200	Yield 1:	50200	Elong% 1:	23							
			Tensile 2:	69500	Yield 2:	53300	Elong% 2:	25							
3 X 2 X 1/4	A36-05/A709-04AEL/SA36-98	403-0573	.109	.852	.240	.046	.009	.003	.002	.430	.150	.160	.040	.015	
			Tensile 1:	67900	Yield 1:	52100	Elong% 1:	22							
			Tensile 2:	66300	Yield 2:	48800	Elong% 2:	23							
3 X 3 X 3/8	ASTM A36-05/A529-05 GR 50	403-0479	.099	1.084	.230	.031	.007	.004	.016	.490	.130	.130	.034	.021	
			Tensile 1:	75300	Yield 1:	54600	Elong% 1:	23							
			Tensile 2:	76400	Yield 2:	54900	Elong% 2:	23							
3 X 3 X 3/8	ASTM A36-05/A529-05 GR 50	403-0473	.091	1.017	.200	.025	.005	.004	.017	.350	.140	.160	.042	.012	
			Tensile 1:	76900	Yield 1:	53800	Elong% 1:	21							
			Tensile 2:	76100	Yield 2:	56100	Elong% 2:	21							
5 X 3 X 1/4	ASTM A36-05/A529-05 GR 50	403-0680	.106	.891	.240	.039	.010	.003	.013	.460	.170	.170	.054	.014	
			Tensile 1:	76500	Yield 1:	58200	Elong% 1:	22							
			Tensile 2:	73500	Yield 2:	55200	Elong% 2:	22							

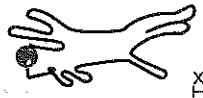
CHIEF METALLURGIST

Ben Cave

By CARMELA



06-26-2007



TX

# OCEANEERING<sup>®</sup>

## INSPECTION

REPORT NO. 409024

Houma, LA  
(985) 868-5097  
New Iberia, LA  
(337) 365-7102  
Ingleside, TX  
(361) 776-7251

MAILING ADDRESS  
Sta. 1 Box 10267  
Houma, LA 70363

(985) 868-5097  
**DAILY WORK REPORT**  
ISO 9002 Certified

Customer <b>OIL STATES</b>	Job Location <b>Houma LA</b>	Inspection Date / Time <b>10-13-07</b>
Billing Address	Project <b>2340711</b>	Oil Job Number <b>57348</b>
	P.O. #	PKC / AFE # <b>LATEST EDITION</b>
	S.S. Procedure # <b>AMS MTO2 Rev1</b>	Acceptance Criteria <b>AMS B1.1 6.1</b>

AD = Accumulations of Discontinuities	ESI = Elongated Slag Inclusion	IFD = Incomplete Fusion Due to Cold Lap	LC = Low Crown
BT = Burn Through	EU = External Undercut	IP = Inadequate Penetration	NW = Narrow Weld
BTA = Burn Through Area	HB = Hollow Bead	IPD = Inadequate Penetration Due to High Low	P = Porosity
C = Crack/Cracks	IC = Internal Concavity	ISI = Isolated Slag Inclusions	
CP = Cluster Porosity	IF = Incomplete Fusion	IU = Internal Undercut	

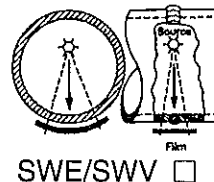
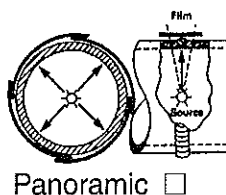
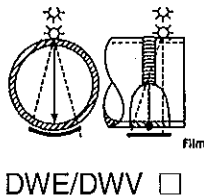
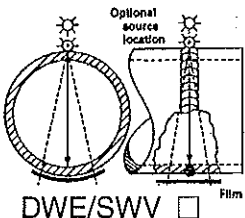
Job Description: **WET mb Exam of:**

RECOMMENDATION				RECOMMENDATION					
WELD NO.	PIPE SIZE	✓ X	ACCEPT REJECT	REMARKS	WELD NO.	PIPE SIZE	✓ X	ACCEPT REJECT	REMARKS
1					31				
2	IDLER 340L				32				
3					33				
4	N95SK1-104				34				
5					35				
6					36				
7					37				
8					38				
9					39				
10	100% mt. of ALL welds.				40				
11					41				
12					42				
13					43				
14				welding stencil	44				
15					45				
16				✓ Acc K.L.	46				
17					47				
18					48				
19					49				
20					50				
21					51				
22					52				
23					53				
24					54				
25					55				
26					56				
27					57				
28					58				
29					59				
30					60				

Technique: check exposure setup

SFD

Thickness



Film Delivered to: SS Manager: _____	Client: _____	Customer Representative: <b>Cory Ford</b>
X-Ray: _____ MAK V: _____	Gamma Ray: _____ Curies: _____	Date: <b>10-13-07</b> Technician: <b>STEVE WAGNER</b>
No. of Welds Checked: _____	Focal Size: _____ Ug: _____	Assistant: _____ Assistant: <b>LEWEL JR</b>
Linear Ft. Film: _____	Type: _____	Instrument: <b>ESX 115</b>
Penetrameter-A _____ B _____ C _____	Required wire: _____	Angles Used: <b>3 to 6" space</b>
Dye Penetrant: _____	Ultrasonic: _____	Magnetic Particle: <input checked="" type="checkbox"/>
Hours Worked: <b>3</b>	Travel Time: _____	Mileage: _____
Sheet # <b>1</b> of <b>1</b>	Substance (check if applicable): _____	Consumables: <b>1 part</b>
Specifications: _____		

Oceaneering Inspection has furnished this Examination Report of weldments as a good faith interpretation. Acceptance or rejection of welding discontinuities to the clients specific codes and/or standards shall not infer any warranty or liability on the part of Oceaneering Inspection as to the fitness for service of such weldments and their intended use by the client.

# OCEANEERING<sup>®</sup>

## INSPECTION

REPORT NO. 408725

Houma, LA  
(985) 868-5097  
New Iberia, LA  
(337) 365-7102  
Ingleside, TX  
(361) 776-7251

MAILING ADDRESS  
Sta. 1 Box 10267  
Houma, LA 70363

(985) 868-5097  
**DAILY WORK REPORT**  
ISO 9002 Certified

Customer <b>OIL STATES</b>	Job Location <b>Houma LA</b>	Inspection Date / Time <b>9-29-07</b>
	Project <b>23407.11</b>	Oil Job Number <b>57348</b>
Billing Address	P.O. #	PKC / AFE # <b>LATEST EDITION</b>
	S.S. Procedure # <b>AWS MFG 2 rev 1</b>	Acceptance Criteria <b>AWS D1.1 6.1</b>

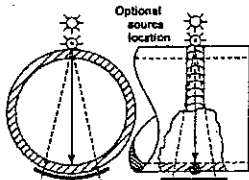
AD = Accumulations of Discontinuities BT = Burn Through BTA = Burn Through Area C = Crack/Cracks CP = Cluster Porosity	ESI = Elongated Slag Inclusion EU = External Undercut HB = Hollow Bead IC = Internal Concavity IF = Incomplete Fusion	IFD = Incomplete Fusion Due to Cold Lap IP = Inadequate Penetration IPD = Inadequate Penetration Due to High Low ISI = Isolated Slag Inclusions IU = Internal Undercut	LG = Low Crown NW = Narrow Weld P = Porosity
--	---	--	--

Job Description: **WET MAG Exam of:**

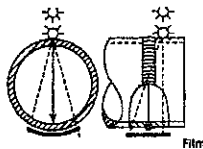
RECOMMENDATION					RECOMMENDATION				
WELD NO.	PIPE SIZE	✓ X	ACCEPT REJECT	REMARKS	WELD NO.	PIPE SIZE	✓ X	ACCEPT REJECT	REMARKS
1					31				
2	<b>BRACKET Boom Lifting</b>				32				
3					33				
4	<b>340L / 440L</b>				34				
5					35				
6	<b>N 99 SKI-110</b>				36				
7					37				
8					38				
9					39				
10					40				
11	<b>10840 m.t. of All welds</b>				41				
12					42				
13	<b>on 2 PCS.</b>				43				
14					44				
15					45				
16					46				
17				<b>Working Strands</b>	47				
18					48				
19				<b>✓ ACC M-1</b>	49				
20					50				
21					51				
22					52				
23					53				
24					54				
25					55	<b>AL Carb</b>			
26					56				<b>Level II</b>
27					57				
28					58				
29					59				
30					60				

Technique: check exposure setup

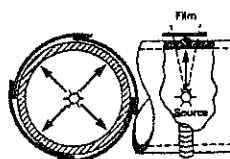
SFD \_\_\_\_\_ Thickness \_\_\_\_\_



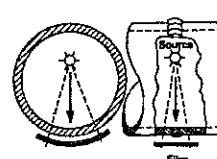
DWE/SWV ☐



DWE/DWV ☐



Panoramic ☐



SWE/SWV ☐


Film Delivered to: SS Manager: _____ Client: _____	Customer Representative: <b>AL CARLOS</b>
X-Ray: _____ MAK V: _____ Gamma Ray: _____ Curies: _____	Date: <b>9-29-07</b> Technician: <b>AL CARLOS</b>
No. of Welds Checked: _____ Focal Size: _____ Ug: _____	Assistant: _____ Assistant: _____
Linear Ft. Film: _____ Type: _____	Instrument: <b>ESX 115</b>
Penetrator-A _____ B _____ C _____ Required wire: _____	Angles Used: <b>3 to 6" SPACE</b>
Achieved wire: _____	Freq <b>110AC</b> Cal Bloc: <b>100B</b>
Dye Penetrant: _____ Ultrasonic: _____ Magnetic Particle: <input checked="" type="checkbox"/>	Couplant: _____
Hours Worked: <b>2</b> Travel Time: _____ Mileage: _____	Consumables: <b>1 paint</b>
Sheet # <b>1</b> of <b>1</b> Subsistence (check if applicable): _____	Specifications: _____

Oceaneering Inspection has furnished this Examination Report of weldments as a good faith interpretation. Acceptance or rejection of welding discontinuities to the clients specific codes and/or standards shall not infer any warranty or liability on the part of Oceaneering Inspection as to the fitness for service of such weldments and their intended use by the client.



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# Material Traceability Log

CRANE WO. NO.:	23407
CUSTOMER:	PEMEX
WELDMENT PART NO.:	N61587-020
WELDMENT S/N:	C07101-03
DESCRIPTION:	Boom Insert Weldment (Mid # 1 – 30°)
MODEL:	340LA-80
CHECKED BY:	
DATE:	9-14-2019

[illegible]

Atlas Tube (Arkansas) Inc.  
8000 N. County Rd. 967  
Blytheville, Arkansas, USA  
72315  
Tel: 519-738-6000  
Fax: 519-738-3537

Ref.B/L: 80185354  
Date: 04.11.2006  
Customer: 193



# MATERIAL TEST REPORT

## Sold to

Tubular Steel  
1031 Executive Parkway  
ST. LOUIS MO 63141  
USA

## Shipped to

Tubular Steel  
27700 Highway Blvd.  
KATY TX 77493  
USA

Material: 4.0x4.0x500x30°0°(4x3).NMHSCROPS1  
Sales order: 209738

Material No: 40040500

Made in: USA

Purchase Order: 3311

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V
162113	0.180	0.710	0.016	0.010	0.160	0.040	0.070	0.003	0.030	0.005	0.000	0.000

Bundle No	Yield	Tensile	Elon.2in
M5-99784	069450 Psi	071010 Psi	35.2 %

## Certification

ATLAS ROPS 1

Material Note:  
Sales Or.Note:

Material: 4.0x4.0x500x40°0°(3x3).ROPS1  
Sales order: 200582

Material No: 40040500

Made in: USA

Purchase Order: 2793

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V
162114	0.180	0.750	0.010	0.011	0.012	0.035	0.000	0.000	0.000	0.000	0.000	0.000

Bundle No	Yield	Tensile	Elon.2in
M5-99787	070750 Psi	073210 Psi	34.2 %

## Certification

ATLAS ROPS 1

Material Note:  
Sales Or.Note:

Material: 4.0x4.0x500x30°0°(4x3).NMHSCROPS1  
Sales order: 209738

Material No: 40040500

Made in: USA

Purchase Order: 3311

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V
162113	0.180	0.710	0.016	0.010	0.160	0.040	0.070	0.003	0.030	0.005	0.000	0.000

Bundle No	Yield	Tensile	Elon.2in
M5-99753	069450 Psi	071010 Psi	35.2 %

## Certification

ATLAS ROPS 1

Material Note:  
Sales Or.Note:

Material: 4.0x4.0x500x25°0°(4x3).NMHSCROPS1  
Sales order: 209738

Material No: 40040500

Made in: USA

Purchase Order: 3311

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V
162113	0.180	0.710	0.016	0.010	0.160	0.040	0.070	0.003	0.030	0.005	0.000	0.000

Bundle No	Yield	Tensile	Elon.2in
M5-99762	069450 Psi	071010 Psi	35.2 %

## Certification

ATLAS ROPS 1

Material Note:  
Sales Or.Note:

Authorized by Quality Assurance: *Obasa*

Page: 1 Of 2



*4-22-06*



Atlas Tube (Arkansas) Inc.  
5000 N. County Rd. 987  
Blytheville, Arkansas, USA  
72315  
Tel: 519-738-5000  
Fax: 519-738-3537

Ref.B/L: 80185354  
Date: 04.11.2006  
Customer: 193



# MATERIAL TEST REPORT

## Sold to

Tubular Steel  
1031 Executive Parkway  
ST. LOUIS MO 63141  
USA

## Shipped to

Tubular Steel  
27700 Highway Blvd.  
KATY TX 77493  
USA

Material: 4.0x4.0x500x24"0(4x3).NMHSCROPS1

Material No: 40040500

Made In: USA

Sales order: 209735

Purchase Order: 3311

Heat No	C	Mn	P	S	Si	Al	Cu	Co	Mo	Ni	Cr	V
162113	0.180	0.710	0.016	0.010	0.160	0.040	0.070	0.003	0.030	0.005	0.000	0.000
Bundle No	Yield		Tensile		Elm.2in		Certification					
M5-89757	068460 Psi		071010 Psi		35.2 %		ATLAS ROPS 1					

Material Note:

Sales Or.Note:

Material: 4.0x4.0x500x24"0(4x3).NMHSCROPS1

Material No: 40040500

Made In: USA

Sales order: 209735

Purchase Order: 3311

Heat No	C	Mn	P	S	Si	Al	Cu	Co	Mo	Ni	Cr	V
162113	0.180	0.710	0.016	0.010	0.160	0.040	0.070	0.003	0.030	0.005	0.000	0.000
Bundle No	Yield		Tensile		Elm.2in		Certification					
M5-89758	068460 Psi		071010 Psi		35.2 %		ATLAS ROPS 1					

Material Note:

Sales Or.Note:

Material: 4.0x4.0x500x24"0(4x3).ROPS1

Material No: 40040500

Made In: USA

Sales order: 200582

Purchase Order: 2793

Heat No	C	Mn	P	S	Si	Al	Cu	Co	Mo	Ni	Cr	V
162114	0.180	0.750	0.010	0.011	0.012	0.035	0.000	0.000	0.000	0.000	0.000	0.000
Bundle No	Yield		Tensile		Elm.2in		Certification					
M5-89786	070780 Psi		073210 Psi		34.2 %		ATLAS ROPS 1					

Material Note:

Sales Or.Note:

Authorized by Quality Assurance:                     

Page: 2 Of 2



R5537461

# MAVERICK

MATERIAL TEST REPORT  
Send-Off, Lot#, Item, Ship To, Qty

Date: 04/11/06  
Time: 19:11:5  
Page: 2

Customer: ATLAS TUBE  
200 CLARK ST  
HARROW, ON N0R 1G0  
CA

MAVERICK TUBE CORPORATION  
16401 SWINGLEY RIDGE RD.  
CHESTERFIELD, MO 63017  
(636) 733-1600

Shipped From: MAVERICK TUBE, LP - 102  
102 4950 N COUNTY RD 967  
C BLYTHEVILLE, AR 72315

Specification ASTM A500-03 Gr. B

Load # 1993411 Product 4 X 4 X 500 240.000  
Date Shipped 04/11/06 Item Number 685417  
Sales Order 278869 SO 2.0 Size 4 X 4 Gauge 0.500 Length 20  
Customer PO 80185354 Mfg. Process COLD FORMED ERW Grade A500-B

## CHARPY V-NOTCH IMPACT TEST

Heat #	Test	Lot Number	Orient	Size	Temp Deg. F	Flattened	Absorbed Energy 1 FT-LBS	Absorbed Energy 2 FT-LBS	Absorbed Energy 3 FT-LBS	Avg. FT-LBS	Shear Area 1 %	Shear Area 2 %	Shear Area 3 %	Avg. %
162113	2491021, 2491023, 2491023	162113	L	3/4	22-	196.00	190.80	184.00	180.67	180.67	95.00	95.00	93.80	93.00

\* Melted and Manufactured in the U.S.A. \*

I HEREBY CERTIFY THAT THE MATERIAL HAS BEEN MANUFACTURED, SAMPLED, TESTED, AND INSPECTED IN ACCORDANCE  
WITH THIS SPECIFICATION AND HAS BEEN FOUND TO MEET THE REQUIREMENTS CALLED FOR BY THE ABOVE ORDER.

APPROVED BY: \_\_\_\_\_  
TIME: \_\_\_\_\_  
Maverick Tube Quality Department Approved  
Signature on File

4-22-06

DATE: 01/01/07  
TIME: 04:16:44  
SERIAL NO: L0014862

TUBULAR PRODUCTS  
CERTIFIED TEST REPORT  
(IN ACCORDANCE WITH ISO 10474/EN10204/DIN50049 3.1.b)

UNITED STATES STEEL



MILL ORDER ITEM NO DR37884 01	SHIPPER NO. R70811	P.O. NUMBER 06-19103	VEHICLE ID LT8138
SOLD TO ADDRESS PIPE DISTRIBUTORS LTD P O BOX 23237 HOUSTON TX 77228-3237		MAIL TO ADDRESS PIPE DISTRIBUTORS LTD P O BOX 23237 HOUSTON TX 77228-3237	
VENDOR USS TUBULAR PRODUCTS 2199 EAST 28TH ST. LORAIN, OH 44055			

## SPECIFICATION AND GRADE

PIPE CARBON SMLS STD PIPE API 5L-43RD EDITION DATED 3/04 PSL-1 GRADE B ASTM A53-\*05 GRADE B ASME  
SA53-\*2004 EDITION GRADE B ASTM A106-\*04B GRADE B/C ASME SA106-\*2004 EDITION GRADE B/C BLK REG MILL  
COAT PE BEV 30 DEG MEETING ALL THE APPLICABLE REQUIREMENTS OF NACE STANDARD MR-01-75 \*2002

MATERIAL COND:		AS ROLLED										O.D.: 1.900 ( 48.260 )										WALL: 0.145 ( 3.683 )										In (mm)	
PRODUCT IDENTIFICATION		TENSILE		TEST COND.		GAUGE WIDTH		YIELD		PSI		EXT %		TENSILE		Y/T		ELONG %		HARDNESS		MIN HYDRO		IDWELL(SEC)									
		TEST TYPE/ ORIENTATION				IN		MIN: MAX:		MIN: MAX:				MIN: MAX:		MAX:		MIN: MAX:		SCALE: HRB		PSI											
B27156		STRIP/L/B		AR		0.750		52500		.50				76000		0.69		33.0		B 70.7		2500		5									
B27447		STRIP/L/B		AR		0.750		51500		.50				75500		0.68		34.0		B 78.7		2500		5									
						** END OF DATA THIS SHEET																											
LEGEND:		L - LONGITUDINAL U - UPSET		T - TRANSVERSE NM - NORMALIZED		QT - QUENCH & TEMPERED SR - STRESS RELIEVED		AR - AS ROLLED		B - BODY		W - WELD																					
PRODUCT IDENTIFICATION		TYPE		C	MIN	P	S	SI	CU	NI	CR	MO	AL	N	V	B	Ti	CB	CO	CE*	MAX												
B27156		19	HEAT	1.06	009	002	18	03	04	09	03	034			00	0001	002	001			.40												
B27156		20	PROD	1.06	009	003	18	03	04	09	03	031			00	0001	001	001			.41												
B27156		18	PROD	1.05	008	003	18	03	04	09	03	031			00	0000	001	001			.39												
B27447		19	HEAT	1.05	009	004	18	04	02	07	02	035			00	0002	001	001			.41												
B27447		20	PROD	1.08	009	004	19	03	02	07	02	034			00	0000	001	001			.41												
B27447		20	PROD	1.08	009	005	19	03	02	07	02	033			00	0001	001	001			.40												
				** END OF DATA		THIS SHEET																											

\*C.E. IS BASED ON THE FOLLOWING EQUATION(S):  
$$CE=C+(MIN/6)+(CR+MO+V)/5+(NI+CU)/15$$

\*C.E. IS BASED ON THE FOLLOWING EQUATION(S):  $CE = C + (MN/6) + (CR+MO+V)/5 + (NI+CU)/15$

DECIMAL POSITIONS FOR ELEMENTS ARE INDICATED BY THE LEFT MARGIN, VERTICAL DOTTED LINE OR DECIMAL POINT.

1/1/2007 4:19 AM  
USS Tubular QA -> MURRY HAMILTON  
Page 2 of 3

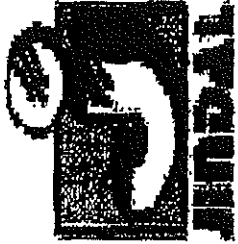


CHAPEL STEEL CO.  
OIL STATES-SKAGIT-SMAICO  
ASTM A36 PER SPEC "M-36-PL-C" ATTACHED  
1/2" X 96.0000" X 120.0000"  
PART NO.

PO/Ref: 1058488

Certificate of Mill Test Results

SO HOU-031146-002  
28 Mar 07  
Pg 1/1



Jindal United Steel Corporation  
5200 E. McKinney Road  
Baytown, TX 77520

TC No.: BR10J027-6179-01

METALLURGICAL TEST REPORT

Sold To: CHAPEL STEEL CO. 590 NORTH WETHELEHAM PKWY P.O. BOX 1600 SPRING HOUSE, PA 19477-1000		Ship To: CHAPEL STEEL CO. 6605 N HOUSTON ROSSLYN RD. HOUSTON, TX 77091		This is to certify that the product described herein was manufactured, sampled, and tested in accordance with the specifications and requirements in such specifications: Fine Grain, Si-AL Fully Killed Steel		Rolled Numr. 101027	
Order No: JUS2561-02		Date: 2/28/2007		Approved By: <i>Helen Green</i>			
P.O. Number: 1100-3180		Shipping Mode: DIRECT TRUCK		DIN 50049 3.1 B / EN 10204 3.1 B			

Specifications:  
HOT ROLLED PLATE CUT HINGE ASTM/A516-01 / ABSGR A / R & A709 - 45 GR  
36 STRUCTURAL QUALITY

Item No.	Material Description			Bulletin		Heat No.	Gage Tested	Test/Plate Identity	Test Coual	Yield Point (KSI)	Tensile Strength (KSI)	Elongation (%)		Yield Strength Determined at
	Gauge	Width	Length	Qty	Wgt							In 8"	In 2"	
02	0.5000	96.0000	480.0000	3	19,602	S06179	0.500 0.500	01D 01C	ABS ABS	48 48	66 66	26 25		0.2% 0.2%
HIS-805513-A														

Heat No. S06179 CE-0.31														
Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Me	Sn	Al	N	V	Ch
LADLE	0.12	1.07	0.013	0.009	0.22	0.03	0.02	0.04	0.010	0.001	0.031	0.004	0.0025	0.005

*Metallurgical Chemistry and Testing Laboratory*

3204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
[metall@anlabs.com](mailto:metall@anlabs.com)

March 27, 2007

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/31146  
Report No. 07-739-3

IDENTIFICATION: 1/2" x 4" x 6", HT# S06179, SL# 08BC  
MATERIAL: ASTM A 36

IMPACT TEST

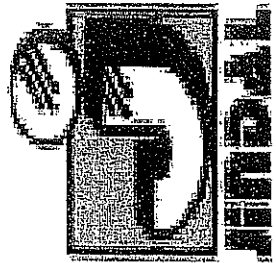
10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
118.0	95	70
118.0	81	60
115.0	92	60

mm

Donald Derrick  
Mechanical Testing Supervisor

JP 3-30-07



# Jindal United Steel Corporation

5200 E. McKinney Road  
Baytown, TX 77520

## METALLURGICAL TEST REPORT

MET-04  
TC No.: BR101680-6170-01

<b>Sold To:</b> CHAPEL STEEL CO. 590 NORTH BETHLEHEM PIKE P.O. BOX 1000 SPRING HOUSE, PA 19477-1000		<b>Ship To:</b> CHAPEL STEEL CO. 6605 N. HOUSTON ROSSLYN RD. HOUSTON, TX 77091		This is to certify that the product described herein was manufactured, sampled, and tested in accordance with the specifications and requirements in such specifications. Fine Grain, Si-AL Fully Killed Steel		Bulletin Num. 101680																									
<b>Order No:</b> JUS2620-07		<b>Date:</b> 4/16/2007		<b>Approved By:</b> <i>J. Aguilera / Amargo</i>																											
<b>Plates Manufactured in the USA</b>		<b>P.O. Number:</b> HOU-3243		<b>Shipping Mode:</b> DIRECT TRUCK																											
<b>Certified by ISO 9001:2000</b>		<b>Date:</b> 4/16/2007		<b>DN:</b> 50049 3.1.B / EN 10204 3.1.B																											
<b>Specifications:</b> HOT ROLLED PLATE CUT EDGE ASTM/ASME A36-05 / ABSGR A / B & A709 - 05 GR 36 STRUCTURAL QUALITY				<b>Insp.</b>		"We hereby certify that the material described herein has been made to the application by the B.O.S. process and tested in accordance with the requirements of American Bureau of Shipping Rules with satisfactory results."																									
<b>Material Description</b>		<b>Bulletin</b>		<b>Test/Plate Identity</b>		<b>Yield Point (KSI)</b>		<b>Tensile Strength (KSI)</b>		<b>Elongation (%)</b>		<b>Yield Strength Determined at</b>		<b>LCVN</b>																	
<b>Item No.</b>	<b>Gauge</b>	<b>Width</b>	<b>Length</b>	<b>Qty</b>	<b>Wgt</b>	<b>Heat No.</b>	<b>Gauge Tested</b>	<b>Test/Plate Identity</b>	<b>Gauge Tested</b>	<b>Heat No.</b>	<b>Yield Point (KSI)</b>	<b>Tensile Strength (KSI)</b>	<b>Elongation (%)</b>	<b>Yield Strength Determined at</b>	<b>LCVN</b>																
07	2.0000	96.0000	480.0000	1	26,137	S06170	2.000	04A	AR	44	72	34	0.2%	108 - 70 - 81 FULL min @ 32°F	25 FT/LBS																
<div style="text-align: center;"></div>																															
																APR 17 2007															
																H3822764A X															
<b>Heat No. S06170 CE-0.38</b>																															
<b>Test Type</b>		<b>C</b>	<b>Mn</b>	<b>P</b>	<b>S</b>	<b>Si</b>	<b>Cu</b>	<b>Ni</b>	<b>Cr</b>	<b>Mo</b>	<b>Sn</b>	<b>Al</b>	<b>N</b>	<b>V</b>	<b>B</b>	<b>Ti</b>	<b>Cb</b>														
LADLE		0.17	1.14	0.015	0.004	0.25	0.04	0.03	0.04	0.010	0.001	0.033	0.005	0.005	0.0005	0.005	0.010														



Metallurgical Chemistry and Testing Laboratory

3204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7801  
FAX: (713) 644-1400  
metallab@an-tech.com

Page 1 of 1

April 24, 2007

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/31453  
Report No. 07-0994

IDENTIFICATION: 2" x 4" x 6", HT# S06170, SL# 04A-A  
MATERIAL: ASTM A36, Mfg. Jin

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
56.0	54	30
45.0	43	20
55.0	52	30

Donald Derrick  
Mechanical Testing Supervisor

Sc



Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.



**CHAPEL STEEL CO.**  
**OIL STATES-SKAGIT SMATCO**  
 ASTM A36 PER SPEC "M-36-PL-C" ATTACHED  
 1" X 96.0000" X 120.0000"  
 PART NO.

PO/Rel 4057853

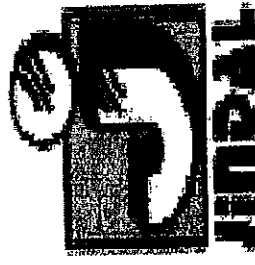
ROBERT

**Certificate of Mill Test Results**  
 SO HOU-030925-001  
 9Mx07  
 Pg 1/1


ATTN:

MET-04  
 TC No.: BR43324-5190-01

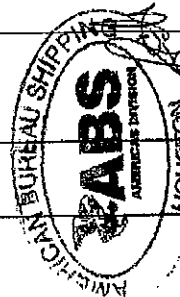
**Jindal United Steel Corporation**  
 5200 E. McKinney Road  
 Baytown, TX 77520



**METALLURGICAL TEST REPORT**

<b>Sold To:</b> CHAPEL STEEL CO. 590 NORTH BETHLEHEM PIKE P.O. BOX 1000 SPRING HOUSE, PA 19477-1000		<b>Ship To:</b> CHAPEL STEEL CO. 6605 N. HOUSTON ROSSLYN RD. HOUSTON, TX 77091		<b>Approved By:</b> 		<b>Bulletin Num.</b> 43324
<b>Order No:</b> JUS2190-08		<b>P.O. Number</b> HOU-2907		<b>Shipping Mode:</b> DIRECT TRUCK		
<b>Date</b> 10/28/2006		<b>DIN</b> 50049 3.1.B / EN 10204 3.1.B				
<b>Specifications:</b> HOT ROLLED PLATE CUT EDGE ASTM/ASME A36 -05 / ABSGR A / B-06 & A709 - 05 GR 36 STRUCTURAL QUALITY						

Insp. "We hereby certify that the material described herein has been made to the application by the B.O.S. process and tested in accordance with the requirements of American Bureau of Shipping Rules with satisfactory results."

Item	Material Description		Bulletin		Heat No.	Gauge Tested	Test/Plate Identity	Test Cond	Yield Point (KSI)	Tensile Strength (KSI)	Elongation (%)		Yield Strength Determined at	LCVN FULL	mm @ 32DEG F
	Gauge	Width	Length	Qty							in 8"	in 2"			
08	1.0000	120.0000	480.0000	2	32,670	1.000	08A	ABS	47	67	29		0.2%	45 - 40 - 40 FULLmm @ 32°F	
<div style="text-align: center;">   <b>HS756919CX</b> </div>															

Heat No.S05190		CE:0.34														
Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Cb
LADLE	0.14	1.09	0.016	0.014	0.23	0.04	0.03	0.05	0.010	0	0.032	0.005	0.005	0.0005	0.005	0.010

3-19-07  




Metallurgical Chemistry and Testing Laboratory

3204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
[metalltesters@an.com](mailto:metalltesters@an.com)

March 8, 2007

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091


P.O. No. 10647/30925  
Report No. 07-0571-2

IDENTIFICATION: 1" x 4" x 6", PLT# H21185, HT# S05190, SL# 08BA  
MATERIAL: ASTM A36, Mfg. CS  
REFERENCE: HOU30925

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
59.0	60	40
58.0	52	40
61.0	61	40

  
Donald Derrick  
Mechanical Testing Supervisor

Sc

Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.

gpc  
INSPECTED  
8  
3-14-07

# GLOBAL X-RAY & TESTING CORPORATION

JOEL MOREAU, President  
Residence: 985-446-6861

Post Office Box 1536  
Morgan City, Louisiana 70381

Bus: 985-631-2426  
Fax: 985-631-0093

## MT WORK REPORT

MT06-07949

GXT-Mpuwm-001-Rev.15

CLIENT Dilstates DATE 8-11-07  
CONTRACTOR Same JOB LOCATION Ind. Avenue  
JOB NO. \_\_\_\_\_ W.O. 23407 AFE \_\_\_\_\_ Other \_\_\_\_\_  
MT TECH. MITCHELL Helmut Level II CLIENT REPRESENTATIVE [Signature]

	WELD NO.	WALL THICKNESS	RECOMMENDATION				WELD NO.	WALL THICKNESS	RECOMMENDATION		
			✓ X	ACCEPT REJECT	REMARKS				✓ X	ACCEPT REJECT	REMARKS
1	100%	MT Insp. of 340L				51					
2						52					
3		lattice boom Base				53					
4						54					
5		mid #1 and mid #2				55					
6						56					
7		✓				57					
8						58					
9						59					
10						60					
11	100%	MT Insp. of Coverup				61					
12						62					
13		areas on 340L lattice				63					
14		boom Point				64					
15						65					
16		✓				66					
17						67					
18						68					
19						69					
20						70					
21		TOTAL weld = 1026				71					
22						72					
23		TOTAL repair = 0"				73					
24						74					
25						75					
26						76					
27						77					
28						78					
29						79					
30						80					
31											
32											
33											
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40											
41											
42											
43											
44											
45											
46											
47											
48											
49											
50											

6 cows highlite

### SURFACE CONDITION

GOOD (✓) FAIR ( ) PAINTED ( ) WELD ( )

### EQUIPMENT

MAKE Edwards MODEL ES-X S/N 9453

### CONTACTS

PROD SPACING 3"-6" CONTINUOUS (✓)  
AC (✓) DC ( ) HALF WAVE (✓) FULL WAVE ( )  
AMPS 5.25

### MEDIA

7C-BLACK WET (✓) 8A-DRY ( ) WHITE HIGHLIGHTER (✓)

### CALIBRATION

10# WEIGHT LIFT (✓) FLUX IND. CHECK (✓)  
CALIBRATION DATE: 8-11-07

### ACCEPTANCE CRITERIA

AWS D11 Sec 6.1.1.1.1  
Latest edition

TOTAL TIME HRS. 6

**GLOBAL X-RAY & TESTING CORPORATION**Post Office Box 1536  
Morgan City, Louisiana 70381JOEL MOREAU, President  
Residence: 985-446-6861Bus: 985-631-2426  
Fax: 985-631-0093**MT WORK REPORT**

HMH 20070831-3

CLIENT Oilstates DATE 08/31/07  
CONTRACTOR Same JOB LOCATION Ind. Avenue  
JOB NO. W.O. 23407 AFE OTHER  
UT TECH Mitchell Hebert/Level III mitchell hebert CLIENT'S REPRESENTATIVE Brent Baggett

WELD NO.	WALL THICKNESS	RECOMMENDATION		REMARKS	WELD NO.	WALL THICKNESS	RECOMMENDATION		REMARKS
		✓ X	ACCEPT REJECT				✓ X	ACCEPT REJECT	
1	100%	MT Insp.		of	51				walkway supports
2	on	340L			52				Lattice Boom
3	Base,	Point,		Mid#1	53				and Mid#2
4					54				
5			/		55				
6					56				
7					57				
8					58				
9					59				
10	TOTAL	WELD=	420"		60				
11					61				
12	TOTAL	REPAIR=	0"		62				
13					63				
14					64				
15					65				
16					66				
17					67				
18					68				
19					69				
20					70				
21					71				
22					72				
23					73				
24					74				
25					75				
26					76				
27					77				
28					78				
29					79				
30					80	2cans	Highlighter		
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									

**SURFACE CONDITION**  
GOOD ☒ FAIR ☐ PAINTED ☐ WELD ☒

**EQUIPMENT**  
MAKE Electrospec MODEL E5-X S/N 9453

**CONTACTS**  
PROD SPACING 3"-6" CONTINUOUS ☒  
AC ☒ DC ☐ HALF WAVE ☒ FULL WAVE ☐

**MEDIA**  
7C BLACK WET ☒ 8A DRY ☐ WHT CONTRAST ☒

**CALIBRATION**  
10# LIFT ☒ FLUX CHECK ☒ DATE: 08/31/07

**ACCEPTANCE CRITERIA**  
AWS D1.1 SEC 6.10/ EXT-MPV-WM-001 REV 16

Substances \_\_\_\_\_  
Auto Transport Miles \_\_\_\_\_  
Travel Time Hrs. \_\_\_\_\_  
Work Time Hrs. \_\_\_\_\_  
Standby Time Hrs. \_\_\_\_\_  
Total Time Hrs. 2Hrs.

# OCEANEERING® INSPECTION

REPORT NO. 408949

(985) 868-5097

## DAILY WORK REPORT

ISO 9002 Certified

Houma, LA  
(985) 868-5097  
New Iberia, LA  
(337) 365-7102  
Ingleside, TX  
(361) 776-7251

MAILING ADDRESS  
Sta. 1 Box 10267  
Houma, LA 70363

Customer <b>OIL STATES</b>	Job Location <b>Houma LA</b>	Inspection Date / Time <b>10-4-07</b>
Billing Address	Project <b>2340202</b>	Oil Job Number <b>57348</b>
	P.O. #	PKC / AFF # <b>LATEST EDITION</b>
	S.S. Procedure # <b>AWS MF02 Rev1</b>	Acceptance Criteria <b>AWS D1.6-1</b>

AD = Accumulations of Discontinuities    ESI = Elongated Slag Inclusion    IFD = Incomplete Fusion Due to Cold Lap    LC = Low Crown  
 BT = Burn Through    EU = External Undercut    IP = Inadequate Penetration    NW = Narrow Weld  
 BTA = Burn Through Area    HB = Hollow Bead    IPD = Inadequate Penetration Due to High Low    P = Porosity  
 C = Crack/Cracks    IC = Internal Concavity    ISI = Isolated Slag Inclusions    IU = Internal Undercut  
 CP = Cluster Porosity    IF = Incomplete Fusion

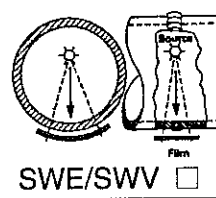
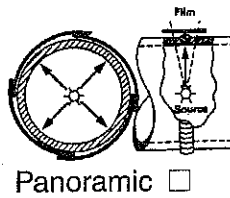
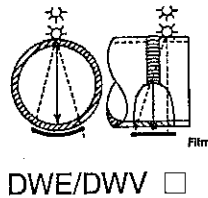
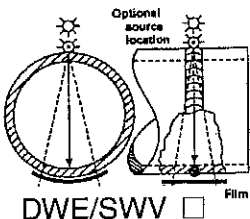
Job Description: **WET MAG Exam of:**

RECOMMENDATION					RECOMMENDATION				
WELD NO.	PIPE SIZE	✓ X	ACCEPT REJECT	REMARKS	WELD NO.	PIPE SIZE	✓ X	ACCEPT REJECT	REMARKS
1					31				
2	Link, pendant N 61597-001				32				
3					33				
4					34				
5					35				
6					36				
7					37				
8					38				
9					39				
10	100% M.T. of All welds on 2 PCS.				40				
11					41				
12					42				
13					43				
14					44				
15				welding stencil	45				
16					46				
17				✓ Acc K	47				
18					48				
19					49				
20					50				
21					51				
22					52				
23					53				
24					54				
25					55				
26					56	All Carls			
27					57				
28					58				
29					59				
30					60				

Technique: check exposure setup

SFD

Thickness





Film Delivered to: SS Manager: _____	Client: _____	Customer Representative: <b>B. J. R. R.</b>
X-Ray: _____ MAK V: _____	Gamma Ray: _____	Curies: _____
No. of Welds Checked: _____	Focal Size: _____	Ug: _____
Linear Ft. Film: _____	Type: _____	Instrument: <b>EX 115</b>
Penetrator-A _____ B _____ C _____	Required wire: _____	Angles Used: <b>370 6" SPACE</b>
Dye Penetrant: _____	Ultrasonic: _____	Magnetic Particle: <input checked="" type="checkbox"/>
Hours Worked: <b>2</b>	Travel Time: _____	Mileage: _____
Sheet # <b>1</b> of <b>1</b>	Subsistence (check if applicable): _____	Consumables: <input checked="" type="checkbox"/>
		Specifications: _____

Oceaneering Inspection has furnished this Examination Report of weldments as a good faith interpretation. Acceptance or rejection of welding discontinuities to the clients specific codes and/or standards shall not infer any warrantee or liability on the part of Oceaneering Inspection as to the fitness for service of such weldments and their intended use by the client.



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# Material Traceability Log

CRANE WO. NO.:	23407
CUSTOMER:	PEMEX
WELDMENT PART NO.:	N61587-020
WELDMENT S/N:	C07101-04
DESCRIPTION:	Boom Insert Weldment (Mid # 2 – 30")
MODEL:	340LA-80
CHECKED BY:	
DATE:	

[illegible]

Atlas ABC Corp (Atlas Tube Chicago)  
1855 East 122nd Street  
Chicago, Illinois, USA  
60633  
Tel: 773-646-4500  
Fax: 773-646-6128



Ref.B/L: 80207438  
Date: 12.13.2006  
Customer: 193

**Sold to**

Tubular Steel  
1031 Executive Parkway  
ST. LOUIS MO 63141  
USA

**MATERIAL TEST REPORT****Shipped to**

Tubular Steel  
27700 Highway Blvd.  
KATY TX 77493  
USA

Material: 4.0x4.0x500x40"0(4x2)NMHROPS1  
Sales order: 222099

Material No: 40040500

Made in: USA

Purchase Order: 4116 HOT NEXT TRUCK!

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V
Y28079	0.080	0.810	0.014	0.006	0.044	0.044	0.030	0.018	0.004	0.010	0.040	0.001

Bundle No	Yield	Tensile	Eln.2in
M900034653	069230 Psi	078140 Psi	33 %

Certification

ATLAS ROPS 1

Material Note:

Sales Or.Note: ALSO MEETS ASTM A500-03A GRADE C &amp; B

Material: 4.0x4.0x500x32"0(4x2)NMHROPS1  
Sales order: 222099

Material No: 40040500

Made in: USA

Purchase Order: 4116 HOT NEXT TRUCK!

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V
Y28080	0.070	0.820	0.015	0.005	0.047	0.032	0.020	0.015	0.005	0.010	0.030	0.001

Bundle No	Yield	Tensile	Eln.2in
M800034686	072230 Psi	078320 Psi	32 %

Certification

ATLAS ROPS 1

Material Note:

Sales Or.Note: ALSO MEETS ASTM A500-03A GRADE C &amp; B

Material: 4.0x4.0x500x32"0(4x2)NMHROPS1  
Sales order: 222099

Material No: 40040500

Made in: USA

Purchase Order: 4116 HOT NEXT TRUCK!

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V
Y28080	0.070	0.820	0.015	0.005	0.047	0.032	0.020	0.015	0.005	0.010	0.030	0.001

Bundle No	Yield	Tensile	Eln.2in
M900034695	072230 Psi	078320 Psi	32 %

Certification

ATLAS ROPS 1

Material Note:

Sales Or.Note: ALSO MEETS ASTM A500-03A GRADE C &amp; B

Material: 4.0x4.0x500x32"0(4x2)NMHROPS1  
Sales order: 222099

Material No: 40040500

Made in: USA

Purchase Order: 4116 HOT NEXT TRUCK!

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V
Y28080	0.070	0.820	0.015	0.005	0.047	0.032	0.020	0.015	0.005	0.010	0.030	0.001

Bundle No	Yield	Tensile	Eln.2in
M900034694	072230 Psi	078320 Psi	32 %

Certification

ATLAS ROPS 1

Material Note:

Sales Or.Note: ALSO MEETS ASTM A500-03A GRADE C &amp; B

Authorized by Quality Assurance:

Page: 1 Of 2



081  
76  
11-11-07



Atlas ABC Corp (Atlas Tube Chicago)  
1855 East 122nd Street  
Chicago, Illinois, USA  
60633  
Tel: 773-648-4500  
Fax: 773-648-6128



Ref.B/L: 80207438  
Date: 12.13.2006  
Customer: 193

**Sold to**

Tubular Steel  
1031 Executive Parkway  
ST. LOUIS MO 63141  
USA

**MATERIAL TEST REPORT****Shipped to**

Tubular Steel  
27700 Highway Blvd.  
KATY TX 77493  
USA

Material: 4.0x4.0x500x40"0(4x2)NMHROPS1  
Sales order: 222099

Material No: 40040500

Made in: USA

Purchase Order: 4116 HOT NEXT TRUCKI

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V
Y28079	0.080	0.810	0.014	0.006	0.044	0.044	0.030	0.018	0.004	0.010	0.040	0.001

Bundle No	Yield	Tensile	Eln.2in
M900034852	069230 Psi	078140 Psi	33 %

Certification

ATLAS ROPS 1

Material Note:

Sales Or.Note: ALSO MEETS ASTM A500-03A GRADE C &amp; B

Material: 4.0x4.0x500x32"0(4x2)NMHROPS1  
Sales order: 222099

Material No: 40040500

Made in: USA

Purchase Order: 4116 HOT NEXT TRUCKI

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V
Y28080	0.070	0.820	0.015	0.005	0.047	0.032	0.020	0.015	0.005	0.010	0.030	0.001

Bundle No	Yield	Tensile	Eln.2in
M900034693	072230 Psi	078320 Psi	32 %

Certification

ATLAS ROPS 1

Material Note:

Sales Or.Note: ALSO MEETS ASTM A500-03A GRADE C &amp; B

Material: 4.0x4.0x500x30"0(5x3)NMHROPS1  
Sales order: 222098

Material No: 40040500

Made in: USA

Purchase Order: 4116 HOT NEXT TRUCKI

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V
Y28080	0.070	0.820	0.015	0.005	0.047	0.032	0.020	0.015	0.005	0.010	0.030	0.001

Bundle No	Yield	Tensile	Eln.2in
M900034697	072230 Psi	078320 Psi	32 %

Certification

ATLAS ROPS 1

Material Note:

Sales Or.Note: ALSO MEETS ASTM A500-03A GRADE C &amp; B

Authorized by Quality Assurance:

Page : 2 Of 2

Atlas ABC Corp (Atlas Tube Chicago)  
1855 East 122nd Street  
Chicago, Illinois, USA  
60633  
Tel: 773-646-4500  
Fax: 773-646-6128



AUG 21 2006

## MATERIAL TEST REPORT

Heat No	C	Mn	P	S	Si	Al	Cu	Cl	Mo	Ni	Cr	V
Y28079	0.080	0.810	0.014	0.006	0.044	0.044	0.030	0.018	0.004	0.010	0.040	0.001

Material	Yield	Tensile	Elo. 2in	Certification
4 X 4 X .500	069230 Psi	078140 Psi	33 %	

Impact Values Req.	Sample Size	Absorbed Energy1 FT-LBS	CHARTY Test Results Absorbed Energy2 FT-LBS	Absorbed Energy3 FT-LBS	Avg FT-LBS	ATLAS ROPS I
TEST @ -22F 10x10 mm	14	174	10	66		

Authorized by Quality Assurance:

*Carrie Lauritzen*

Page : 1 Of 1



DATE: 01/01/07  
TIME: 04:16:44  
SERIAL NO: I0014862

TUBULAR PRODUCT'S  
CERTIFIED TEST REPORT

IN ACCORDANCE WITH ISO 10474/EN10204/DIN50049 3.1.b)

MILL ORDER ITEM NO DR37884 01	SHIPPERS NO. R70811	P.O. NUMBER 06-19103	VEHICLE ID LT8138	VENDOR USS TUBULAR PRODUCTS 2199 EAST 28TH ST. LORAIN, OH 44055
SOLD TO ADDRESS PIPE DISTRIBUTORS LTD P O BOX 23237 HOUSTON TX 77228-3237		MAIL TO ADDRESS PIPE DISTRIBUTORS LTD P O BOX 23237 HOUSTON TX 77228-3237		

## SPECIFICATION AND GRADE

PIPE CARBON SMLS STD PIPE API 5L-43RD EDITION DATED 3/04 PSL-1 GRADE B ASTM A53-05 GRADE B ASME SA53-2004 EDITION GRADE B ASTM A106-04B GRADE B/C ASME SA106-2004 EDITION GRADE B/C BLK REG MILL

MATERIAL COND.: AS ROLLED				O.D.: 1.900 ( 48.260 )		WALL: 0.145 ( 3.683 )		IN (mm)		IT (mm)								
TENSILE		TEST TYPE/ ORIENTATION	GAUGE WIDTH IN	YIELD		EXT % PSI	TENSILE	Y/T	ELONG % (IN.2" )	HARDNESS	MIN HYDRO PSI	DWELL(SEC)						
TEST TYPE/ ORIENTATION	MIN: MAX:			PSI	MIN: MAX:		SCALE:HRB			MIN: MAX:								
B27156	STRIP/L/B	AR	0.750	52500	.50		76000	0.69	33.0	B 70.7	2500	5						
B27447	STRIP/L/B	AR	0.750	51500	.50	**	75500	0.68	34.0	B 78.7	2500	5						
				** END OF DATA THIS SHEET **														
LEGEND:		L - LONGITUDINAL U - UPSET	T - TRANSVERSE NM - NORMALIZED	QT - QUENCH & TEMPERED SR - STRESS RELIEVED			AR - AS ROLLED			B - BODY		W - WELD						
PRODUCT IDENTIFICATION	TYPE	C	MN	P	S	SI	CU	NI	CR	MO	AL	N	V	B	TI	CB	CD	C.E.*
B27156	HEAT	19	1.06	0.09	0.02	1.8	.03	.04	09	03	034		.00	0001	.002	.001		.40
B27156	PROD	20	1.06	0.09	0.03	1.8	.03	.04	09	03	031		.00	0001	.001	.001		.41
B27156	PROD	18	1.05	0.08	0.03	1.8	.03	.04	09	03	031		.00	0000	.001	.001		.39
B27447	HEAT	19	1.05	0.09	0.04	1.8	.04	.02	07	02	035		.00	0002	.001	.001		.39
B27447	PROD	20	1.08	0.09	0.04	1.9	.03	.02	07	02	034		.00	0000	.001	.001		.41
B27447	PROD	20	1.08	0.09	0.05	1.9	.03	.02	07	02	033		.00	0001	.001	.001		.40
				** END OF DATA THIS SHEET **														
*C.E. IS BASED ON THE FOLLOWING EQUATION(S): CE=C+(MN/6)+(CR+MO+V)/5+(NI+CU)/15																		

CR = C ÷ (MN / 6) + (CR + MO + V) / 5 + (NI + CU) / 15

DECIMAL POSITIONS FOR ELEMENTS ARE INDICATED BY THE LEFT MARGIN, VERTICAL DOTTED LINE OR DECIMAL POINT.

PAGE: 1 OF 2

Ca. 1. 2. 3.

DATE: 01/01/07  
TIME: 04:16:44  
SERIAL NO: 10014862

**UNITED STATES STEEL**  
**TUBULAR PRODUCTS**  
**CERTIFIED TEST REPORT**  
**(IN ACCORDANCE WITH ISO 10474/EN10204/DIN50049 3.1.b)**



MILL ORDER ITEM NO DR37884 01		SHIPPER'S NO. R70811		P.O. NUMBER 06-19103		Q.D. 1.900 ( 48.260 )		WALL THICKNESS 0.145 ( 3.683 )		P.O. NUMBER 0024707	
MATERIAL COND: AS ROLLED		MIN COLLAPSE		DIR		TEST LOC		TEMP		SIZE	
PRODUCT IDENTIFICATION B27156 B27447		FLAT		BEND		GRAIN SIZE		END OF DATA THIS SHEET **		HAZ - HEAT AFFECTED ZONE	
LEGEND		L - LONGITUDINAL		T - TRANSVERSE		B - BODY		W - WELD		HAZ - HEAT AFFECTED ZONE	
TEST / INSPECTION		YES		TESTING / INSPECTION INFORMATION		RESULTS / COMMENTS					
FULL LENGTH VISUAL		X		OD		OD/ID		L		L/T	
FULL LENGTH EMI				ID		OD/ID		L		L/T	
FULL LENGTH MPI				MPI		UT					
FULL LENGTH UT				MPI		UT					
END AREA INSPECTION (PLAIN END)				DRIFT MANDREL SIZE:							
SPECIAL END AREA (SEA) INSP											
FULL LENGTH DRIFT											
ADDITIONAL NOTES/COMMENTS											
MELTED AND MANUFACTURED IN THE USA. NO REPAIRS BY WELDING. NO MERCURY OR MERCURY COMPOUNDS ARE ADDED TO THE STEEL AND ALL MERCURY BEARING EQUIPMENT IS PROTECTED BY A DOUBLE BOUNDARY OF CONTAINMENT.											

THIS IS TO CERTIFY THAT THE PRODUCT DESCRIBED HEREIN WAS MANUFACTURED, SAMPLED, TESTED AND/OR INSPECTED IN ACCORDANCE WITH THE SPECIFICATION AND FULFILLS THE REQUIREMENTS IN SUCH RESPECTS.

PREPARED BY THE OFFICE OF: J. MAJURZAK - MANAGER, Q. A.

DATE 01/01/07

PAGE 2 OF 2

\*\*

2-19-07

CHAPEL STEEL CO.  
OIL STATES-SKAGIT-SMAICO  
ASTM A36 PER SPEC "M-36-PL-C" ATTACHED  
1/2" X 96.0000" X 120.0000"  
PART NO.

PO/Ref: 1058488

Certificate of Mill Test Results

28 Mar 07  
Pg 1/1



Jindal United Steel Corporation  
5200 E. McKinney Road  
Baytown, TX 77520

TC No.: BR10J027-6179-01

METALLURGICAL TEST REPORT

Sold To: CHAPEL STEEL CO. 590 NORTH WETHELEHAM PKWY P.O. BOX 1600 SPRING HOUSE, PA 19477-1000		Ship To: CHAPEL STEEL CO. 6605 N HOUSTON ROSSLYN RD. HOUSTON, TX 77091		This is to certify that the product described herein was manufactured, sampled, and tested in accordance with the specifications and requirements in such specifications: Fine Grain, Si-AL Fully Killed Steel		Rolled Numr. 101027	
Order No: JUS2561-02		P.O. Number HOU-3188		Approved By: <i>Helen Green</i>			
Date 2/28/2007		Shipping Mode: DIRECT TRUCK		DIN 50049 3.1 B / EN 10204 3.1 B			

Specifications:  
HOT ROLLED PLATE CUT HINGE ASTM/A516-01 / ABSGR A / R & A709 - 45 GR  
36 STRUCTURAL QUALITY

Item	Material Description			Bulletin		Heat No.	Gage Tested	Test/Plate Identity	Test Coual	Yield Point (KSI)	Tensile Strength (KSI)	Elongation (%)		Yield Strength Determined at
	Gauge	Width	Length	Qty	Wgt							In 8"	In 2"	
02	0.5000	96.0000	480.0000	3	19,602	S06179	0.500 0.500	01D 01C	ABS ABS	48 48	66 66	26 25		0.2% 0.2%
HIS-805513-A														

Heat No. S06179 CE-0.31														
Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Me	Sn	Al	N	V	Ch
LADLE	0.12	1.07	0.013	0.009	0.22	0.03	0.02	0.04	0.010	0.001	0.031	0.004	0.0025	0.005

*Metallurgical Chemistry and Testing Laboratory*

3204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
[metall@anlabs.com](mailto:metall@anlabs.com)

March 27, 2007

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/31146  
Report No. 07-739-3

IDENTIFICATION: 1/2" x 4" x 6", HT# S06179, SL# 08BC  
MATERIAL: ASTM A 36

IMPACT TEST

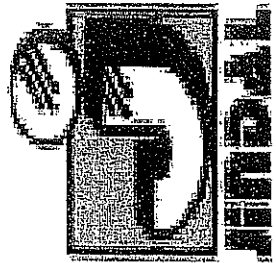
10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
118.0	95	70
118.0	81	60
115.0	92	60

mm



Donald Derrick  
Mechanical Testing Supervisor



# Jindal United Steel Corporation

5200 E. McKinney Road  
Baytown, TX 77520

## METALLURGICAL TEST REPORT

MET-04  
TC No.: BR101680-6170-01

<b>Sold To:</b> CHAPEL STEEL CO. 590 NORTH BETHLEHEM PIKE P.O. BOX 1000 SPRING HOUSE, PA 19477-1000		<b>Ship To:</b> CHAPEL STEEL CO. 6605 N. HOUSTON ROSSLYN RD. HOUSTON, TX 77091		This is to certify that the product described herein was manufactured, sampled, and tested in accordance with the specifications and requirements in such specifications. Fine Grain, Si-AL Fully Killed Steel		Bulletin Num. 101680																									
<b>Order No:</b> JUS2620-07		<b>Date:</b> 4/16/2007		<b>Approved By:</b> <i>J. Aguilera / Amargo</i>																											
<b>Plates Manufactured in the USA</b>		<b>P.O. Number:</b> HOU-3243		<b>Shipping Mode:</b> DIRECT TRUCK																											
<b>Certified by ISO 9001:2000</b>		<b>Date:</b> 4/16/2007		<b>DN:</b> 50049 3.1.B / EN 10204 3.1.B																											
<b>Specifications:</b> HOT ROLLED PLATE CUT EDGE ASTM/ASME A36-05 / ABSGR A / B & A709 - 05 GR 36 STRUCTURAL QUALITY				<b>Insp.</b>		"We hereby certify that the material described herein has been made to the application by the B.O.S. process and tested in accordance with the requirements of American Bureau of Shipping Rules with satisfactory results."																									
<b>Material Description</b>		<b>Bulletin</b>		<b>Test/Plate Identity</b>		<b>Yield Point (KSD)</b>		<b>Tensile Strength (KSD)</b>		<b>Elongation (%)</b>		<b>Yield Strength Determined at</b>		<b>LCVN</b>																	
<b>Item No.</b>	<b>Gauge</b>	<b>Width</b>	<b>Length</b>	<b>Qty</b>	<b>Wgt</b>	<b>Heat No.</b>	<b>Gauge Tested</b>	<b>Test/Plate Identity</b>	<b>Gauge Tested</b>	<b>Heat No.</b>	<b>Yield Point (KSD)</b>	<b>Tensile Strength (KSD)</b>	<b>Elongation (%)</b>	<b>Yield Strength Determined at</b>	<b>LCVN</b>																
07	2.0000	96.0000	480.0000	1	26,137	S06170	2.000	04A	AR	44	72	34	0.2%	108 - 70 - 81 FULL min @ 32°F	25 FT/LBS																
<div style="text-align: center;"></div>																															
																APR 17 2007															
																H3822764A X															
<b>Heat No. S06170 CE-0.38</b>																															
<b>Test Type</b>		<b>C</b>	<b>Mn</b>	<b>P</b>	<b>S</b>	<b>Si</b>	<b>Cu</b>	<b>Ni</b>	<b>Cr</b>	<b>Mo</b>	<b>Sn</b>	<b>Al</b>	<b>N</b>	<b>V</b>	<b>B</b>	<b>Ti</b>	<b>Cb</b>														
LADLE		0.17	1.14	0.015	0.004	0.25	0.04	0.03	0.04	0.010	0.001	0.033	0.005	0.005	0.0005	0.005	0.010														



Metallurgical Chemistry and Testing Laboratory

3204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7801  
FAX: (713) 644-1400  
metallab@an-tech.com

Page 1 of 1

April 24, 2007

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/31453  
Report No. 07-0994

IDENTIFICATION: 2" x 4" x 6", HT# S06170, SL# 04A-A  
MATERIAL: ASTM A36, Mfg. Jin

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
56.0	54	30
45.0	43	20
55.0	52	30

Donald Derrick  
Mechanical Testing Supervisor

Sc



Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.

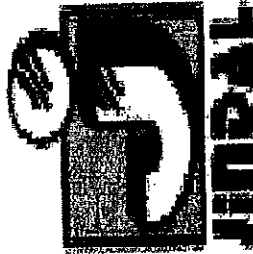


PO/Rel 4057853- ROBERT

## Atéris

**MPET-04**

TC No.: BR43324-5190-01

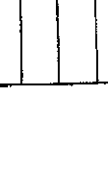


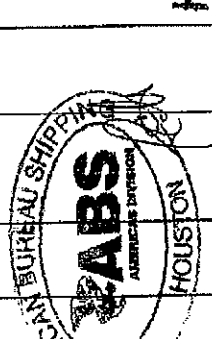
# Jindal United Steel Corporation

5200 E. McKinney Road

Baytown, TX 77520

# METALLURGICAL TEST REPORT

<b>SHIP TO:</b> CHAPEL STEEL CO. 590 NORTH BETHLEHEM PIKE P.O. BOX 1000 SPRING HOUSE, PA 19477-1000				<b>SHIP TO:</b> CHAPEL STEEL CO. 6605 N HOUSTON ROSSLYN RD. HOUSTON, TX 77091				<b>Ship To:</b> CHAPEL STEEL CO. 6605 N HOUSTON ROSSLYN RD. HOUSTON, TX 77091				<b>Ship To:</b> CHAPEL STEEL CO. 6605 N HOUSTON ROSSLYN RD. HOUSTON, TX 77091											
<b>Order No:</b> JUS2190-08				<b>P.O. Number</b> HOU-2907				<b>Order No:</b> JUS2190-08				<b>P.O. Number</b> HOU-2907											
<b>Date</b> 10/20/2006				<b>Plates Manufactured in the USA</b>				<b>Date</b> 10/20/2006				<b>P.O. Number</b> HOU-2907											
<b>Specifications:</b> HOT ROLLED PLATE CUT EDGE ASTM/AASME A36 -05 / ABSGR A / B-06 & A709 - 05 GR 36 STRUCTURAL QUALITY				<b>Insp.</b>				<b>Shipping Mode:</b> DIRECT TRUCK DIN 50049 3.1.B / EN 10204 3.1.B				<b>Approved By:</b> 											
This is to certify that the product described herein was manufactured, sampled, and tested in accordance with the specifications and requirements in such specifications. Fine Grain, Si-AL Fully Killed Steel												We hereby certify that the material described herein has been made to the application by the B.O.S. process and tested in accordance with the requirements of American Bureau of Shipping Rules with satisfactory results.											

Material Description				Bulletin		Heat No.	Gauge Tested	Test/Plate Identity	Test Cond	Yield Point (KSI)	Tensile Strength (KSI)	Elongation (%)		Yield Strength Determined at	LCVN
Item	Gauge	Width	Length	Qty	Wgt							in 8"	in 2"		
08	1.0000	120.0000	480.0000	2	32.670	S05190	1.000	08A	ABS	47	67	29		0.29%	FULL mm @ 32DEG F 25 FT/LBS 45 - 40 - 40 FULLmm @ 32°F
															
<b>HS756919CX</b>															

Heat No. S05190 CE-0.34																	
Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Su	Al	N	V	B	Ti	Cb	
LADLE	0.14	1.09	0.016	0.014	0.23	0.04	0.03	0.05	0.010	0	0.032	0.005	0.005	0.0005	0.005	0.010	

3-19-60  
U.S. DEPT. OF JUSTICE  
RECEIVED



Metallurgical Chemistry and Testing Laboratory

3204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
[metalltesters@an.com](mailto:metalltesters@an.com)

March 8, 2007

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091


P.O. No. 10647/30925  
Report No. 07-0571-2

IDENTIFICATION: 1" x 4" x 6", PLT# H21185, HT# S05190, SL# 08BA  
MATERIAL: ASTM A36, Mfg. CS  
REFERENCE: HOU30925

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
59.0	60	40
58.0	52	40
61.0	61	40

  
Donald Derrick  
Mechanical Testing Supervisor

Sc

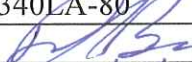

Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.

  
3-14-07



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# Material Traceability Log

CRANE WO. NO.:	23407
CUSTOMER:	PEMEX
WELDMENT PART NO.:	N61588-001
WELDMENT S/N:	C07101-05
DESCRIPTION:	Boom Point Weldment
MODEL:	340LA-80
CHECKED BY:	
DATE:	9/7/07 

[illegible]

222 Cavalcade Street, 77009-3213  
P.O. Box 8768, Houston, Texas 77249-8768  
Tel: (713) 692-9151 Fax: (713) 696-6205

*Attention: Accounts Payable*  
**TUBULAR STEEL, INC.**  
1031 Executive Parkway Dr.  
Saint Louis, MO 63141  
P: 314-851-9200 / F: 314/851-9336

W/O. No.: TUB035-09-20-19048-1  
P.O. No.: 17449  
Report Date: 9/22/2006  
Rev. 1:

Heat #: Y28080  
Description: 4.0" OD x 4.0 OD x 0.50" W  
Material: ROPS TUBING

**CHARPY TEST RESULTS**

Specification: Per Client  
Test Method: ASTM A370-05 / ASTM E23-06  
Direction: Longitudinal  
Specimen Size: 10mm x 10mm x 2mmV

Test Temperature: +10°F  
Specimen Type: ASTM Type A

Specimen	Location	Impact Value (Ft.Lbs)				Lateral Expansion (Mils)			Percent Shear Fracture (%)		
		Individual		Avg.							
Requirements		15		20		---			---		
1,2,3	NA	24	197	115	112	17	74	58	30	100	90

The samples tested met the specification charpy requirements.



*Handwritten signature and date: 9/27-06*



**Certificate Number 1480-05**

**Respectfully Submitted:**

*Handwritten signature of Tom Jarvie*  
Tom Jarvie  
Manager, Fracture Mechanics

Our letters and reports are for the exclusive use of the client to whom they are addressed and shall not be reproduced except in full without the approval of the testing laboratory. The use of our name must receive our written approval. Our letters and reports apply only to the sample tested and/or inspected, and are not indicative of the quantities of apparently identical or similar products. Material submitted to our metals department will be discarded after a period of 30 days unless otherwise directed.

Stork SWL, is an operating unit of Stork Materials Technology B.V., Amsterdam, The Netherlands, which is a member of the Stork group

Atlas ABC Corp (Atlas Tube Chicago)  
1855 East 122nd Street  
Chicago, Illinois, USA  
60633  
Tel: 773-848-4600  
Fax: 773-640-6128



Ref. B/L: 80207438  
Date: 09.06.2006  
Customer: 193

**Sold to**

Tubular Steel  
1031 Executive Parkway  
ST. LOUIS MO 63141  
USA

**MATERIAL TEST REPORT****Shipped to**

Tubular Steel  
27700 Highway Blvd.  
KATY TX 77493  
USA

Material: 4.0x4.0x500x40"0"0(4x2)NMHROPS1

Material No: 40040500

Made in: USA

Sales order: 222099

Purchase Order: 4116 HOT NEXT TRUCK!

Heat No	C	Mn	P	S	Si	Al	Cu	Ch	Mo	Ni	Cr	V
Y28079	0.080	0.810	0.014	0.008	0.044	0.044	0.030	0.018	0.004	0.010	0.040	0.001

Bundle No

Yield

Tensile

Elm. 2in

Certification

M900034653

069230 Psi

078140 Psi

33 %

ATLAS ROPS 1

Material Note:

Sales Or. Note:

Material: 4.0x4.0x500x32"0"0(4x2)NMHROPS1

Material No: 40040500

Made in: USA

Sales order: 222099

Purchase Order: 4116 HOT NEXT TRUCK!

Heat No	C	Mn	P	S	Si	Al	Cu	Ch	Mo	Ni	Cr	V
Y28080	0.070	0.820	0.015	0.008	0.047	0.032	0.020	0.018	0.008	0.010	0.030	0.001

Bundle No

Yield

Tensile

Elm. 2in

Certification

M900034656

072230 Psi

078320 Psi

32 %

ATLAS ROPS 1

Material Note:

Sales Or. Note:

Material: 4.0x4.0x500x32"0"0(4x2)NMHROPS1

Material No: 40040500

Made in: USA

Sales order: 222099

Purchase Order: 4116 HOT NEXT TRUCK!

Heat No	C	Mn	P	S	Si	Al	Cu	Ch	Mo	Ni	Cr	V
Y28080	0.070	0.820	0.015	0.008	0.047	0.032	0.020	0.018	0.008	0.010	0.030	0.001

Bundle No

Yield

Tensile

Elm. 2in

Certification

M900034658

072230 Psi

078320 Psi

32 %

ATLAS ROPS 1

Material Note:

Sales Or. Note:

Material: 4.0x4.0x500x32"0"0(4x2)NMHROPS1

Material No: 40040500

Made in: USA

Sales order: 222099

Purchase Order: 4116 HOT NEXT TRUCK!

Heat No	C	Mn	P	S	Si	Al	Cu	Ch	Mo	Ni	Cr	V
Y28080	0.070	0.820	0.015	0.008	0.047	0.032	0.020	0.018	0.008	0.010	0.030	0.001

Bundle No

Yield

Tensile

Elm. 2in

Certification

M900034654

072230 Psi

078320 Psi

32 %

ATLAS ROPS 1

Material Note:

Sales Or. Note:

Authorized by Quality Assurance



09/13/2006 15:38 281-371-5204  
09/13/2006 10:19 3148519338  
09/13/2006 09:56 281-371-5204

TUBULAR STEEL, TEXAS  
TUBULAR STEEL INC  
TUBULAR STEEL, TEXAS

PAGE 10/1  
PAGE 01  
PAGE 02

Atlas ABC Corp (Atlas Tube Chicago)  
1856 East 122nd Street  
Chicago, Illinois, USA  
60633  
Tel: 773-646-4500  
Fax: 773-646-6128

Ref.B/L: 80207438  
Date: 09.06.2008  
Customer: 193



## MATERIAL TEST REPORT

### Sold to

Tubular Steel  
1031 Executive Parkway  
ST. LOUIS MO 63141  
USA

### Shipped to

Tubular Steel  
27700 Highway Blvd.  
KATY TX 77493  
USA

Material: 4.0x4.0x500x40\*0\*(14x2)NMHROPS1

Material No: 40040500

Made in: USA

Sales order: 222099

Purchase Order: 4116 HOT NEXT TRUCKI

Heat No	C	Mn	P	S	Si	Al	Cu	Cr	Mo	Ni	Cr	V
Y28079	0.080	0.810	0.014	0.006	0.044	0.044	0.030	0.018	0.004	0.010	0.040	0.001

Bundle No

Yield

Tensile

Eln.2in

Certification

M900034852

069230 Psi

078140 Psi

33 %

ATLAS ROPS 1

Material Note:

Sales Or.Note:

Material: 4.0x4.0x500x32\*0\*(14x2)NMHROPS1

Material No: 40040500

Made in: USA

Sales order: 222099

Purchase Order: 4116 HOT NEXT TRUCKI

Heat No	C	Mn	P	S	Si	Al	Cu	Cr	Mo	Ni	Cr	V
Y28080	0.070	0.820	0.015	0.005	0.047	0.032	0.020	0.016	0.005	0.010	0.030	0.001

Bundle No

Yield

Tensile

Eln.2in

Certification

M900034893

072230 Psi

078320 Psi

32 %

ATLAS ROPS 1

Material Note:

Sales Or.Note:

Material: 4.0x4.0x500x30\*0\*(15x3)NMHROPS1

Material No: 40040500

Made in: USA

Sales order: 222099

Purchase Order: 4116 HOT NEXT TRUCKI

Heat No	C	Mn	P	S	Si	Al	Cu	Cr	Mo	Ni	Cr	V
Y28080	0.070	0.820	0.015	0.006	0.047	0.032	0.020	0.015	0.005	0.010	0.030	0.001

Bundle No

Yield

Tensile

Eln.2in

Certification

M900034897

072230 Psi

078320 Psi

32 %

ATLAS ROPS 1

Material Note:

Sales Or.Note:

Authorized by Quality Assurance:

Page : 2 of 2



01/11/2006 9:38:58 AM -0400 Copperweld Corp.

PAGE 3 OF 3



ATLAS ABC CORPORATION  
1855 E. 122nd Street  
CHICAGO, IL 60633  
TEL: 773-646-4500

## TEST REPORT

Customer Order No.

4890

Internal Order No. 152438

Invoice No. 19191283

Date 01/11/06

Customer:										Specification:									
TUBULAR STEEL 1031 EXECUTIVE PARKWAY DRIVE ATTN: BONNIE WALKER TEST REPORTS ST. LOUIS, MO 63141-6351										3 IN, SQ; 1/4 26 Ft KOMATSU LW0940									
HEAT NO.		CHEMICAL ANALYSIS, %																	
		C	Mn	P	S	SI	AL	CB	V	CU	NI	CR	E						
E05413*	C.E.	.32	.13	1.13	.010	.007	.20	.041	.001	.001	.010	.010	.020	.0002					
M07140~*	C.E.	.33	.14	1.15	.017	.008	.19	.035	.001	.001	.020	.010	.020	.0003					
MECHANICAL PROPERTIES																			
HEAT NO.	C.I./D.I.	YIELD STRENGTH PSI				TENSILE STRENGTH PSI				ELONGATION %		HARDNESS RL							
E05413		63000				76300				34									
CHARPY TEST	-30C SIZE (MM)	4.0 X 10.0																	
SAMPLE 1	46 44	44 AVG FT/LB				44.6													
M07140~		67400				79100				30									
CHARPY TEST	-30C SIZE (MM)	4.0 X 10.0																	
SAMPLE 1	44 44	42 AVG FT/LB				43.3													
YIELD STRENGTH IS 0.2% OFFSET - ELONGATION IN 2 INCHES																			
Other Tests																			
* MELTED & MANUFACTURED IN THE U.S.A. (D)																			
ALSO MEETS ASTM A500-03A GRADE C & B																			
Atlas Tube certifies that the material purchased on this order meets all chemical and physical requirements in accordance with the specification noted above.										 CARRIE LAURITZEN, QUALITY ASSURANCE MANAGER									



926-1-07



DATE: 01/01/07  
TIME: 04:16:44  
SERIAL NO: L0014862

TUBULAR PRODUCTS  
CERTIFIED TEST REPORT

(IN ACCORDANCE WITH ISO 10474/EN10204/DIN50049 3.1.b)

UNITED STATES STEEL



MILL ORDER ITEM NO DR37884 01	SHIPPER NO. R70811	P.O. NUMBER 06-19103	VEHICLE ID LT8138
SOLD TO ADDRESS PIPE DISTRIBUTORS LTD P O BOX 23237 HOUSTON TX 77228-3237		MAIL TO ADDRESS PIPE DISTRIBUTORS LTD P O BOX 23237 HOUSTON TX 77228-3237	
VENDOR USS TUBULAR PRODUCTS 2199 EAST 28TH ST. LORAIN, OH 44055			

SPECIFICATION AND GRADE

PIPE CARBON SMLS STD PIPE API 5L-43RD EDITION DATED 3/04 PSL-1 GRADE B ASTM A53-\*05 GRADE B ASME SA53-\*2004 EDITION GRADE B ASTM A106-\*04B GRADE B/C ASME SA106-\*2004 EDITION GRADE B/C BLK REG MILL COAT PE BEV 30 DEG MEETING ALL THE APPLICABLE REQUIREMENTS OF NACE STANDARD MR-01-75 \*2002

MATERIAL COND:	AS ROLLED	O.D.: 1.900 ( 48.260 )										I.D.: 0.145 ( 3.683 )										In (mm)	
		YIELD					TENSILE					ELONG %					HARDNESS					In (mm)	
		MIN: 40000					MIN: 70000					MIN: 20.0					MIN: 99.0					In (mm)	
PRODUCT IDENTIFICATION	TENSILE TEST TYPE/ ORIENTATION	TEST COND.	GAUGE WIDTH IN	YIELD	TENSILE	EXT %	Y/T	ELONG %	HARDNESS	MIN HYDRO PSI	DWELL (SEC)	B-BODY	W-WELD	CE*	MAX	CE*	MAX	CE*	MAX	CE*	MAX	CE*	MAX
B27156	STRIP/L/B	AR	0.750	52500	.50		0.69	33.0	B 70.7	2500	5												
B27447	STRIP/L/B	AR	0.750	51500	.50		0.68	34.0	B 78.7	2500	5												
				** END OF DATA THIS SHEET **																			

\*C.E. IS BASED ON THE FOLLOWING EQUATION(S):  $CE = C + (MN/6) + (CR+MO+V)/5 + (NI+CU)/15$

DECIMAL POSITIONS FOR ELEMENTS ARE INDICATED BY THE LEFT MARGIN, VERTICAL DOTTED LINE OR DECIMAL POINT.

1/1/2007 4:19 AM

DATE: 01/01/07  
TIME: 04:16:44  
SERIAL NO: 10014862

**UNITED STATES STEEL**  
**TUBULAR PRODUCTS**  
**CERTIFIED TEST REPORT**  
**(IN ACCORDANCE WITH ISO 10474/EN10204/DIN50049 3.1.b)**



MILL ORDER ITEM NO DR37884 01		SHIPPER'S NO. R70811		P.O. NUMBER 06-19103		Q.D. 1.900 ( 48.260 )		WALL THICKNESS 0.145 ( 3.683 )		P.O. NUMBER 0024707	
MATERIAL COND: AS ROLLED		MIN COLLAPSE		DIR		TEST LOC		TEMP		SIZE	
PRODUCT IDENTIFICATION B27156 B27447		FLAT		BEND		GRAIN SIZE		END OF DATA THIS SHEET **		HAZ - HEAT AFFECTED ZONE	
LEGEND		L - LONGITUDINAL		T - TRANSVERSE		B - BODY		W - WELD		HAZ - HEAT AFFECTED ZONE	
TEST / INSPECTION		YES		TESTING / INSPECTION INFORMATION		RESULTS / COMMENTS					
FULL LENGTH VISUAL		X		OD		OD/ID		L		L/T	
FULL LENGTH EMI				ID		OD/ID		L		L/T	
FULL LENGTH MPI				MPI		UT					
FULL LENGTH UT				MPI		UT					
END AREA INSPECTION (PLAIN END)				DRIFT MANDREL SIZE:							
SPECIAL END AREA (SEA) INSP											
FULL LENGTH DRIFT											
ADDITIONAL NOTES/COMMENTS											
MELTED AND MANUFACTURED IN THE USA. NO REPAIRS BY WELDING. NO MERCURY OR MERCURY COMPOUNDS ARE ADDED TO THE STEEL AND ALL MERCURY BEARING EQUIPMENT IS PROTECTED BY A DOUBLE BOUNDARY OF CONTAINMENT.											

THIS IS TO CERTIFY THAT THE PRODUCT DESCRIBED HEREIN WAS MANUFACTURED, SAMPLED, TESTED AND/OR INSPECTED IN ACCORDANCE WITH THE SPECIFICATION AND FULFILLS THE REQUIREMENTS IN SUCH RESPECTS.

PREPARED BY THE OFFICE OF: J. MAJURZAK - MANAGER, Q.A.

DATE 01/01/07

PAGE 2 OF 2

\*\*

2-19-07

7/13/2006 7:55 AM

USS Tubular QA -> MAIRA ZARATE

PAGE 2 of 2

DATE: 05/13/06  
TIME: 07:54:19  
SERIAL NO: 10006626

TUBULAR PRODUCTS

CERTIFIED TEST REPORT

(IN ACCORDANCE WITH ISO 9001:2000 AND ISO 9001:2004)

UNITED STATES STEEL		TUBULAR PRODUCTS		CERTIFIED TEST REPORT		(IN ACCORDANCE WITH ISO 9001:2000 AND ISO 9001:2004)	
WELDING SYMBOL DR34950 01	SUPPLIER NO. 11/2 3/40	PIPE DISTRIBUTORS LTD P O BOX 23237 HOUSTON TX 77228-3237	MAX ADDRESS PIPE DISTRIBUTORS LTD P O BOX 23237 HOUSTON TX 77228-3237	VERIFIED USS TUBULAR PRODUCTS 2199 EAST 28TH ST. LORRAIN, OH 44055			
PIPE CARBON SMILE STD PIPE API 5L-43RD EDITION DATED 3/04 PSL-1 GRADE B ASTM A53-04A GRADE B ASME SA53-2004 EDITION GRADE B ASTM A106-04B GRADE B/C ASME SA106-2004 EDITION GRADE B/C BLK REC MILL COAT 9E REV 30 DEG MEETING ALL THE APPLICABLE REQUIREMENTS OF NACE STANDARD MR-01-75 +2002							
MATERIAL CODE		AS ROLLED		YIELD		TENSILE	
A20857		STRIP/L/B		YIELD MIN: 40000 MAX: 50000		TENSILE MIN: 70000 MAX: 74500	
PRODUCT IDENTIFICATION		TEST CODE		GAUGE WIDTH		TENSILE	
A20857		AR		0.750		74500	
		** END OF DATA THIS SHEET **					
LEGEND		T-TENSILE		QT-QUENCH & TEMPERED		W-WELD	
1-LONGITUDINAL		T-NORMALIZED		QT-NORMALIZED		W-NORMALIZED	
4-LFSEI		C		S		D	
TYPE		HEAT		PROD		PROD	
A20857		16		103		103	
A20857		19		106		107	
A20857		18		105		107	
		** END OF DATA THIS SHEET **					
T.E. IS BASED ON THE FOLLOWING EQUATION(S):		CE=C+(MIN/6)+(CR+HD+V)/5+(RI+CD)/15					

DECIMAL POSITIONS FOR ELEMENTS ARE INDICATED BY THE LEFT MARGIN, VERTICAL DOTTED LINE OR DECIMAL POINT.

PAGE 1 OF 2

15  
INSPECT

7-5-07

202

USS Tubular QA -> MAIRA ZARATE

Page 3 of 3

MILL IDENTIFICATION NO.		P.O. NUMBER		ENTRANCE NO.		DATE		WALL		DIP	
DE 34950 01		06-18864		06-18864		06-18864		06-18864		06-18864	
MATERIAL CODE:		AS ROLLED		Q.D.		1.900 { 48.260 }		0.145 { 3.683 }		0.145 { 3.683 }	
PRODUCT IDENTIFICATION		FLAT		RND		ORIGIN SIZE		MIN. COMPOSE		TEST LOC	
R20857		OR		OR		OR		OR		OR	
TEST / INSPECTION		T-TRANSVERSE		R-BODY		W-BELD		R2-HEAT AFFECTED ZONE		R2-HEAT AFFECTED ZONE	
FULL LENGTH VISUAL		X		X		X		X		X	
FULL LENGTH EM											
FULL LENGTH MP											
FULL LENGTH UT											
END AREA INSPECTION (PLAIN END)											
SPECIAL END AREA (SEMI-SP)											
FULL LENGTH DRIFT											
<p>TESTING INSPECTION INFORMATION</p> <p>RESULTS/COMMENTS</p>											
<p>ADDITIONAL NOTES/COMMENTS</p> <p>MELTED AND MANUFACTURED IN THE USA. NO REPAIRS BY WELDING. NO MERCURY OR MERCURY COMPOUNDS ARE ADDED TO THE STEEL AND ALL MERCURY BEARING EQUIPMENT IS PROTECTED BY A DOUBLE BOUNDARY OF CONTAINMENT.</p>											

THIS IS TO CERTIFY THAT THE PRODUCT DESCRIBED HEREIN WAS MANUFACTURED, SAMPLED, TESTED AND INSPECTED IN ACCORDANCE WITH THE SPECIFICATION SET FORTH IN THE REQUIREMENTS FOR SUCH PRODUCTS.

PREPARED BY THE OFFICE OF: J. KATJOREK - MANAGER, Q. A.

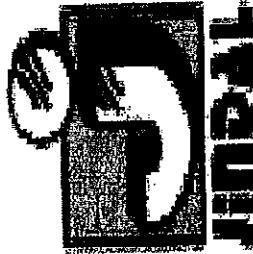
05/13/06

PAGE 2 OF 2

1570

PO/Rel 4057853- ROBERT

## Abstract



# Jindal United Steel Corporation

5200 E. McKinney Road  
Baytown, TX 77520

# METALLURGICAL TEST REPORT

<b>JUNE</b>						<b>METALLURGICAL TEST REPORT</b>						<b>Bulletin Num. 43324</b>											
<b>Sold To:</b> CHAPEL STEEL CO. 590 NORTH BETHLEHEM PIKE P.O. BOX 1000 SPRING HOUSE, PA 19477-1000						<b>Ship To:</b> CHAPEL STEEL CO. 6605 N HOUSTON ROSSLYN RD. HOUSTON, TX 77091						This is to certify that the product described herein was manufactured, sampled, and tested in accordance with the specifications and requirements in such specifications. Fine Grain, Si-AL Fully Killed Steel											
Order No: JUS2190-08						P.O. Number HOU-2907						Approved By: [Signature]											
Plates Manufactured in the USA						Date 10/28/2006						Shipping Mode: DIRECT TRUCK											
Specifications: HOT ROLLED PLATE CUT EDGE ASTM/AISME A36 -05 / ABSGR A / B-06 & A709 - 05 GR 36 STRUCTURAL QUALITY						Insp.						We hereby certify that the material described herein has been made to the application by the B.O.S. process and tested in accordance with the requirements of American Bureau of Shipping Rules with satisfactory results."											
Material Description				Bulletin		Heat No.	Gauge Tested	Test/Plate Identity	Test Cond	Yield Point (KSI)	Tensile Strength (KSI)	Elongation (%)		Yield Strength Determined at	LCVN								
Item	Gauge	Width	Length	Qty	Wgt							in 8"	in 2"										
No. 08	1.0000	120.0000	480.0000	2	32.670	S05190	1.000	08A	ABS	47	67	29		0.2%	FULL mm @ 32DEGF 25 FT/LBS 45 - 40 - 40 FULLmm @ 32°F								
HS756919CX																							
Heat No. S05190 CE-0.34																							
Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Cb							
LADLE	0.14	1.09	0.016	0.014	0.23	0.04	0.03	0.65	0.010	0	0.032	0.005	0.005	0.0005	0.005	0.010							

3-19-60  
U.S. DEPT. OF JUSTICE  
RECEIVED



Metallurgical Chemistry and Testing Laboratory

3204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
[metalltesters@an.com](mailto:metalltesters@an.com)

March 8, 2007

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091


P.O. No. 10647/30925  
Report No. 07-0571-2

IDENTIFICATION: 1" x 4" x 6", PLT# H21185, HT# S05190, SL# 08BA  
MATERIAL: ASTM A36, Mfg. CS  
REFERENCE: HOU30925

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

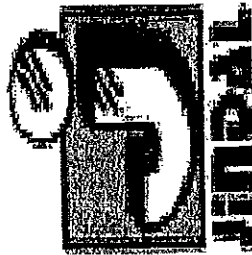
<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
59.0	60	40
58.0	52	40
61.0	61	40

  
Donald Derrick  
Mechanical Testing Supervisor

Sc


Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.

  
3-14-07



Jindal United Steel Corporation  
5200 E. McKinney Road  
Baytown, TX 77520

# METALLURGICAL TEST REPORT

Sold To: CHAPEL STEEL CO. 590 NORTH BETHLEHEM PIKE P.O. BOX 1000 SPRING HOUSE, PA 19477-1000				Ship To: CHAPEL STEEL CO. 6605 N. HOUSTON ROSSLYN RD. HOUSTON, TX 77091				This is to certify that the product described herein was manufactured, sampled, and tested in accordance with the specifications and requirements in such specifications. Fine Grain, Si-AL Fully Killed Steel				Bulletin Num. 43280																	
Order No: JUS2190-08				P.O. Number HOU-2987				Approved By: <i>J. Laguarda / Analyst</i>				Shipping Mode: DIRECT TRUCK																	
Date 10/19/2006				Plates Manufactured in the USA				DIN 50049 3.1 B / EN 10204 3.1 B				Insp.																	
Specifications: HUT ROLLED PLATE CUT EDGE ASTM/ASME A36-05 / ABS GR. A / B-06 & A709 - 05 GR 36 STRUCTURAL QUALITY												"We hereby certify that the material described herein has been made to the application by the B.O.S. process and tested in accordance with the requirements of American Bureau of Shipping Rules with satisfactory results."																	
Material Description			Bulletin		Heat No.	Gauge Tested	Test/Plate Identity	Test Cond	Yield Point (KSI)	Tensile Strength (KSI)	Elongation (%)		Yield Strength Determined at	LCVN															
Item No.	Gauge	Width	Length	Qty							Wgt																		
08	1.0000	120.0000	480.0000	1	16.335	S04385	1.000	05C	ABS	43	66	32	0.2%	101 - 176 - 229 FULL mm @ 32°F															
<div style="text-align: center;">  </div>															<div style="text-align: right;">             OCT 19 2006              HS7569194X           </div>														

Heat No. S04385 CE:0.33

Heat No. S04385		CE-0.33														
Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Cb
LADLE	0.15	1.02	0.012	0.0066	0.24	0.04	0.02	0.03	0.010	0.001	0.036	0.007	0.005	0.0003	0.005	0.010

QAC 3-19-07



Metallurgical Chemistry and Testing Laboratory

3204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
[metalltesters@msn.com](mailto:metalltesters@msn.com)

March 8, 2007

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/30925  
Report No. 07-0571-1

IDENTIFICATION: 1" x 4" x 6", HT# S04385, SL# 10AA  
MATERIAL: ASTM A36, Mfg. CS  
REFERENCE: HOU30925

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
112.0	94	70
101.0	82	60
118.0	94	70

Donald Derrick  
Mechanical Testing Supervisor

Sc

Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.

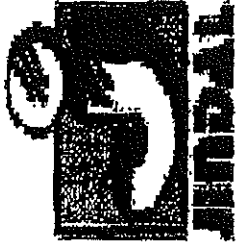
gpc  
8  
3-19-07



CHAPEL STEEL CO.  
OIL STATES-SKAGIT-SMAICO  
ASTM A36 PER SPEC "M-36-PL-C" ATTACHED  
1/2" X 96.0000" X 120.0000"  
PART NO.

PO/Ref 1058488

Certificate of Mill Test Results  
SO HOU-031146-002  
28 Mar 07  
Pg 1/1



Jindal United Steel Corporation  
5200 E. McKinney Road  
Baytown, TX 77520

TC No.: BR10J027-6179-01

METALLURGICAL TEST REPORT

Sold To: CHAPEL STEEL CO. 590 NORTH WETHELEHAM PKWY P.O. BOX 1600 SPRING HOUSE, PA 19477-1000	Ship To: CHAPEL STEEL CO. 6605 N HOUSTON ROSSLYN RD. HOUSTON, TX 77091	Order No: JUS2561-02	Approved By: <i>Helen Green</i>	Rolls Numr. 101027
Plates Manufactured in the USA Certified by ISO 9001:2008	Date 2/28/2007	P.O. Number HOU-3188	Shipping Mode: DIRECT TRUCK DIN 50049 3.1 B / EN 10204 3.1 B	

Specifications:  
HOT ROLLED PLATE CUT HINGE ASTM/A516-01 / ABSGR A / R & A709 - 45 GR  
36 STRUCTURAL QUALITY

Insp. "We hereby certify that the material described herein has been made to the application by the B.O.S. process and tested in accordance with the requirements of American Bureau of Shipping Rules with satisfactory results."

Item No.	Material Description			Bulletin		Heat No.	Gauge Tested	Test/Plate Identity	Test Coual	Yield Point (KSI)	Tensile Strength (KSI)	Elongation (%)		Yield Strength Determined at
	Gauge	Width	Length	Qty	Wgt							In 8"	In 2"	
02	0.5000	96.0000	480.0000	3	19,602	S06179	0.500 0.500	01D 01C	ABS ABS	48 48	66 66	26 25		0.2% 0.2%
HIS-805513-A														

Heat No. S06179 CE-0.31														
Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Me	Sn	Al	N	V	Ch
LADLE	0.12	1.07	0.013	0.009	0.22	0.03	0.02	0.04	0.010	0.001	0.031	0.004	0.0025	0.005

103-30-07

*Metallurgical Chemistry and Testing Laboratory*

3204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
[metall@anlabs.com](mailto:metall@anlabs.com)

March 27, 2007

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/31146  
Report No. 07-739-3

IDENTIFICATION: 1/2" x 4" x 6", HT# S06179, SL# 08BC  
MATERIAL: ASTM A 36

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
118.0	95	70
118.0	81	60
115.0	92	60

mm

Donald Derrick  
Mechanical Testing Supervisor

JP 3-30-07

CHAPEL STEEL CO.  
OIL STATES-SKAGIT SMATCO  
ASTM A36 PER CUSTOMER SPEC "M-36-PL C"  
1/2" X 96.0000" X 120.0000"  
PART NO.

PO/Rel 4060104 /ROBERT H.

Certificate of Mill Test Results  
SO HOU-031768-001  
17May07  
Pg 1/1

**NUCOR**  
PLATE MILL

P.O. Box 279  
Winton, NC 27986  
(252) 356-3700

## Mill Test Report

Page 2



Issuing Date : 03/12/2007 B/L No. : 158163  
Vehicle No: TTPX 80655  
Specification : 0.5000" x 96.000" x 120.000"  
ASTM A36-05/ABS Grade A/ABS Grade B/ASME SA36-03a/A709 36-06a

Our Order No. : 51884/2  
Ship To : CHAPEL STEEL  
6605 N. HOUSTON ROSSLYN ROAD  
RAIL SITE 720703  
HOUSTON, TX 77091

Sold To : CHAPEL STEEL CO  
P O Box 1000  
FAX# 215-793-9415  
SPRINGHOUSE, PA 19477

Cust. Order No. : HOU-3183

Marking :

Heat No	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Alz	V	Nb	Ti	N	Ca	B	Sn	CEQ	PCM
7101673	0.05	0.88	0.016	0.004	0.29	0.20	0.08	0.13	0.01	0.024	0.002	0.001	0.001	0.001	0.0009	0.0001	0.008	0.25	0.13
Plate Serial No	Pieces	Dir.	Yield	Tensile	Elongation % in 2"	Elongation % in 8"	Dir.	Charpy Impacts											
								(%) shear	(%) shear	(%) shear	(%) shear	(%) shear	(%) shear	(%) shear	(%) shear	(%) shear	(%) shear	Min Temp	Ave.
7101673-03	2	T	44,000	62,600	26.9	26.9													
		T	44,500	61,000	28.0	28.0													
7101673-04	5	T	44,000	62,600	26.9	26.9													
		T	44,500	61,000	28.0	28.0													
7101673-06	1	T	44,000	62,600	26.9	26.9													
		T	44,500	61,000	28.0	28.0													

OSI  
15  
APR 2007  
W5-24-07

Manufactured to fully killed fine grain practice by Electric Arc Furnace. Welding or weld repair was not performed on this material. We hereby certify that the contents of this report are accurate and correct. All test results and operations performed by the material manufacturer are in compliance with the applicable specifications.

Post = C-(S30303)-Mn-20H-Cu-20H-Ni-80H-(C220Y-Mn-15H-VN0)-68  
Milled and manufactured in the USA. ISO 9001-2000 certified (#12443-0) by SRI Quality System Registrar (#0885-09). PED 97/23/EC Compliant.  
DIN 50048 3.1.B1EN 10204 3.1.B(2004) compliant. For ABS grades only. Quality Assurance certificate No. 03-MMPQA-182

03/14/2007 12:15:58 PM

T. A. Depretis, Metallurgist



Metallurgical Chemistry and Testing Laboratory

3204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
[metallab@an-tech.com](mailto:metallab@an-tech.com)

May 16, 2007

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/31768  
Report No. 07-1153-1

IDENTIFICATION: 1/2" x 4" x 6", HT# 7101673, SL# 06  
MATERIAL: ASTM A36, Mfg. NUC  
REFERENCE: HOU-31768

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
237.0	97	100
238.0	99	100
228.0	96	100

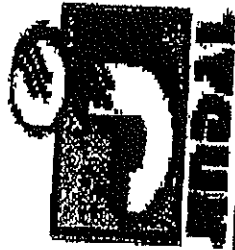


JP5-24-07

Donald Derrick  
Mechanical Testing Supervisor

Sc

Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.



**Jindal United Steel Corporation**  
5200 E. McKinney Road  
Baytown, TX 77520

**METALLURGICAL TEST REPORT**

<b>Sold To:</b> CHAPEL STEEL CO. 590 NORTH BETHLEHEM PIKE P.O. BOX 1400 SPRING HOUSE, PA 19477-1400		<b>Ship To:</b> CHAPEL STEEL CO. 6605 N. HOUSTON ROSSELLEN RD. HOUSTON, TX 77091		<b>Order No:</b> J082561-04 <b>Date:</b> 2/23/2007 <b>P.O. Number:</b> MDU-1188		<b>Plates Manufactured in the USA</b> <b>Certified by ISO 9001:2000</b> <b>Specifications:</b> HOT ROLLED PLATE CUT EDGE ASTM A572M A36 - 65 / ABS GRA B / B-06 & A709 - 05 GR 36 STRUCTURAL QUALITY		<b>Approved By:</b> <i>Helen Green</i> <b>Shipping Method:</b> DIRECT TRUCK <b>EN 50049 3.1 B / EN 10204 3.1 B</b>		<b>Inspected:</b> "We hereby certify that the material described herein has been made to the applications by the B.Q.S. process and tested in accordance with the requirements of American Bureau of Shipping Rules with satisfactory results."		<b>Heat No. S06168</b> <b>Test Type:</b> LADLE <b>Chemical Analysis:</b> <table border="1"> <tr> <th>C</th> <th>Mn</th> <th>P</th> <th>S</th> <th>Si</th> <th>Cu</th> <th>Ni</th> <th>Cr</th> <th>Mo</th> <th>Sn</th> <th>Al</th> <th>N</th> <th>V</th> <th>B</th> <th>Ti</th> <th>Cb</th> </tr> <tr> <td>0.14</td> <td>0.08</td> <td>0.014</td> <td>0.015</td> <td>0.24</td> <td>0.06</td> <td>0.03</td> <td>0.04</td> <td>0.010</td> <td>0.001</td> <td>0.032</td> <td>0.005</td> <td>0.005</td> <td>0.0005</td> <td>0.005</td> <td>0.010</td> </tr> </table>		C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Cb	0.14	0.08	0.014	0.015	0.24	0.06	0.03	0.04	0.010	0.001	0.032	0.005	0.005	0.0005	0.005	0.010
C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Cb																														
0.14	0.08	0.014	0.015	0.24	0.06	0.03	0.04	0.010	0.001	0.032	0.005	0.005	0.0005	0.005	0.010																														
<b>Material Description</b> 36 STRUCTURAL QUALITY		<b>Bulletin</b> Qty: 2 Length: 480.0000 Width: 96.0000 Gauge: 0.7500		<b>Heat No.</b> S06168 <b>Wgt</b> 19,602		<b>Test/Plate Identity</b> 01C 04A		<b>Gauge Tested</b> 0.625 0.750		<b>Test Cond</b> ABS ABS		<b>Yield Point (KSI)</b> 46 47		<b>Tensile Strength (KSI)</b> 65 68		<b>Elongation (%)</b> In 8" In 2"		<b>Yield Strength Determined at</b> 0.2% 0.2%																											
<b>Item No.</b> 04		<b>Material Description</b>		<b>Heat No.</b> S06168		<b>Test/Plate Identity</b>		<b>Gauge Tested</b>		<b>Test Cond</b>		<b>Yield Point (KSI)</b>		<b>Tensile Strength (KSI)</b>		<b>Elongation (%)</b>		<b>Yield Strength Determined at</b>																											
<b>Heat No. S06168</b>		<b>Material Description</b>		<b>Heat No.</b> S06168		<b>Test/Plate Identity</b>		<b>Gauge Tested</b>		<b>Test Cond</b>		<b>Yield Point (KSI)</b>		<b>Tensile Strength (KSI)</b>		<b>Elongation (%)</b>		<b>Yield Strength Determined at</b>																											

*Metallurgical Chemistry and Testing Laboratory*

3204 BROADWAY (77017)  
POST OFFICE BOX 282285  
HOUSTON, TEXAS 77207-2285  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
[metalltesters@an-tech.com](mailto:metalltesters@an-tech.com)

March 27, 2007

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/31146  
Report No. 07-739-4

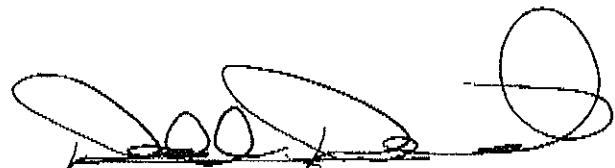
IDENTIFICATION: 3/4" x 4" x 6", HT# S06168, SL# 04AB  
MATERIAL: ASTM A 36

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
79.0	82	70
67.0	66	60
58.0	56	40

mm

  
Donald Derrick  
Mechanical Testing Supervisor

Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.

3-30-07

# Steel Certificate of Test

# TIMKEN

WORLDWIDE LEADER IN BEARINGS AND STEEL

1835 DUEBER AVE. S.W.  
CANTON, OHIO 44706

Page 1 of 2

09/01/2004

ID #0086080-1

S Tubular Steel Inc.  
O T 1031 EXECUTIVE PARKWAY DR  
L O  
D ST LOUIS MO 63141 USA  
ATTN: JANE KOPECKY

S TUBULAR STEEL INCORPORATED  
H T 7220 POLSON LANE  
I O  
P HAZELWOOD MO 63042 USA

Customer Order: 1115-137 Hazelwood Customer Part Number: STEEL SERVICE CENTER  
Timken Order: 37232-A (1209580) Heat Number(s): Y5644

## Description of Material

OD: 10.000 in (254.000 mm) WALL: 1.750 in (44.450 mm) ID: 6.500 in (165.100 mm)  
Shape: RD  
Sales Type: 1026  
Int Quality: ELECTRIC FURNACE-VACUUM DEGAS-ULTRASONIC  
Condition: HOT ROLL

## Specification

- ASTM A 106 Grades B and C Rev. 02a EXCEPT WEIGHING OF INDIVIDUAL TUBES
- ASME SA-106 Rev. 2001 EDITION GRADES B & C EXCEPT WEIGHING OF INDIVIDUAL TUBES
- ASTM A 105 / A 105M Rev. 02 FOR CHEMISTRY & PROPERTIES ONLY
- ASME SA-105/SA-105M Rev. 2001 EDITION FOR CHEMISTRY & PROPERTIES ONLY
- ASTM A 519 Rev. 03
- NACE MR0175 Rev. 97 01/01/1997
- ASME CODE CASE 2237 03/10/1997

## Chemistry Information

	%C	%Mn	%P	%S	%Si	%Cr	%Ni	%Mo	%Cu	%Al	%V	%Cb
SPEC Ladle Min:	.22	.60			.10							
SPEC Ladle Max:	.28	.90	.025	.025	.35	.20	.25	.06	.35		.030	.020
Y5644 Ladle:	.24	.80	.010	.020	.24	.08	.15	.04	.31	.030	.001	.001

## Metallurgy Information

SPEC: Grain Size SIZE 5/FINER

Heat Y5644 SIZE: 5/FINER

When shipping document is attached it becomes part of this certification.

We certify the above materials have been inspected and tested in accordance with the methods prescribed in the governing specifications and consistent with our Standard Commercial Terms and Conditions for Sale, Manufacture, and Shipping, which are incorporated into and made part of this certification. The results of such inspections and tests conform with the applicable requirements. This certificate or report shall not be reproduced except in full, without the written approval of the Timken Corporation.

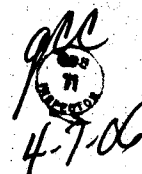
Approved: \_\_\_\_\_

NOTARY PUBLIC

by



Essie Dillard, CERTIFICATION PROCESSOR



THE TIMKEN CORPORATION

# Steel Certificate of Test

# TIMKEN

1835 DUEBER AVE. S.W.  
CANTON, OHIO 44706

Page 2 of 2

WORLDWIDE LEADER IN BEARINGS AND STEEL

09/01/2004

ID #0086080-1

Customer Order: 1115-137 Hazelwood Customer Part Number: STEEL SERVICE CENTER  
Timken Order: 37232-A (1209580) Heat Number(s): Y5644

## Metallurgy Information (cont.)

SPEC: Hardness MIDWALL 187 Max UOM BRINELL

Heat	Piece#				UOM
Y5644	A	MIDWALL	166	/	170 BRINELL

SPEC: Tensile MIN ELONGATION 22 Min MIN REDUCTION IN AREA 30 Min STRENGTH UOM PSI  
TENSILE 70,000.00 Min YIELD .2 40,000.00 Min

Heat	Piece#	Tensile Strength	UOM	.2% Yld Strength	Elong %	%Red	Gauge Length	Specimen	Direction
Y5644	A	78,880	PSI	48,690	29.9	59.7	2 IN	0.505 in RD	LONG.

Flattening test - Satisfactory

Ultrasonic in lieu of hydrostatic testing - Satisfactory.

The Timken Company certifies that there is no mercury or radio-active material used in the melting or processing.

Material melted and produced in the USA

No welding of this material has occurred.

*gpc*  
4-7-06

THE TIMKEN CORPORATION



# Steel Certificate of Test

1835 DUEBER AVE. S.W.  
CANTON, OHIO 44706

Page 1 of 2

# TIMKEN

Where You Turn  
09/23/2005

ID #0117898-1

S Marmon/Keystone Corporation  
O T 105 GOODRICH DR  
L O  
D TARRANT AL 35217 USA

S Marmon/Keystone Corporation  
H T 105 GOODRICH DR  
I O  
P TARRANT AL 35217 USA

Customer Order: 10-010010-020 Customer Part Number: 6.52.130  
Timken Order: 40653-A (1264120) Heat Number(s): X2080

T 6.52. 130 T-I

## Description of Material

OD: 6.500 in (165.100 mm) WALL: 2.000 in (50.800 mm) ID: 2.500 in (63.500 mm)  
Shape: RD  
Sales Type: 1026  
Int Quality: ELECTRIC FURNACE-ULTRASONIC  
Condition: HOT ROLL

## Specification

- ASTM A 106 Rev. 02a GRADES B & C EXCEPT WEIGHING OF INDIVIDUAL TUBES
- ASME SA-106 Rev. 2001 EDITION GRADES B & C EXCEPT WEIGHING OF INDIVIDUAL TUBES
- ASTM E 213 Rev. 02 FOR NONDESTRUCTIVE ELECTRIC TESTING
- ASTM A 519 Rev. 03
- NACE MR0175 Rev. 97 01/01/1997
- BRITISH STANDARD BS EN 10204 01/01/1991 SECTION 3.1.B
- DIN EN 10204 01/01/1991 SECTION 3.1.B

## Chemistry Information

	%C	%Mn	%P	%S	%Si	%Cr	%Ni	%Mo	%Cu	%Al	%V
SPEC Ladle Min:	.22	.60			.10						
SPEC Ladle Max:	.28	.90	.025	.025		.40	.40	.15	.40		.080
X2080 Ladle:	.26	.69	.006	.021	.25	.13	.15	.07	.24	.030	.001

When shipping document is attached it becomes part of this certification.

We certify the above materials have been inspected and tested in accordance with the methods prescribed in the governing specifications and consistent with our Standard Commercial Terms and Conditions for Sale, Manufacture, and Shipping, which are incorporated into and made part of this certification. The results of such inspections and tests conform with the applicable requirements. This certificate or report shall not be reproduced except in full, without the written approval of the Timken Corporation.

Approved: \_\_\_\_\_  
NOTARY PUBLIC

by

*Essie Dillard*  
Essie Dillard, CERTIFICATION PROCESSOR

THE TIMKEN CORPORATION



*gpc*  
11-11-06

# Steel Certificate of Test

1835 DUEBER AVE. S.W.  
CANTON, OHIO 44706

Page 2 of 2

# TIMKEN

Where You Turn  
09/23/2005

ID #0117898-1

Customer Order: 10-010010-020 Customer Part Number: 6.52.130  
Timken Order: 40653-A (1264120) Heat Number(s): X2080

## Metallurgy Information

SPEC: Hardness MIDWALL 22 Max UOM ROCKWELL C

Heat	Piece#				UOM
X2080	A	MIDWALL	89	/	90 ROCKWELL B

SPEC: Tensile MIN ELONGATION 22 Min STRENGTH UOM PSI TENSILE 70,000.00 Min YIELD .2  
40,000.00 Min

Heat	Piece#	Tensile Strength	UOM	.2% Yld Strength	Elong %	%Red	Gauge Length	Specimen	Direction
X2080	A	76,930	PSI	44,281	27.8	53.3	2 IN	0.505 in RD	LONG.

Flattening test - Satisfactory

Ultrasonic in lieu of hydrostatic testing - Satisfactory.

The Timken Company certifies that there is no mercury or radio-active material used in the melting or processing.

Material melted and produced in the USA

THE TIMKEN CORPORATION

*gpl*  
098  
11  
1-11-06

**CHAPEL STEEL CO.**  
**OIL STATES-SKAGIT SMATCO**  
 ASTM A36 PER SPEC "M-36-PL-C" ATTACHED  
 1-1/2" X 96.0000" X 120.0000"  
 PART NO.

PO/Rel 4059464

ROBERT HUDSON

**Certificate of Mill Test Results**  
 30Apr07  
 80 HOU-031547-001  
 Pg 1/1



**Jindal United Steel Corporation**  
 5200 E. McKinney Road  
 Baytown, TX 77520

TC No.: BRJ01617-6171-01  
 MET-04

**METALLURGICAL TEST REPORT**

<b>Sold To:</b> CHAPEL STEEL CO. 590 NORTH BETHLEHEM PIKE P.O. BOX 1000 SPRING HOUSE, PA 19477-4000				<b>Ship To:</b> CHAPEL STEEL CO. 6605 N. HOUSTON ROSSLYN RD. HOUSTON, TX 77061				This is to certify that the product described herein was manufactured, sampled, and tested in accordance with the specifications and requirements in such specifications: Fine Grains, Si-AL Fully Killed Steel				<b>Bulletin Name:</b> 101617				
<b>Order No:</b> JUS2624-06				<b>P.O. Number:</b> HOU-3243				<b>Approved By:</b> <i>Helen Green</i>								
<b>Date:</b> 4/11/2007				<b>F.O. Number:</b> HOU-3243				<b>Shipping Mode:</b> DIRECT TRUCK								
<b>Plates Manufactured in the USA</b> Certified by ISO 9001:2000								<b>Inspection:</b> We hereby certify that the material described herein has been made to the application by the B.O.S. process and tested in accordance with the requirements of American Bureau of Shipping Rules with satisfactory results.								
<b>Specifications:</b> HOT ROLLED PLATE CUT EDGE ASTM/A36-05 / A500 A / B & A709 - 05 GR 36 STRUCTURAL QUALITY																
Material Description			Bulletin		Test/Plate		Heat		Tensile		Elongation (%)		Yield Strength		LCVN	
Item No.	Gauge	Width	Length	Qty	Wgt	Identify	Test Cond	No.	Yield Point (KSI)	Strength (KSI)	In 8"	In 3"	Yield Strength Determined at	Full. min @ 32 DEG F	Full. min @ 32 DEG F	
06	1.5000	96.0000	480.0000	2	39,204	01A 01B	AR AR	S06171 1.500	50 50	72 64	25 26		0.2% 0.2%	122 - 93 - 102 FULL min @ 32°F 110 - 65 - 78 FULL min @ 32°F		
<div style="text-align: center;"> </div>																
<b>Test No. S06171</b> <b>CR-0.36</b>																
<b>Test Type</b>	<b>C</b>	<b>Mn</b>	<b>P</b>	<b>S</b>	<b>Si</b>	<b>Cu</b>	<b>Ni</b>	<b>Cr</b>	<b>Mg</b>	<b>Su</b>	<b>Al</b>	<b>N</b>	<b>V</b>	<b>B</b>	<b>Ti</b>	<b>Cl</b>
LADLE	0.17	1.09	0.017	0.008	0.25	0.03	0.02	0.03	0.010	0.001	0.034	0.005	0.005	0.0005	0.005	0.040

153  
 15-1-0

*Metallurgical Chemistry and Testing Laboratory*

3204 BROADWAY (77017)  
POST OFFICE BOX 282286  
HOUSTON, TEXAS 77207-2286  
PHONE: (713) 844-7601  
FAX: (713) 844-1400  
mailto:info@an-tech.com

April 25, 2007

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/31547  
Report No. 07-1014

IDENTIFICATION: 1-1/2" x 4" x 6", HT# S06171, SL# 01BA  
MATERIAL: ASTM A36, Mfg. Jus  
REFERENCE: HOU31540

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
69.0	61	40
63.0	58	50
55.0	50	40

Donald Derrick  
Mechanical Testing Supervisor

Sc

Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.



JP 5-1-07

Attn:



Jindal United Steel Corporation  
5200 E. McKinney Road  
Baytown, TX 77520

MEI-04  
TC No.: BR36605-3(31-01)

## METALLURGICAL TEST REPORT

<b>Sold To:</b> CHAPEL STEEL CO. 590 NORTH BETHLEHEM PIKE P.O. BOX 1000 SPRING HOUSE, PA 19477-1000		<b>Ship To:</b> CHAPEL STEEL CO. 6605 N.HOUSTON ROSSLYN RD. HOUSTON, TX 77091		<b>Bulletin Num.</b> 36605	
<b>Plates Manufactured in the USA</b>		<b>Order No:</b> JUS1941-06		<b>Approved By:</b> <i>Heidi Green</i>	
		<b>Date</b> 4/8/2006	<b>P.O. Number</b> HOU-2806	<b>Shipping Mode:</b> DIRECT TRUCK	
<b>Specifications:</b> H0T ROLLED PLATE CUT EDGE ASTM A36 -05 / ABS GR A / B & A709 - 05 GR 36 STRUCTURAL QUALITY					
<b>Material Description</b>		<b>Bulletin</b>		<b>Insp.</b> "We hereby certify that the material described herein has been made to the application by the B.O.S. process and tested in accordance with the requirements of American Bureau of Shipping Rules with satisfactory results."	
<b>Item No.</b>	<b>Gauge</b> 1.2500	<b>Width</b> 96.0000	<b>Length</b> 480.0000	<b>Qty</b> 1	<b>Wgt</b> 16,335
<b>Heat No.</b> S03631		<b>Gauge Tested</b> 1.250		<b>Test/Plate Identity</b> 01B	
<b>Yield Point (KSI)</b> 42		<b>Tensile Strength (KSI)</b> 72		<b>Elongation (%)</b> in 8" 31	
<b>Test Cond</b> ABS		<b>Yield Strength Determined at</b> 32 - 30 - 32 FULLmm @ 32°F		<b>LCVN</b> FULL mm @ 32DEG F 25 FT/LBS	
<b>Heat No. S03631 CE:0.35</b>					

Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mu	Sn	Al	N	V	B	Ti	Ch
LADLE	0.17	1.02	0.015	0.008	0.27	0.01	0.02	0.03	0.001	0.001	0.029	0.006	0.006	0.0005	0.001	0.005

*Handwritten signature and date 4/28/06*

# NUCOR

## BAR MILL GROUP

### JEWETT DIVISION

CERTIFIED MILL TEST REPORT

B/L# 418670  
Date 1/16/07

Post Office Box 126 Jewett, Texas 75846 Telephone (903) 626-4461 Sales (800) 527-6445  
A Division of NUCOR Corporation  
ISO 9002 Registered by

43077  
Sold To: Namasco  
P. O. Box 450469  
Houston TX 77245-0469

Ship TO: Namasco  
14200 Almeda Rd  
HOUSTON TX

SIZE	GRADE	HEAT NUMBER	CUSTOMER PO NUMBER	C	Mn	Si	S	P	V	Nb	Cu	Cr	Ni	Mo	Bend Sn Test
3/4 X 2	A36-05/A709-04AEL/SA36-98	402-4755	6075001	.11	.85	.20	.030	.018	.004	.001	.46	.16	.19	.034	.016
				Tensile 1: 64600 Yield 1: 42300 Elong% 1: 25											
				Tensile 2: 64000 Yield 2: 42400 Elong% 2: 25											
5 X 3 X 5/16	ASTM A36-05/A529-05 GR 50	402-5212	6074778	.13	.87	.19	.034	.015	.005	.015	.44	.15	.16	.059	.018
				Tensile 1: 78700 Yield 1: 57200 Elong% 1: 20											
				Tensile 2: 75500 Yield 2: 57800 Elong% 2: 20											
5/16 X 6	ASTM A529-05 GRADE 55	402-5378	6074778	.10	1.12	.19	.030	.015	.006	.037	.53	.21	.14	.044	.013
				Tensile 1: 81500 Yield 1: 61500 Elong% 1: 20											
				Tensile 2: 81400 Yield 2: 61200 Elong% 2: 20											
3/8 X 3	A36-05/A709-04AEL/SA36-98	402-4871	6074778	.10	.83	.17	.043	.008	.007	.002	.40	.10	.14	.031	.011
				Tensile 1: 64900 Yield 1: 43700 Elong% 1: 27											
				Tensile 2: 64600 Yield 2: 43600 Elong% 2: 24											
3/8 X 3	A36-05/A709-04AEL/SA36-98	402-4872	6074778	.09	.79	.16	.039	.008	.007	.002	.38	.10	.12	.027	.012
				Tensile 1: 66000 Yield 1: 45800 Elong% 1: 25											
				Tensile 2: 65900 Yield 2: 44300 Elong% 2: 22											
1 X 2	A36-05/A709-04AEL/SA36-98	402-4753	6074510	.09	.83	.21	.040	.018	.004	.001	.51	.12	.30	.046	.014
				Tensile 1: 66500 Yield 1: 45200 Elong% 1: 22											
				Tensile 2: 66500 Yield 2: 45400 Elong% 2: 23											
1/2	ASTM A529-05 GD 50	610-6521	6074778	.18	.82	.16	.025	.025	.000	.000	.34	.20	.11	.039	.000
				Tensile 1: 79600 Yield 1: 55100 Elong% 1: 25											
				Tensile 2: 79600 Yield 2: 55100 Elong% 2: 25											

ELONGATION IN 8 INCH SCALE  
MELTED AND MANUFACTURED IN U.S.A.

ALL MATERIAL STRAND CAST

CHIEF METALLURGIST

*Ben R. Kemp*



203-9-07

**CHAPEL STEEL CO.**  
OIL STATES-SKAGIT-SMITHCO  
ASTM A36 PER CUSTOMER SPEC "M-36-PL-C"  
1-1/2" X 96.0000" X 120.0000"  
PART NO.

PO/Rel 4060104

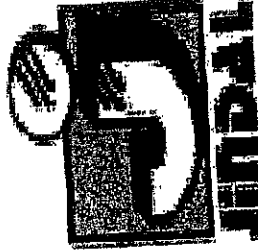
/ROBERT H.

**Certificate of Mill Test Results**  
7Jan07  
Pg 1/1  
SO HOU-032045-001

Attn:

MET-04  
TC No.: BR102301-6261-01

**Jindal United Steel Corporation**  
5200 E. McKinney Road  
Baytown, TX 77520



# METALLURGICAL TEST REPORT

**Sold To:**  
CHAPEL STEEL CO.  
590 NORTH BETHLEHEM PIKE  
P.O. BOX 1000  
SPRING HOUSE, PA 15477-1000

**Ship To:**  
CHAPEL STEEL CO.  
6605 N. HOUSTON ROSSLYN RD.  
HOUSTON, TX 77091

Bulletin Num. 102301

This is to certify that the product described herein was manufactured, sampled, and tested in accordance with the specifications and requirements in such specifications. Fine Grain, Si-AL Fully Killed Steel

Order No: JUS2658-10

Date 5/15/2007  
P.O. Number HOU-3259

Approved By: *Steven Green*

Shipping Mode: DIRECT TRUCK

Plates Manufactured in the USA

Certified by ISO 9001:2000

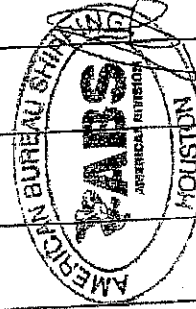
DN 50049 1.1.B / EN 10204:2004 3.1

Insp.

"We hereby certify that the material described herein has been made to the application by the B.O.S. process and tested in accordance with the requirements of American Bureau of Shipping Rules with satisfactory results."

**Specifications:**  
HOT ROLLED PLATE CUT EDGE ASTM/ASME A36 -05 / ABS GR A / B & A709 - 05 GR  
36 STRUCTURAL QUALITY

Item	Material Description		Bulletin		Heat No.	Gauge Tested	Test/Plate Identity	Test Cond	Yield Point (KSI)	Tensile Strength (KSI)	Elongation (%)		Yield Strength Determined at	LCVN
	Gauge	Width	Length	Qty							In 8"	In 2"		
10	1.5000	96.0000	480.0000	1	19.602	S06261	1.500	06C	AR	47	68	25	0.2%	FULL mm @ 32DEG F 25 FT/LBS 239 - 238 - 239 FULLmm @ 32°F
MAY 17 2007														
H5035U99AX														



Heat No. S06261 CE-0.32

Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Su	Al	N	V	B	Ti	Cb
LADLE	0.14	1.04	0.010	0.003	0.30	0.03	0.01	0.02	0.009	0.001	0.029	0.005	0.001	0.0002	0.003	0.002

15  
RECEIVED

06-16-07



Metallurgical Chemistry and Testing Laboratory

3204 BROADWAY (77017)  
POST OFFICE BOX 282265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
[info@an-tech.com](mailto:info@an-tech.com)

June 15, 2007

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/32045  
Report No. 07-1481

IDENTIFICATION: 1-1/2" x 6" x 6", HT# S06261, SL# 06CA  
MATERIAL: ASTM A36, Mfg. JUS  
REFERENCE: HOU32045

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
110.0	96	60
97.0	88	50
88.0	79	50

Donald Derrick  
Mechanical Testing Supervisor



Sc

Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.

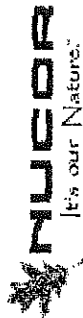


**NUCOR**

P.O. Box 279  
 Winton, NC 27986  
 (252) 366-3700

**PLATE MILL**

**Mill Test Report**  
 Page 1



Issuing Date : 03/12/2007 BIL No. : 153163 Our Order No. : 51864/1 Cust. Order No. : HOU-3193  
 Vehicle No. : TTPX 80655 Ship To : CHAPEL STEEL  
 Specification : 0.3750" x 96.000" x 120.000" P O Box 1090 6605 N. HOUSTON ROSSLYN ROAD  
 ASTM A36-06/ABS Grade A/ABS Grade B/ASME SA36-03a/A709 36-06a FAX# 215-793-9415 RAIL SITE 720703  
 SPRINGHOUSE, PA 19477 HOUSTON, TX 77091

Marking :

Heat No	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Alz	V	Nb	Ti	N	Ca	B	Sn	CEQ	PCM
7101673	0.05	0.88	0.016	0.004	0.29	0.20	0.08	0.13	0.01	0.024	0.002	0.001	0.001	—	0.0009	0.0001	0.008	0.25	0.13
7101795	0.07	0.87	0.013	0.009	0.29	0.26	0.08	0.11	0.01	0.030	0.003	0.001	0.001	—	0.0007	0.0001	0.012	0.00	0.00

Plate Serial No	Places	Dir.	Tensile Test		Elongation		Charpy Impacts					Min Ave.								
			(psi) Yield	(psi) Tensile	% in 2"	% in 8"	Dir.	1	2	3	(%) shear		(%) shear	Size	Temp					
7101673-07	6	T	44,000	62,600		26.9														
		T	44,500	61,000		28.0														
7101673-08	6	T	44,000	62,600		26.9														
		T	44,500	61,000		28.0														
7101795-04	6	T	48,800	65,500		28.1														
		T	48,700	68,500		29.1														



Manufactured to fully killed fine grain practice by Electric Arc Furnace. Welding or weld repair was not performed on this material. We hereby certify that the contents of this report are accurate and correct. All test results and operations performed by the material manufacturer are in compliance with the applicable specifications.

*T. A. Depreis*  
 T. A. Depreis, Metallurgist

Mercury has not been used in the direct manufacturing of this material. Produced as continuous cast as-rolled discrete plate.  
 Yield by 0.5EUL method unless otherwise specified. Cem = C+(Mn/6)+((C+Mn+V)/5)+(Cu+Ni)/15  
 PCM = C+Si/30+(Mn/20)+(Cu/20)+(Ni/60)+(H/20)+(Mn/5)+(V/10)+Sb  
 Melted and manufactured in the USA. ISO 9001:2000 certified (#12443-0) by SRI Quality System Registrar (#0885-08). PED 9723/EC Compliant.  
 DIN 50049 3.1, BEN 10204 3.1, B2004 compliant. For ABS grades only. Quality Assurance certificate No. 05-MM/FQA-182

03/14/2007 12:15:58 PM



*Metallurgical Chemistry and Testing Laboratory*

3204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
[metallab@an-tech.com](mailto:metallab@an-tech.com)

April 18, 2007

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/31468  
Report No. 07-0962

IDENTIFICATION: 3/8" x 4" x 6", HT# 7101673, SL# 07  
MATERIAL: ASTM A36, Mfg. JUS

IMPACT TEST

9mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
224.0	94	100
220.0	92	100
222.0	91	100

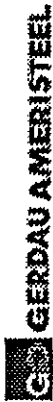


4-25-07

Donald Derrick  
Mechanical Testing Supervisor

Sc

Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.



CHARLOTTE STEEL MILL  
6601 LAKEVIEW ROAD  
CHARLOTTE NC 28269 USA  
(704) 596-0361

Chemical and Physical Test Report  
MADE IN UNITED STATES

C-502769

PRODUCED IN: CHARLOTTE

SHIP TO NAMASCO CORP 3775 NAMASCO COURT HWY 23 (2 MILES S HWY 317) SUWANEE, GA 30174	INVOICE TO NAMASCO CORP (T FL) ***ACCTS PAYABLE** 500 COLONIAL CENTER PKWY S-500 ROSWELL, GA 30076	SHIP DATE 01/30/07  CUST. ACCOUNT NO 33119363
--	--	---

SHAPE + SIZE		GRADE	SPECIFICATION										SALES ORDER	CUST P.O. NUMBER
F1/2 X 1 1/2		A36	A36 ASTM A36-05										7605489-01	ATL6076760-01
HEAT I.D.	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Nb	Sn	Al	C Eqv
C608081	.15	.73	.005	.034	.21	.34	.09	.05	.020	.002	<.008	.012	.000	.313

Mechanical Test: Yield 45599 PSI, 314.39 MPA Tensile: 67827 PSI, 467.65 MPA %EL: 30.0/8in, 30.0/200MM Bend: OK Std Dev:0 Id Diam: .435  
Customer Requirements CASTING: STRAND CAST  
CUST ITEM NUMBER: MB12112FL T20A36

This material, including the billets, was produced and manufactured in the United States of America

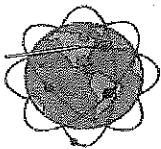
Bhaskar Yalamanchili  
Quality Director  
Gerdau Ameristeel

THE ABOVE FIGURES ARE CERTIFIED EXTRACTS FROM THE ORIGINAL CHEMICAL AND PHYSICAL TEST RECORDS AS CONTAINED IN THE PERMANENT RECORDS OF COMPANY.

Mgr. Metallurg. Svcs.  
CHARLOTTE STEEL MILL



*Handwritten signature and date 01-30-07*



# GLOBAL X-RAY & TESTING CORPORATION

JOEL MOREAU, President  
Residence: 985-446-6861

Post Office Box 1536  
Morgan City, Louisiana 70381

Bus: 985-631-2426  
Fax: 985-631-0093

## MT WORK REPORT

HMH 20070824-1

CLIENT Oilstates DATE 08/24/07  
CONTRACTOR Same JOB LOCATION Ind. Avenue  
JOB NO. W.O. 23407 AFE OTHER  
UT TECH Mitchell Hebert/Level II CLIENT'S REPRESENTATIVE Paul Beggs

WELD NO.	WALL THICKNESS	RECOMMENDATION		REMARKS	WELD NO.	WALL THICKNESS	RECOMMENDATION		REMARKS
		✓ X	ACCEPT REJECT				✓ X	ACCEPT REJECT	
1	100% MT	insp. Of			51				
2	340L	Lattice			52				
3	boom	point	/		53				
4					54				
5					55				
6	total	weld =	520		56				
7					57				
8	total	repair =	0		58				
9					59				
10					60				
11					61				
12					62				
13					63				
14					64				
15					65				
16					66				
17					67				
18					68				
19					69				
20					70				
21					71				
22					72				
23					73				
24					74				
25					75				
26					76				
27					77				
28					78				
29					79				
30					80	2 cans	highlighter		
31					SURFACE CONDITION				
32					GOOD	FAIR	PAINTED	WELD	
33					EQUIPMENT				
34					MAKE	Electrospec	MODEL	ES-X	S/N 9453
35					CONTACTS				
36					PROD SPACING	3"-6"	CONTINUOUS		
37					AC	DC	HALF WAVE	FULL WAVE	
38					MEDIA				
39					7C BLACK WET	8A DRY	WHT CONTRAST		
40					CALIBRATION				
41					10# LIFT	FLUX CHECK	DATE:	8-24-07	
42					ACCEPTANCE CRITERIA				
43					AWS D1.1 SEC 6 / EXT-MPV-WM-001 REV 16				
44					Substances				
45					Auto Transport Miles				
46					Travel Time Hrs.				
47					Work Time Hrs.				
48					Standby Time Hrs.				
49					Total Time Hrs. 3 hrs				
50									

# OCEANEERING<sup>®</sup>

## INSPECTION

REPORT NO. 409044

Houma, LA  
(985) 868-5097  
New Iberia, LA  
(337) 365-7102  
Ingleside, TX  
(361) 776-7251

MAILING ADDRESS  
Sta. 1 Box 10267  
Houma, LA 70363

(985) 868-5097  
**DAILY WORK REPORT**  
ISO 9002 Certified

Customer <b>OIL STATES</b>	Job Location <b>Houma LA</b>	Inspection Date / Time <b>10-8-07</b>
Billing Address	Project <b>23407.11</b>	Oil Job Number <b>57388</b>
	P.O. #	PKC / AEE # <b>LATEST EDITION</b>
	S.S. Procedure # <b>AWS M-02 Rev 1</b>	Acceptance Criteria <b>AWS 5.1 6.1</b>

AD = Accumulations of Discontinuities	ESI = Elongated Slag Inclusion	IFD = Incomplete Fusion Due to Cold Lap	LC = Low Crown
BT = Burn Through	EU = External Undercut	IP = Inadequate Penetration	NW = Narrow Weld
BTA = Burn Through Area	HB = Hollow Bead	IPD = Inadequate Penetration Due to High Low	P = Porosity
C = Crack/Cracks	IC = Internal Concavity	ISI = Isolated Slag Inclusions	
CP = Cluster Porosity	IF = Incomplete Fusion	IU = Internal Undercut	

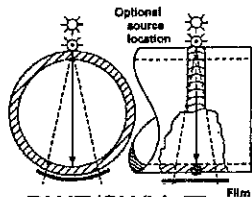
Job Description: **WET MAG Exam of**

RECOMMENDATION					RECOMMENDATION				
WELD NO.	PIPE SIZE	✓ X	ACCEPT REJECT	REMARKS	WELD NO.	PIPE SIZE	✓ X	ACCEPT REJECT	REMARKS
1					31				
2	BRACKET, Load Pin				32				
3					33				
4	Indicator				34				
5					35				
6	N 61980-004				36				
7					37				
8					38				
9					39				
10	100% Mt. of All welds.				40				
11					41				
12					42				
13					43				
14				welding stencil	44				
15					45				
16				✓ Acc M-L, K	46				
17					47				
18					48				
19					49				
20					50				
21					51				
22					52				
23					53				
24					54				
25					55				
26					56				
27					57				
28					58				
29					59				
30					60				

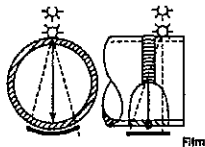
Technique: check exposure setup

SFD \_\_\_\_\_

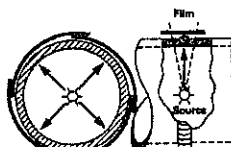
Thickness \_\_\_\_\_



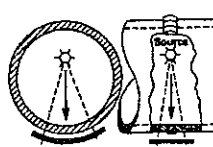
DWE/SWV ☐



DWE/DWV ☐



Panoramic ☐



SWE/SWV ☐

Film Delivered to: SS Manager: _____	Client: _____	Customer Representative: <b>Conny Zand</b>
X-Ray: _____ MAK V: _____	Gamma Ray: _____	Curies: _____
No. of Welds Checked: _____	Focal Size: _____	Ug: _____
Linear Ft. Film: _____	Type: _____	Instrument: <b>ESX 115</b>
Penetrant-A _____ B _____ C _____	Required wire: _____	Angles Used: <b>3 to 6° space</b>
Dye Penetrant: _____	Ultrasonic: _____	Magnetic Particle: <input checked="" type="checkbox"/>
Hours Worked: <b>2</b>	Travel Time: _____	Mileage: _____
Sheet # <b>1</b> of <b>1</b>	Subsistence (check if applicable): _____	Consumables: <b>1 paint</b>
Specifications: _____		

Oceaneering Inspection has furnished this Examination Report of weldments as a good faith interpretation. Acceptance of or rejection of welding discontinuities to the clients specific codes and/or standards shall not infer any warranty or liability on the part of Oceaneering Inspection as to the fitness for service of such weldments and their intended use by the client.

# GLOBAL X-RAY & TESTING CORPORATION

JOEL MOREAU, President  
Residence: 985-446-6861

Post Office Box 1536  
Morgan City, Louisiana 70381

Bus: 985-631-2426  
Fax: 985-631-0093

## MT WORK REPORT

MT06-09293

GTT. MPV. WM-001-REV. 14

CLIENT PILSTATES DATE 11/29/07  
CONTRACTOR SAME JOB LOCATION MULBERRY ROAD  
JOB NO. W.O. 23407.1.1 AFE \_\_\_\_\_ Other \_\_\_\_\_  
MT TECH. Clifford Allen LEVEL II CLIENT REPRESENTATIVE Cory Ford

	WELD NO.	WALL THICKNESS	RECOMMENDATION				WELD NO.	WALL THICKNESS	RECOMMENDATION		
			✓ X	ACCEPT REJECT	REMARKS				✓ X	ACCEPT REJECT	REMARKS
1	CLEWIS UNIVERSAL					51					
2						52					
3			✓		WS J1	53					
4						54					
5						55					
6						56					
7						57					
8						58					
9						59					
10						60					
11	WELD = 20"					61					
12	REP = 0"					62					
13						63					
14						64					
15						65					
16						66					
17						67					
18						68					
19						69					
20						70					
21						71					
22						72					
23						73					
24						74					
25						75					
26						76					
27						77					
28						78					
29						79					
30						80					

**SURFACE CONDITION**  
GOOD (✓) FAIR ( ) PAINTED ( ) WELD ( )

**EQUIPMENT**  
MAKE PARKER MODEL 1300 S/N 15982

**CONTACTS**  
PROD SPACING 6 CONTINUOUS (✓)  
AC (✓) DC ( ) HALF WAVE (✓) FULL WAVE ( )  
AMPS 6

**MEDIA**  
7C-BLACK WET (✓) 8A-DRY ( ) WHITE HIGHLIGHTER (✓)

**CALIBRATION**  
10# WEIGHT LIFT (✓) FLUX IND. CHECK ( )  
CALIBRATION DATE: 11/29/07

**ACCEPTANCE CRITERIA**  
AWS D1.1 PART 6.1  
2006 EDITION

TOTAL TIME HRS. 1

## GLOBAL X-RAY &amp; TESTING CORPORATION

Post Office Box 1536  
Morgan City, Louisiana 70381JOEL MOREAU, President  
Residence: 985-446-6861Bus: 985-631-2426  
Fax: 985-631-0093

## MT WORK REPORT

MT06-08207

GXT-mpuwm-001-Rew.15

CLIENT Oil States DATE 8-14-07  
 CONTRACTOR Same JOB LOCATION Ind. Avenue  
 JOB NO. \_\_\_\_\_ W.O. 23407 AFE \_\_\_\_\_ Other \_\_\_\_\_  
 MT TECH. Mitchell Helbert Level II CLIENT REPRESENTATIVE Butt Began

	WELD NO.	WALL THICKNESS	RECOMMENDATION				WELD NO.	WALL THICKNESS	RECOMMENDATION		
			✓ X	ACCEPT REJECT	REMARKS				✓ X	ACCEPT REJECT	REMARKS
1	100%	MT Insp.			of Coverup	51					
2						52					
3		Areas on 340L Lattice				53					
4						54					
5		Boom Point				55					
6						56					
7		✓				57					
8						58					
9						59					
10						60					
11						61					
12		TOTAL weld = 120"				62					
13						63					
14		TOTAL repair = 0"				64					
15						65					
16						66					
17						67					
18						68					
19						69					
20						70					
21						71					
22						72					
23						73					
24						74					
25						75					
26						76					
27						77					
28						78					
29						79					
30						80					
31											
32											
33											
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## SURFACE CONDITION

GOOD (✓) FAIR ( ) PAINTED ( ) WELD ( )

## EQUIPMENT

MAKE ElectroSpec MODEL ES-X S/N 9453

## CONTACTS

 PROD SPACING 3 1/2" CONTINUOUS (✓)  
 AC (✓) DC ( ) HALF WAVE (✓) FULL WAVE ( )  
 AMPS 5.75

## MEDIA

7C-BLACK WET (✓) 8A-DRY ( ) WHITE HIGHLIGHTER (✓)

## CALIBRATION

 10# WEIGHT LIFT (✓) FLUX IND. CHECK (✓)  
 CALIBRATION DATE: 8-14-07

## ACCEPTANCE CRITERIA



AWS D1.1 Sec. 6.1.0  
Latest edition
TOTAL TIME HRS. 1 hr



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# Material Traceability Log

CRANE WO. NO.:	23407
CUSTOMER:	Pemex
WELDMENT PART NO.:	N61591-001
WELDMENT S/N:	C07101-06
DESCRIPTION:	Bridle Weldment
MODEL:	340LA-80
CHECKED BY:	
DATE:	6-8-07 

[illegible]

DATE	10/12/05
INVOICE NO.	975275
BILL OF LADING	751649
CUSTOMER NO.	5547
CUSTOMER P.O.	27596

**NUCOR-YAMATO STEEL CO.**  
P.O. BOX 1228 • BLYTHEVILLE, AR 72316

# **CERTIFIED MILL TEST REPORT**

100% MELTED AND MANUFACTURED IN U.S.A.  
All shapes produced by Nucor-Yamato Steel are cast and rolled to a fully killed and fine grain practice.

S  
H SAGINAW PIPE  
I 1980 HWY 31 S  
P PO BOX 8  
T SAGINAW, AL 35137-0000  
O

S  
P  
E  
C  
I  
F  
I  
C  
A  
T  
I  
O  
N  
S  
ASTM A572/A572M GR50-03a  
ASTM A709/A709M-03a GR50 (345)

S  
O  
L  
D  
T  
O  
SAGINAW PIPE  
1980 HWY 31 S  
PO BOX 8  
SAGINAW, AL 35137-0000

ASTM A6/A6M-04a

ITEM #	ITEM DESCRIPTION	QTY	HEAT #	MECHANICAL PROPERTIES						CHEMICAL PROPERTIES													
				YIELD TO TENSILE RATIO	YIELD STRENGTH	TENSILE STRENGTH	ELONG %	CHARPY IMPACT		C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Cb	CE		
					PSI	PSI		TEMP	IMPACT ENERGY														
					MPa	MPa		° F	FT-LBS														

FLONGATION BASED ON 8.00 INCH GAUGE LENGTH

I hereby certify that the contents of this report are accurate and correct. All test results and operations performed by this material manufacturer are in compliance with the requirements of the material specifications, and when designated by the purchaser, meet the applicable specifications.

*Gay Lennell*

QUALITY ASSURANCE

CUSTOMER COPY

STATE OF ARKANSAS COUNTY OF MISSISSIPPI  
SWORN TO AND SUBSCRIBED BEFORE ME

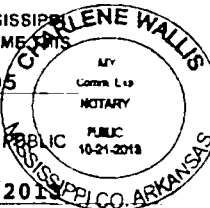
12 Day of 10/05

*Charlene Wallis*

NOTARY PUBLIC

MY COMMISSION EXPIRES

10/21/2010



**Steel Certificate of Test**

1835 DUEBER AVE. S.W.  
CANTON, OHIO 44706  
ID #0130170-1

Page 1 of 2

**TIMKEN**

Where You Turn

02/28/2006

S Marmon/Keystone Corporation  
O T PO Box 588  
L O  
D Bucyrus OH 44820 USA

S Marmon/Keystone Corporation  
H T 930 N. Sandusky Ave.  
I O  
P Bucyrus OH 44820 USA

Customer Order: 87-021720-002 Customer Part Number: 5..75130  
Timken Order: 44062-A (1327254) Heat Number(s): 20110

**Description of Material**

OD: 5.000 in (127.000 mm) WALL: 0.750 in (19.050 mm) ID: 3.500 in (88.900 mm)  
Shape: RD  
Sales Type: 1026  
Int Quality: ELECTRIC FURNACE-ULTRASONIC  
Condition: HOT ROLL

**Specification**

- ASTM A 106 / A 106M Grades B and C Rev. 04b EXCEPT AS NOTED; EXCEPT WEIGHING OF INDIVIDUAL TUBES
- ASME SA-106 Rev. 2004 EDITION GRADES B & C; EXCEPT WEIGHING OF INDIVIDUAL TUBES
- ASTM E 213 Rev. 04 FOR NONDESTRUCTIVE ELECTRIC TESTING
- NACE MR0175 Rev. 97 1/1/1997
- ASTM A 519 Rev. 03
- BRITISH STANDARD BS EN 10204 1/1/1991 SECTION 3.1.B
- DIN EN 10204 1/1/1991 SECTION 3.1.B

**Chemistry Information**

	%C	%Mn	%P	%S	%Si	%Cr	%Ni	%Mo	%Cu	%Al	%V
SPEC Ladle Min:	.22	.60			.10						
SPEC Ladle Max:	.28	.90	.025	.025		.40	.40	.15	.40		.080
20110 Ladle:	.27	.86	.009	.025	.26	.12	.09	.03	.20	.032	.002

When shipping document is attached it becomes part of this certification.

We certify the above materials have been inspected and tested in accordance with the methods prescribed in the governing specifications and consistent with our Standard Commercial Terms and Conditions for Sale, Manufacture, and Shipping, which are incorporated into and made part of this certification. The results of such inspections and tests conform with the applicable requirements. This certificate or report shall not be reproduced except in full, without the written approval of the Timken Corporation.

Approved: \_\_\_\_\_

NOTARY PUBLIC

by

*Essie Dillard*  
Essie Dillard, CERTIFICATION PROCESSOR

THE TIMKEN CORPORATION



*mc*  
5-9-06

**Steel Certificate of Test**1835 DUEBER AVE. S.W.  
CANTON, OHIO 44706**TIMKEN**  
Where You Turn

ID #0130170-1

Page 2 of 2

02/28/2006

Customer Order: 87-021720-002 Customer Part Number: 5..75130  
Timken Order: 44062-A (1327254) Heat Number(s): 20110**Metallurgy Information**

SPEC: Hardness MIDWALL 22 Max UOM ROCKWELL C

Heat	Piece#		UOM
20110	A	MIDWALL 90 / 90	ROCKWELL B

SPEC: Tensile TENSILE 70,000.00 Min STRENGTH UOM PSI YIELD .2 40,000.00 Min  
MIN ELONGATION 22 Min

Heat	Piece#	Tensile Strength	UOM	.2% Yld Strength	Elong %	Gauge %Red	Length	Specimen	Direction
20110	A	83,470	PSI	55,859	26.7	56.3	2 IN	0.505 in RD	LONG.

Flattening test - Satisfactory

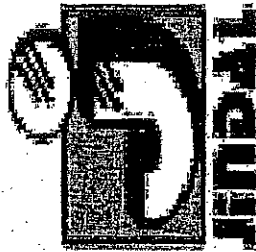
Ultrasonic in lieu of hydrostatic testing - Satisfactory.

The Timken Company certifies that there is no mercury or radio-active material used in the melting or processing.

Material melted and produced in the USA

THE TIMKEN CORPORATION

Handwritten signature and date: 5-9-06



# Jindal United Steel Corporation

5200 E. McKinney Road  
Baytown, TX 77520

## METALLURGICAL TEST REPORT

TC No.: BR101994-6170-02

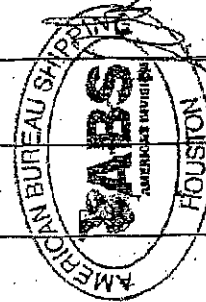
Sold To: CITAPEL STEEL CO. 590 NORTH BETHLEHEM PIKE P.O. BOX 1000 SPRING HOUSE, PA 19477-1000		Ship To: CHAPEL STEEL CO. 6605 N. HOUSTON ROSSLYN RD. HOUSTON, TX 77091		This is to certify that the product described herein was manufactured, sampled, and tested in accordance with the specifications and requirements in such specifications. Fine Grain, Si-AL Fully Killed Steel		Bulletin Num. 101994
Plates Manufactured in the USA		Order No: JUS2639-07		Approved By: <i>Helen Green</i>		
Certified by ISO 9001:2000		Date 5/2/2007		Shipping Mode: DIRECT TRUCK		
		P.O. Number HOU-3248		DIN 50049 3.1.B / EN 10204:2004 3.1		

**Specifications:**  
HOT ROLLED PLATE CUT EDGE ASTM/ASME A36 -05 / ABSGR A / B & A709 - 05 GR  
36 STRUCTURAL QUALITY

Insp.

\* We hereby certify that the material described herein has been made to the application by the B.O.S. process and tested in accordance with the requirements of American Bureau of Shipping Rules with satisfactory results.

Item No.	Material Description		Bulletin		Heat No.	Gauge Tested	Test/Plate Identity	Test Cond	Yield Point (KSI)	Tensile Strength (KSI)	Elongation (%)		Yield Strength Determined at	LCVN FULL num @ 32 DEG F
	Gauge	Width	Length	Qty							in 8"	in 2"		
07	1.0000	96.0000	480.0000	1		1.125 1.125	08A 08B	ABS ARS	47 55	71 71	24 24		0.2% 0.2%	120 - 112 - 118 FULLmm @ 32°F 105 - 92 - 109 FULLmm @ 32°F
MAY - 3 2007														
HS8023764AX														



15  
INSPECT

Heat No. S06170		CE:0.38														
Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Cb
LADLE	0.17	1.14	0.015	0.004	0.25	0.04	0.03	0.04	0.010	0.001	0.033	0.005	0.005	0.0005	0.005	0.010



Metallurgical Chemistry and Testing Laboratory

3204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
metallab@an-tech.com

May 16, 2007

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No 10647/31768  
Report No. 07-1153-2

IDENTIFICATION: 1" x 4" x 6", HT# S06170, SL# 7BA  
MATERIAL: ASTM A36, Mfg. JUS  
REFERENCE: HOU-31768

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
103.0	91	60
112.0	94	60
90.0	77	50



JP 5-22-07

Donald Derrick  
Mechanical Testing Supervisor

Sc

Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.

PO/Rel

ALABAMA

PART NO.

**NUCOR**P.O. Box 279  
Winston, NC 27986  
(252) 358-3700**Mill Test Report**

Page 2

**NUCOR**  
It's our Nature!

Issuing Date : 01/06/2007

Vehicle No: ALY 91721

Specification : 2.0000" x 96.000" x 480.000"

ASTM A36-05/ABS Grade A/ABS Grade B/A36-03/A709 36-063

Load No. : 154226

Sold To : CHAPEL STEEL CO  
P O Box 1000

FAX# 215-783-9415

SPRINGHOUSE, PA 19477

Our Order No. : 5121514

Ship To : CHAPEL STEEL

8605 N. HOUSTON ROSSLYN ROAD

RAIL SITE 720703

HOUSTON, TX 77081

Marking :

Heat No	C	Min	P	S	Si	Cu	Mn	Gr	Al	V	Nb	Ti	N	Ca	B	Sn	CEQ	PCM
7100130	0.06	1.10	0.010	0.004	0.30	0.20	0.06	0.08	0.01	0.033	0.003	0.002	0.0015	0.0001	0.008	0.28	0.14	
Tensile Test																		
Plate Serial No	Pieces	Dir.	Yield	Tensile	Elongation % in 2"	Elongation % in 8"	Charpy Impacts											
7100130-02	3	T	38,200	58,600	22.0	34.9	H-L	252.4	250.4	255.7	250.5	255.7	250.5	256.2	248.2	10mm	32	20
7100130-03	1	T	36,800	59,100	22.0	34.9	H-L	248.3	245.8	250.5	250.5	255.7	250.5	256.2	248.2	10mm	32	20

Manufactured to fully killed line grain practices by Electric Arc Furnace. Welding or weld repair was not performed on this material. Mercury has not been used in the direct manufacturing of this material. Produced as continuous cast as-cast discrete plate. Yield by U.S.E.L. method unless otherwise specified. Ceq = C+(Mn/6)+(Cr+Mo+V/5)+(Cu+Ni/15)

Pcm = C+(Si/20)+(Mn/20)+(Ni/20)+(Nb/10)+(V/10)+(Mo/10)+(Cu+Ni/15)

Melting and manufacturing in the USA. ISO 9001:2000 certified (#12443-0) by SRI Quality System Registrar (#0805-09). PED 9723/EC Compliant. DIN 50048 3.1.B/EN 10204 3.1.B(2004) compliant. For ABS grades only. Quality Assurance certificate No. 03-MAPQA-182

We hereby certify that the contents of this report are accurate and correct. All test results and operations performed by the material manufacturer are in compliance with the applicable specifications.

T.A. Depotis

01/12/2007 12:31:15 PM

T.A. Depotis, Metallurgist



Metallurgical Chemistry and Testing Laboratory

3204 BROADWAY (77017)  
POST OFFICE BOX 262285  
HOUSTON, TEXAS 77207-2285  
PHONE: (713) 644-7801  
FAX: (713) 644-1400  
metallab@msn.com

February 15, 2007

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

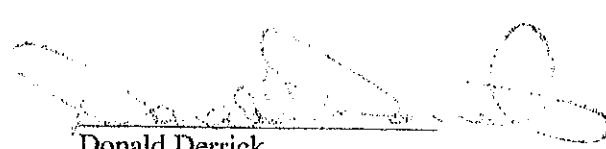
P.O. No. 10647/30671  
Report No. 07-0369

IDENTIFICATION: 2" x 4" x 6", HT# 7100130, SL# 02  
MATERIAL: ASTM A36, Mfg. NUC  
REFERENCE: HOU-30671

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
228.0	98	100
232.0	97	100
232.0	98	100

  
Donald Derrick  
Mechanical Testing Supervisor

Sc

Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.





CUST PO#: 46692

**Richard S. Ray - CHC Steel SC**  
*Quality Assurance Manager*

100% MELTED AND MANUFACTURED IN THE USA AND FREE OF MERCURY CONTAMINATION IN THE PROCESS
REMARKS:

# OCEANEERING® INSPECTION

REPORT NO. 410034

Houma, LA  
(985) 868-5097  
New Iberia, LA  
(337) 365-7102  
Ingleside, TX  
(361) 776-7251

MAILING ADDRESS  
Sta. 1 Box 10267  
Houma, LA 70363

(985) 868-5097  
**DAILY WORK REPORT**  
ISO 9002 Certified

Customer <i>Oil Skated</i>	Job Location <i>Houma, LA</i>	Inspection Date / Time
Billing Address	Project <i>23407</i>	OII Job Number <i>57348</i>
	P.O. #	PKC / AFE #
	S.S. Procedure # <i>MT02 Rv1</i>	Acceptance Criteria <i>AWS D1.1</i>

AD = Accumulations of Discontinuities    ESI = Elongated Slag Inclusion    IFD = Incomplete Fusion Due to Cold Lap    LC = Low Crown  
BT = Burn Through    EU = External Undercut    IP = Inadequate Penetration    NW = Narrow Weld  
BTA = Burn Through Area    HB = Hollow Bead    IPD = Inadequate Penetration Due to High Low    P = Porosity  
C = Crack/Cracks    IC = Internal Concavity    ISI = Isolated Slag Inclusions  
CP = Cluster Porosity    IF = Incomplete Fusion    IU = Internal Undercut

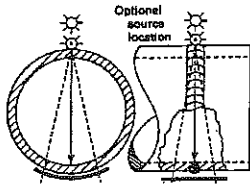
Job Description: *Magnetic Particle Inspection of:*

WELD NO.		PIPE SIZE	RECOMMENDATION			WELD NO.		PIPE SIZE	RECOMMENDATION		
			✓ X	ACCEPT REJECT	REMARKS				✓ X	ACCEPT REJECT	REMARKS
1						31					
2	W10#					32					
3						33					
4	Item # NG1591 - 001					34					
5						35					
6	Buckle, 340L / 340LA					36					
7						37					
8	(M-36-PL-C)					38					
9						39					
10	Boom Suspension Assy					40					
11						41					
12	340L-80 / PAMAX					42					
13						43					
14	MT of Buckle					44					
15						45					
16	Accepted					46					
17						47					
18						48					
19						49					
20						50					
21						51					
22						52					
23						53					
24						54					
25						55					
26						56					
27						57					
28						58					
29						59					
30						60					

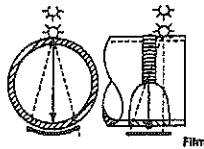
Technique: check exposure setup

SFD

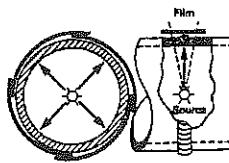
Thickness



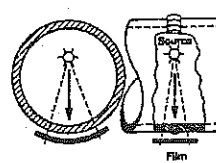
DWE/SWV ☐



DWE/DWV ☐



Panoramic ☐



SWE/SWV ☐

Film Delivered to: SS Manager: \_\_\_\_\_ Client: \_\_\_\_\_

X-Ray: \_\_\_\_\_ MAK V: \_\_\_\_\_ Gamma Ray: \_\_\_\_\_ Curies: \_\_\_\_\_

No. of Welds Checked: \_\_\_\_\_ Focal Size: \_\_\_\_\_ Ug: \_\_\_\_\_

Linear Ft. Film: \_\_\_\_\_ Type: \_\_\_\_\_

Penetrometer-A \_\_\_\_\_ B \_\_\_\_\_ C \_\_\_\_\_

Dye Penetrant: \_\_\_\_\_ Ultrasonic: \_\_\_\_\_ Magnetic Particle: ☒

Hours Worked: *2* Travel Time: \_\_\_\_\_ Mileage: \_\_\_\_\_

Sheet # \_\_\_\_\_ of \_\_\_\_\_ Substistence (check if applicable): \_\_\_\_\_

Customer Representative: *ma Ph*

Date: *7-27-07* Technician: *Sterry Paguin*

Assistant: \_\_\_\_\_ Assistant: \_\_\_\_\_

Instrument: *ESX115VOK*

Angles Used: *W4 Method*

Freq: *AC Cal Bloc: 70B/600*

Couplant: *Various Method*

Consumables: *1 can paint*



Specifications: \_\_\_\_\_

Oceaneering Inspection has furnished this Examination Report of weldments as a good faith interpretation. Acceptance or rejection of welding discontinuities to the clients specific codes and/or standards shall not infer any warranty or liability on the part of Oceaneering Inspection as to the fitness for service of such weldments and their intended use by the client.



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# Material Traceability Log

CRANE WO. NO.:	23407
CUSTOMER:	PEMEX
WELDMENT PART NO.:	N61583-003
WELDMENT S/N:	C07107-01
DESCRIPTION:	Gantry Weldment
MODEL:	340LA-100
CHECKED BY:	
DATE:	8-16-07 

[illegible]



100

Jindal United Steel Corporation

5200 E. McKinney Road  
Baytown, TX 77520

# METALLURGICAL TEST REPORT

**MEET-04**

TC No.: BR102012-6409-01

[illegible]

HCHL No. S06409	CE: 0.30
-----------------	----------

CE-8.30																
HCHL No.2506409																
Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Cb
LADLE	0.12	1.03	0.011	0.009	0.23	0.02	0.02	0.03	0.010	0.001	0.038	0.005	0.005	0.0005	0.005	0.010

15  
INSPECTED  
ISO

5-150



*Metallurgical Chemistry and Testing Laboratory*

3204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2285  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
[metallab@an.com](mailto:metallab@an.com)

May 11, 2007

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/31692  
Report No. 07-1128

IDENTIFICATION: 1" x 4" x 6", HT# S06409, SL# 07BA  
MATERIAL: ASTM A36, Mfg. Jin  
REFERENCE: HOU-31646

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
115.0	92	70
111.0	96	70
107.0	94	70

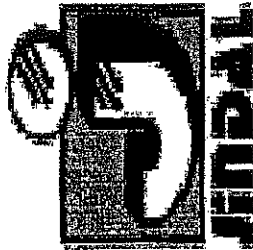


5-15-07

Donald Derrick  
Mechanical Testing Supervisor

Sc

Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.



# Jindal United Steel Corporation

5200 E. McKinney Road  
Baytown, TX 77520

## METALLURGICAL TEST REPORT

MET-04  
TC No.: BRJ02169-6341-01

Sold To: CHAPEL STEEL CO. 590 NORTH BETULEHEM PIKE P.O. BOX 1000 SPRING HOUSE, PA 19477-1000		Ship To: CHAPEL STEEL CO. 6605 N. HOUSTON ROSSLYN RD. HOUSTON, TX 77091		This is to certify that the product described herein was manufactured, sampled, and tested in accordance with the specifications and requirements in such specifications: Fine Grain, Si-AL Fully Killed Steel		Bulletin Num. 102169
Order No: JUS2664-09		Approved By: <i>Helen Green</i>				
Plates Manufactured in the USA		Date 5/8/2007		Shipping Mode: DIRECT TRUCK		
Certified by ISO 9001:2000		P.O. Number HOU-3266		DTN 50049 3.1.B / EN 10204:2004 3.1		

Specifications:  
HOT ROLLED PLATE CUT EDGE ASTM/A36-05 / ABS GR A / B & A709 - 05 GR  
36 STRUCTURAL QUALITY

Insp. "We hereby certify that the material described herein has been made to the application by the B.O.S. process and tested in accordance with the requirements of American Bureau of Shipping Rules with satisfactory results."

Item No.	Material Description		Bulletin		Heat No.	Gauge Tested	Test/Plate Identity	Test Cond	Yield Point (KSI)	Tensile Strength (KSI)	Elongation (%)		Yield Strength Determined at	LCVN
	Gauge	Width	Length	Qty							in 8"	in 2"		
09	2.0000	96.0000	480.0000	1	26.137	S06341	2.000	01A	AR	40	69	35	0.2%	FULL min @ 32DEG F 25 FT/LBS 201 - 158 - 176 FULL min @ 32°F
AMERICAN BUREAU OF SHIPPING ABS HOUSTON														
15 2007 15 2007														
HS823764A														

Heat No. S06341		CE:0.34														
Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Cb
LADLE	0.16	1.07	0.016	0.005	0.28	0.03	0.01	0.02	0.003	0.001	0.038	0.005	0.001	0.0001	0.003	0.001



*Metallurgical Chemistry and Testing Laboratory*

3204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
02/01/08 10:00:00

June 7, 2007

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/32042  
Report No. 07-1387-2

IDENTIFICATION: 2" x 4" x 6", PLT# H21695, HT# S06341, SL# 01A-A  
MATERIAL: ASTM A36, Mfg. JUS  
REFERENCE: HOU-32042

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
65.0	57	40
45.0	49	30
50.0	43	30

Donald Derrick  
Mechanical Testing Supervisor

Sc

Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.



06-15-07





化 学 成 分  
Chemical Composition

証明番号

BASE METAL

Certificate No. : UE-06-0014

頻 度

Sampling Frequency : 2/ 1HEAT

Page : 1

製造番号 Manufacture No.				5Y-01890	5Y-01891			
鋼 番 管理Code-Heat No.				4-1294	4-1294			
		Min.	Max.					
C	%	L	0.18	0.13	0.13			
		P	0.18	0.12	0.13			
Si	%	L	-	0.21	0.21			
		P	-	0.20	0.20			
Mn	%	L	1.20	0.95	0.95			
		P	1.20	0.93	0.94			
P	%	L	0.025	0.016	0.016			
		P	0.025	0.016	0.015			
S	%	L	0.015	0.003	0.003			
		P	0.015	0.003	0.003			
Cu	%	L	-	0.01	0.01			
		P	-	0.01	0.01			
Ni	%	L	-	0.01	0.01			
		P	-	0.01	0.01			
Cr	%	L	-	0.02	0.02			
		P	-	0.01	0.01			
Mo	%	L	-	0.00	0.00			
		P	-	0.00	0.00			
V	%	L	-	0.002	0.002			
		P	-	0.002	0.002			
Nb	%	L	-	0.000	0.000			
		P	-	0.000	0.000			
Ti	%	L	0.04	0.00	0.00			
		P	0.04	0.00	0.00			
B	%	L	-	0.0000	0.0000			
		P	-	0.0000	0.0000			
Nb+V +Ti	%	L	0.15	0.00	0.00			
		P	0.15	0.00	0.00			
Ceq. 7B	%	L	0.40	0.29	0.29			
		P	0.40	0.28	0.29			
Pcm.	%	L						
		P	0.25	0.17	0.18			
		L						
		P						
		L						
		P						
		L						
		P						
		L						
		P						
		L						
		P						
		L						
		P						

Note L: Ladle Analysis - とりだ分析

P: Product Analysis - 製品分析

Ceq.7B= C+Mn/6+(Cu+Ni)/15+(Cr+Mo+V)/5

## 引張試験 Tensile Test

証明書番号

Certificate No. : UE-06-0014

頻 度

Sampling Frequency : 1/ 100P/HEAT

Page : 2

单位

Unit : KSI

試片記号 Spec. Mark		耐 力 Yield Strength	引張強さ Tensile Strength	伸 び Elongation(%)	降伏比 Yield Ratio(%)
TS	Min.	42.0	60.0	30	93
	Max.	72.0	110.0		
TW	Min.		60.0		
	Max.		110.0		
	Min.				
	Max.				
	Min.				
	Max.				

[illegible]

Note Spec. Mark: 註記

TS: Transverse Stock      取样方向 TS: Strip (W=38.1mm)

## 曲 げ 試 験 Bend Test

証明書番号

Certificate No. : UE-06-0014

頻度

Sampling Frequency : 1/ 50P

Page : 3

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[illegible]

Note A: JIG Dimension

\* REDUCED WALL SPECIMEN

# シャルピー衝撃試験 Charpy Impact Test

証明番号

Certificate No. : UE-06-0014

頻度

Sampling Frequency : 1/ 100P/HEAT

Page

: 4

単位

Unit : FT-LBS

	Test Temperature	Energy		Fracture(%)		試片寸法 Specimen Size
		Min.	Ave.	Min.	Ave.	
TRANSVERSE BODY	0.0°F	15	25	-	-	(CENTER) 10 X 10 2mm V Notch
WELD	0.0°F	15	25	-	-	(CENTER) 10 X 10 2mm V Notch

製造番号 Manufacture No.		5Y-01890							
鋼番 管理Code-Heat No.		4-1294							
TRANSVERSE BODY (CENTER) 0.0°F	1	88	55						
	2	106	70						
	3	56	35						
	Ave.	83	53						
WELD (CENTER) 0.0°F	1	113	70						
	2	71	60						
	3	133	75						
	Ave.	106	68						
	1								
	2								
	3								
	Ave.								
	1								
	2								
	3								
	Ave.								
	1								
	2								
	3								
	Ave.								

Note  
E : Energy

## 硬 度 試 驗 Hardness Test

証明書番号

Certificate No. : UE-06-0014

頻度

Sampling Frequency : 1/ 100P/HEAT

## 試驗方法

Test Method : VICKERS

Page : 5.

荷重

Load : 10KG

	Spec.		RECORDED HARDNESS VALUES ARE MAXIMUM VALUES OBTAINED.
	Min.	Max.	
Body		248	
H. A. Z.		248	
Weld		248	

[illegible]

Note

Atlas ABC Corp (Atlas Tube Chicago)  
1855 East 122nd Street  
Chicago, Illinois, USA  
60633  
Tel: 773-646-4500  
Fax: 773-646-6128

Ref.B/L: 80211500  
Date: 10.06.2006  
Customer: 193



## MATERIAL TEST REPORT

## Sold to

Tubular Steel  
1031 Executive Parkway  
ST. LOUIS MO 63141  
USA

## Shipped to

Tubular Steel  
7220 Polson Lane  
HAZELWOOD MO 63141  
USA

Material: 14.0x10.0x500x24"0"0(1x2).  
Sales order: 251791

Material No: 140100500  
Purchase Order: 2415

Made in: USA

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V
T23027	0.210	0.770	0.009	0.006	0.022	0.044	0.020	0.002	0.001	0.010	0.030	0.001

Bundle No	Yield	Tensile	Eln.2in
M900041831	055850 Psi	070980 Psi	41 %

## Certification

ASTM A500-03A GRADE C &amp; B

Material Note:  
Sales Or.Note:

Material: 14.0x10.0x500x24"0"0(1x2).  
Sales order: 251791

Material No: 140100500  
Purchase Order: 2415

Made in: USA

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V
T23027	0.210	0.770	0.009	0.006	0.022	0.044	0.020	0.002	0.001	0.010	0.030	0.001

Bundle No	Yield	Tensile	Eln.2in
M900041830	055850 Psi	070980 Psi	41 %

## Certification

ASTM A500-03A GRADE C &amp; B

Material Note:  
Sales Or.Note:

Material: 14.0x10.0x625x44"0"0(1x2).  
Sales order: 251791

Material No: 140100625  
Purchase Order: 2415

Made in: USA

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V
BB6441	0.210	0.830	0.015	0.014	0.022	0.042	0.050	0.002	0.014	0.020	0.040	0.000

Bundle No	Yield	Tensile	Eln.2in
M900041848	063050 Psi	077330 Psi	39 %

## Certification

ASTM A500-03A GRADE C &amp; B

Material Note:  
Sales Or.Note:

Material: 14.0x10.0x625x40"0"0(1x2).  
Sales order: 251791

Material No: 140100625  
Purchase Order: 2415

Made in: USA

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V
BB6474	0.220	0.780	0.015	0.006	0.027	0.042	0.050	0.000	0.005	0.010	0.070	0.003

Bundle No	Yield	Tensile	Eln.2in
M900041857	060350 Psi	073670 Psi	39 %

## Certification

ASTM A500-03A GRADE C &amp; B

Material Note:  
Sales Or.Note:

Authorized by Quality Assurance: \_\_\_\_\_

Page : 1 Of 2



1-17-07

Atlas ABC Corp (Atlas Tube Chicago)  
1855 East 122nd Street  
Chicago, Illinois, USA  
60633  
Tel: 773-646-4500  
Fax: 773-646-6128



Ref.B/L: 80211500  
Date: 10.06.2006  
Customer: 193

# MATERIAL TEST REPORT

## Sold to

Tubular Steel  
1031 Executive Parkway  
ST. LOUIS MO 63141  
USA

## Shipped to

Tubular Steel  
7220 Polson Lane  
HAZELWOOD MO 63141  
USA

Material: 14.0x10.0x625x36'0"0(1x2).  
Sales order: 251791

Material No: 140100625  
Purchase Order: 2415

Made in: USA

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V
BB6441	0.210	0.830	0.015	0.014	0.022	0.042	0.050	0.002	0.014	0.020	0.040	0.000

Bundle No	Yield	Tensile	Elm. 2in
M900041846	063050 Psi	077330 Psi	39 %

Certification  
ASTM A500-03A GRADE C & B

Material Note:  
Sales Or.Note:

Material: 14.0x10.0x625x32'0"0(1x2).  
Sales order: 251791

Material No: 140100625  
Purchase Order: 2415

Made in: USA

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V
BB6441	0.210	0.830	0.015	0.014	0.022	0.042	0.050	0.002	0.014	0.020	0.040	0.000

Bundle No	Yield	Tensile	Elm. 2in
M900041849	063050 Psi	077330 Psi	39 %

Certification  
ASTM A500-03A GRADE C & B

Material Note:  
Sales Or.Note:

Authorized by Quality Assurance: \_\_\_\_\_

Page : 01 2



1-11-07





2810 Clark Avenue • St. Louis, MO 63103-2574 • (314) 531-8080 • FAX (314) 531-8085  
Chemical, Metallurgical, Mechanical, Nondestructive, Environmental Testing, Analyses and Field Service.

**TUBULAR STEEL, INC.**  
1031 Executive Parkway Drive  
Creve Coeur, MO 63141

November 16, 2006  
Lab No.06P-4235  
P.O. No.40716  
Page 1 of 1

Attention: **JAMES GRIFFIN**

**REPORT OF CHARPY IMPACT TEST**

**MATERIAL (SAMPLE ID):** 14.000OD X 10.000 OD X .825W, HT# BB6441  
**SPECIFICATION:** ASTM A 370-05a  
**SPECIMEN TYPE:** "A" Vee Notch  
**SPECIMEN SIZE:** 10 mm x 10 mm  
**TEMPERATURE OF TEST:** 10°F

**RESULTS:**

BASE METAL	FOOT LBS.	LATERAL EXPANSION	% SHEAR
BB6441-7	36	0.040	40
BB6441-8	40	0.050	50
BB6441-9	56	0.070	50
<b>Average</b>	<b>44</b>	<b>0.053</b>	<b>47</b>

*(Identification of tested specimens provided by client.)*

KS/rfb

*Karl Schmitz, Director*  
Materials Testing



Certificate No. 0007-01  
Certificate No. 0397-02

AN OFFICIAL COPY OF TEST REPORT WILL BE PROVIDED BY THIS LABORATORY ON REQUEST.  
NOT OFFICIAL WITHOUT THE RAISED SEAL OF ST. LOUIS TESTING LABORATORIES, INC.  
SEE REVERSE FOR CONDITIONS.



*JP 11-07*



I certify the above to be correct as contained in the records of COLUMBIA STRUCTURAL TUBING, BY

**COLUMBIA SOUTHERN LUMBER**  
A Division of The Lumber Group  
P.O. BOX 2781 Portland, Oregon 97208 • Fax (503) 737-1200 • Fax (503) 737-1201

# REPORT OF CHEMICAL/PHYSICAL TESTS

CERTIFICATE NO.	DATE	PAGE
218086	Mar 22, 2006	1
INTEL ORDER NO.	DATE	
19805		
CUSTOMER ORDER NO.		
2815		
JOBBER NO.		
SHIPPERS NO.	DATE	
218086	03/22/2006	
TEACHER		
UNION PACIFIC		
CUSTOMER NO.		
TTDTR806262		

<p><b>SOLD TO</b></p>	<p>TUBULAR STEEL 1031 EXECUTIVE PARKWAY ATTN: ACCOUNTS PAYABLE SAINT LOUIS, MO 63141-6351 US</p>	<p>TUBULAR STEEL 1031 EXECUTIVE PARKWAY SAINT LOUIS, MO 63141-6351 USA</p>
<p>THIS MATERIAL HAS BEEN MANUFACTURED, TESTED AND FOUND TO MEET THE SPECIFICATIONS AND PURCHASE ORDER REQUIREMENTS CST ERW STRUCTURAL TUBING ASTM A500-01A GRADE C. CAN 25 FT/LBS AVG @ +1.0 F (H) 17 FT/LBS MIN.</p>		

## PHYSICAL PROPERTIES

Q&H ITEM	DESCRIPTION	HEAT NO.	SLAB	YIELD F80 X 100	TENSILE F80 X 100	% ELONG 8" 2"	% RA	HARDNESS BHN	RENO TEST	IMPACTS
1	10,000 X 10,000 X 0.5000 X 32" CHARPY TEST 25/17 FT LBS @ +10F 4 PCS 7992 LBS	V02578		600	715	39		LCVN @ 10	DEE F	10.0mm 187 185 183/185 ft/lbs
2	10,000 X 10,000 X 0.5000 X 36" CHARPY TEST 25/17 FT LBS @ +10F 4 PCS 8992 LBS	V02578		600	715	39		LCVN @ 10	DEE F	10.0mm 187 185 183/185 ft/lbs
3	10,000 X 10,000 X 0.5000 X 40" CHARPY TEST 25/17 FT LBS @ +10F 12 PCS 29964 LBS	V02578		600	715	39				

## CHEMICAL ANALYSIS

CHEMICAL ANALYSIS																	CE
HEAT NO.	C	Mn	P	S	Si	Cu	Ni	V	Co	Al	Cr	Mo	Ti	B	N <sub>2</sub>	Ca	MACROALLOY CONTENT (Percent Total)
W02578	.13	.73	.016	.003	.21	.01	.01	.002	.001	.030	.02	.00	.001				
HEATS INDICATED WITH (+) WERE MELTED & MANUFACTURED IN THE USA. ALL OTHER HEATS WERE ROLLED IN THE USA.																	

## CONCRETE BEAMS CONTAINED IN THE RECORDS OF CORBIA STRUCTURAL TUBING BY

**Stable Structures**  
As Simple As Your Dream

## REPORT OF CHEMICAL PHYSICAL TESTS

100-2-10

VICTOR STEEL  
 14031 EXECUTIVE PARKWAY  
 DATTIN: ACCOUNTS PAYABLE  
 SAINT LOUIS, MO 63141-6351  
 US

**TUBULAR STEEL  
1031 EXECUTIVE PARKWAY  
SAINT LOUIS, MO 63141-6351  
USA**

THIS MATERIAL HAS BEEN MANUFACTURED, TESTED AND FOUND TO MEET THE SPECIFICATIONS AND PURCHASE ORDER REQUIREMENTS  
CST ERW STRUCTURAL TUBING ASTM A500-01A GRADE C. CUN 25 FT/LBS AVG @ +10 F (H)  
17 FT/LBS MIN.

**17 YEARS MIN.**

## PHYSICAL PROPERTIES

QUN ENTD	DESCRIPTION	HEAT NO.	SLAB	YIELD PSI X 100	TENSILE PSI X 100	% ELONG 5" 2"	% RA	HARDNESS BHN	DEMO TEST	IMPFCTS
3	10.000 X 10.000 X 0.5000 X 40'	V02578								
	20 PCS 46948 LBS TOTALS									
							ICIN @ 10	DEE F	10.0mm	187 185 183/185 ft./lbs

# CHEMICAL ANALYSIS

HEAT NO.	C	Mn	P	S	Si	Cu	Ni	V	Cr	Mo	Ti	B	Nb	Ca	CE	ANALYST'S NAME
902578	.13	.73	.015	.003	.21	.01	.01	.001	.001	.02	.00	.001				
HEATS INDICATED WITH (+) WERE MELTED & MANUFACTURED IN THE USA. ALL OTHER HEATS WERE ROLLED IN THE USA.																
.....																
END OF REPORT																

Atlas Tube (Arkansas) Inc.  
5000 N. County Rd. 987  
Blytheville, Arkansas, USA  
72315  
Tel: 519-738-6000  
Fax: 519-738-3537



Ref.B/L: 80212250  
Date: 11.27.2006  
Customer: 193

**Sold to**

Tubular Steel  
1031 Executive Parkway  
ST. LOUIS MO 63141  
USA

**MATERIAL TEST REPORT****Shipped to**

Tubular Steel  
27700 Highway Blvd.  
KATY TX 77493  
USA

Material: 8.0x8.0x500x40"0(2x2)VNMHRPS1  
Sales order: 249972

Material No: 80080500

Made In: USA

Purchase Order: 2399

Heat No	C	Mn	P	S	Si	Al	Cu	Co	Mo	Ni	Cr	V
267304	0.030	1.090	0.010	0.000	0.231	0.035	0.110	0.000	0.010	0.040	0.040	0.001

Bundle No	Yield	Tensile	Eln.2In	Certification
M5-112284	072170 Psi	073500 Psi	39.2 %	ATLAS ROPS 1

Material Note:  
Sales Or.Note:

Material: 8.0x8.0x500x40"0(2x2)VNMHRPS1  
Sales order: 249972

Material No: 80080500

Made In: USA

Purchase Order: 2399

Heat No	C	Mn	P	S	Si	Al	Cu	Co	Mo	Ni	Cr	V
267304	0.030	1.090	0.010	0.000	0.231	0.035	0.110	0.000	0.010	0.040	0.040	0.001

Bundle No	Yield	Tensile	Eln.2In	Certification
M5-112285	072170 Psi	073500 Psi	39.2 %	ATLAS ROPS 1

Material Note:  
Sales Or.Note:

Material: 8.0x8.0x500x40"0(2x2)VNMHRPS1  
Sales order: 249972

Material No: 80080500

Made In: USA

Purchase Order: 2399

Heat No	C	Mn	P	S	Si	Al	Cu	Co	Mo	Ni	Cr	V
267304	0.030	1.090	0.010	0.000	0.231	0.035	0.110	0.000	0.010	0.040	0.040	0.001

Bundle No	Yield	Tensile	Eln.2In	Certification
M5-112283	072170 Psi	073500 Psi	39.2 %	ATLAS ROPS 1

Material Note:  
Sales Or.Note:

Material: 8.0x8.0x500x40"0(2x2)VNMHRPS1  
Sales order: 249972

Material No: 80080500

Made In: USA

Purchase Order: 2399

Heat No	C	Mn	P	S	Si	Al	Cu	Co	Mo	Ni	Cr	V
267304	0.030	1.090	0.010	0.000	0.231	0.035	0.110	0.000	0.010	0.040	0.040	0.001

Bundle No	Yield	Tensile	Eln.2In	Certification
M5-112281	072170 Psi	073500 Psi	39.2 %	ATLAS ROPS 1

Material Note:  
Sales Or.Note:

Authorized by Quality Assurance:

Page: 1 Of 2



11-11-07

Atlas Tube (Arkansas) Inc.  
5000 N. County Rd. 967  
Blytheville, Arkansas, USA  
72315  
Tel: 519-738-5000  
Fax: 519-738-3537



Ref.B/L: 80212250  
Date: 11/27/2006  
Customer: 193

**Sold to**

Tubular Steel  
1031 Executive Parkway  
ST. LOUIS MO 63141  
USA

**MATERIAL TEST REPORT****Shipped to**

Tubular Steel  
27700 Highway Blvd.  
KATY TX 77493  
USA

Material: 8.0x8.0x500x4000(2x2)VNMHROPS1  
Sales order: 249972

Material No: 80060500

Made in: USA

Purchase Order: 2399

Heat No	C	Mn	P	S	Si	Al	Cu	Co	Mo	Ni	Cr	V
267304	0.030	1.090	0.010	0.000	0.231	0.035	0.110	0.000	0.010	0.040	0.040	0.001

Bundle No	Yield	Tensile	Elm.2In	Certification
M5-112282	072170 Psi	073500 Psi	38.2 %	ATLAS ROPS 1

Material Note:  
Sales Or.Note:

Material: 8.0x8.0x500x4000(2x2)VNMHROPS1  
Sales order: 249972

Material No: 80060500

Made in: USA

Purchase Order: 2399

Heat No	C	Mn	P	S	Si	Al	Cu	Co	Mo	Ni	Cr	V
267304	0.030	1.090	0.010	0.000	0.231	0.035	0.110	0.000	0.010	0.040	0.040	0.001

Bundle No	Yield	Tensile	Elm.2In	Certification
M5-112280	072170 Psi	073500 Psi	38.2 %	ATLAS ROPS 1

Material Note:  
Sales Or.Note:

Authorized by Quality Assurance:

Page: 2 Of 2

051  
16  
11-11-07

Atlas Tube (Arkansas) Inc.  
5000 N. County Rd. 987  
Blytheville, Arkansas, USA  
72315  
Tel: 519-738-5000  
Fax: 519-738-3537



# MATERIAL TEST REPORT

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V
267304	0.030	1.090	0.010	0.000	0.231	0.035	0.110	0.000	0.010	0.040	0.040	0.001

Material	Yield	Tensile	Elm.2in	Certification
8 X 8 X .500	072170 Psi	073500 Psi	39.2 %	

Impact Value Req.	Sample Size	Absorbed Energy1 FT-LBS	CHARPY Test Results Absorbed Energy2 FT-LBS	Absorbed Energy3 FT-LBS	Avg FT-LBS	Shear Area1 %	Shear Area2 %	Shear Area3 %	Avg %
20/13 FT-LBS @ -4 F	10x7.5 mm	194	196	193	194	95	95	95	95

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V
267304	0.030	1.090	0.010	0.000	0.231	0.035	0.110	0.000	0.010	0.040	0.040	0.001

Material	Yield	Tensile	Elm.2in	Certification
8 X 8 X .500	072170 Psi	073500 Psi	39.2 %	

Impact Value Req.	Sample Size	Absorbed Energy1 FT-LBS	CHARPY Test Results Absorbed Energy2 FT-LBS	Absorbed Energy3 FT-LBS	Avg FT-LBS	Shear Area1 %	Shear Area2 %	Shear Area3 %	Avg %
20/13 FT-LBS @ -4 F	10x7.5 mm	194	196	193	194	95	95	95	95

Authorized by Quality Assurance:

*[Signature]*

Page: 1 OF 1



*[Handwritten signature]*



06/27/2007 From: AMERICAN ALLOY STEEL  
F.O.#: \*\*4061359RPL  
Item: 1 (2 PC) 3/4" X 120" X 96" ( MARK D-0-R)  
S.O.#: 296699  
TO: OIL STATES-SKAGIT-SMATCO  
AA PL#:MS9096



Jindal United Steel Corporation  
5200 E. McKinney Road  
Baytown, TX 77520

AMERICAN ALLOY STEEL  
PLATE # *ms9096*  
TC No.: BR100094-5219-01  
MET-94

## METALLURGICAL TEST REPORT

Sold To: AMERICAN ALLOY STEEL INC. 7721 PINEMONT HOUSTON, TX 77040		Ship To: AMERICAN ALLOY STEEL INC. 7105 ST. GABRIEL ST. ST. GABRIEL, LA 70776		This is to certify that the product described herein was manufactured, sampled, and tested in accordance with the specifications and requirements in such specifications: Fine Grain, Si-AL Fully Killed Steel		Bulletin Num. 100094
Plates Manufactured in the USA Certified by ISO 9001:2000		Order No: JUS2418-06		Approved: <i>Helen Green</i>		
Date 1/4/2007		P.O. Number 68436-LA		Shipping Mode: DIRECT TRUCK		
Specifications: HOT ROLLED PLATE CUT EDGE ASTM/ASME A36-05/SA36-05 EDI ABS-06 GR A DUAL TO A131 GRA STRUCTURAL QUALITY		Insp.		We hereby certify that the material described herein has been made to the application by the B.O.S. process and tested in accordance with the requirements of American Bureau of Shipping Rules with satisfactory results."		
Material Description		Bulletin		Tensile Strength (KSI)		
Item No.	Gauge Width Length Qty	Wgt	Heat No.	Gauge Tested	Test/Plate Identity	Test Cond
06	0.7500 120.0000 480.0000 2	24,504	S05219	0.500 1.250	03A 05C	ABS ABS
Yield Point (KSI)		Yield Strength (KSI)		Elongation (%)		
50 42		70 63		in 8" in 2"		
0.2%		0.2%		Certified true copy of the original retained in our file.		
AMERICAN ALLOY STEEL, INC.		AMERICAN ALLOY STEEL, INC.		H 57760526X		
Heat No. S05219 CE:0.30		JAN - 4 2007				
Test Type	C Mn P S Si Cu Ni Cr Mo Sn	N		V		Clb
LADLE	0.12 1.02 0.011 0.014 0.25 0.01 0.02 0.03 0.001 0.001	0.007		0.006		0.003

15  
JAN 15 2007  
H 57760526X



06/27/2007 From: AMERICAN ALLOY STEEL

P.O.# : \*4061359RPL

S.O.# : 296699

To: OIL STATES-SKAGIT-SMATCO

AA PL#: MS9096

Item : 1 (2 PC) 3/4" X 120" X 96" ( MARK D-0-R)

: TAG: N00160-012



*Metallurgical Chemistry and Testing Laboratory*

3204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
EMAIL: [an-tech@an-tech.com](mailto:an-tech@an-tech.com)

June 27, 2007

Page 1 of 2

American Alloy Steel, Inc.

Attn: Q. A. Department

P.O. Box 40460

Houston, TX 77240

P.O. No. 71819

Report No. 07-1607

IDENTIFICATION: 3/4" x 4" x 6", PLT# MS9096, HT# S05219

MATERIAL: SA-36, Mfg. JUS

REFERENCE: S/O# 296699

IMPACT TEST

10mm x 10mm CVN @ +10°F

(Longitudinal)

Foot/Pounds

Lateral Expansion (mils)

%Shear

79.0

58

40

81.0

77

50

71.0

74

40



JP6-29-07

MECH. TESTING - O.K.

DATE

BY

6/27/07  
Sandra Vazano

Donald Derrick  
Mechanical Testing Supervisor

05/27/2007 From: AMERICAN ALLOY STEEL

P.O.# : \*4061359RPL

S.O.# : 296699

TO: OIL STATES-SKAGIT-SMATCO

AA PL#:MS9096

Item : 1 (2 PC) 3/4" X 120" X 96" ( MARK D-0-R)

:TAG: N00160-012



100 : 1

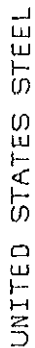
200  $\mu$ m

AN-TECH REPORT#07-1607 100X NITAL ETCH; AMERICAN ALLOY  
3/4"PLATE HEAT#SO5219PLATE#MS9096  
MATERIAL: SA-36

PHOTOMICROGRAPH OF SUBMITTED TRANSVERSE SECTIONS  
SHOWING AN AVERAGE AS RECEIVED FERRITIC GRAIN SIZE  
=7(COMPOSED OF SIZES 6, 7 AND 8)



JP6-24-07



TUBULAR PRODUCTS

# CERTIFIED TEST REPORT

(TYPE B - IN ACCORDANCE WITH ISO 10474/EN10204/DIN50049 3.1.b)

**CALL ORDER/ITEM NO.**

DR33131 02 R64708

**SOLD TO ADDRESS**

DIXIE PIPE SALES LP

P.O. BOX 300550

HOUSTON TX 77230-0650

**P.O. NUMBER**

4708

MAIL TO ADDRESS

DIXIE TYPE SALES - R.

PO BOX 38055

HOUSTON TX 77230-0650

VEHICLE I.D.

LT8067

WEINER

US TIBETAN BONNETS

2199 EAST 28TH ST

LABORATORY OH 44055

### **SPECIFICATION AND GRADE**

PIPE CARBON SMLS STD PIPE API 5L-X43RD EDITION DATED 3/04 PSL-1 GRADE B AND GRADE X42 ASTM A53-X04A  
ASTM A106-X04B GRADE B QUAD STENCIL ASME SA53-X2004 EDITION ASME SA106-X2004 EDITION GRADE B CARBON  
EQUIVALENT .43 MAX TO SR18 BLK REG MILL COAT PE BEV 30 DEG MEETING ALL THE APPLICABLE REQUIREMENTS OF  
NACE STANDARD MR-01-75 X2002

MATERIAL COND:		AS ROLLED		OD: 3.500( 88.900)		WALL: 0.216 ( 5.486)		in (mm)		in (mm)													
PRODUCT IDENTIFICATION		TENSILE		YIELD		EXT %		TENSILE PSI		Y/T		ELONG % (IN 2" )		HARDNESS SCALE: HRB		MIN HYDRO PSI		DWELL (SEC)					
		TEST TYPE/ ORIENTATION		TEST COND.		GAUGE WIDTH IN		MIN: MAX:		MIN: MAX:		MIN: MAX:		MIN: MAX:									
B06713		STRIP/L/B		AR		0.750		50500		.50		75500		0.67		35.0		B 80.0		3000			
B06715		STRIP/L/B		AR		0.750		50000		.50		76500		0.66		34.0		B 79.7		3000			
				** END OF DATA THIS SHEET **																			
LEGEND:		L - LONGITUDINAL U - UPSET		T - TRANSVERSE N - NORMALIZED		QT - QUENCHED & TEMPERED SR - STRESS RELIEVED		AR - AS ROLLED		B - BODY		W - WELD											
PRODUCT IDENTIFICATION		TYPE		C	MN	P	S	SI	CU	NI	CR	MO	AL	N	V	B	TI	CB	CO	CE*	MAX		
B06713		HEAT		.19	125	008	004	.18	.06	.05	.10	.02	.027			.0002	.002	.001			.43		
B06713		PROD		.18	123	008	005	.18	.03	.02	.07	.01	.027			.0004	.002	.001			.40		
B06713		PROD		.18	123	008	005	.18	.03	.02	.07	.01	.027			.0004	.002	.001			.37		
B06716		HEAT		.20	124	017	006	.18	.03	.02	.09	.02	.026			.0003	.001	.001			.39		
B06716		PROD		.20	124	015	006	.17	.03	.02	.09	.01	.024			.0002	.002	.001			.39		
B06716		PROD		.18	122	014	006	.17	.03	.02	.09	.01	.025			.0002	.002	.001			.37		
				** END OF DATA THIS SHEET **																			

\*CE IS BASED ON THE FOLLOWING EQUATION(S): CE = C + (MN/6) + (CR+MO+V)/5 + (NI+CU)/15

DECIMAL POSITIONS FOR ELEMENTS ARE INDICATED BY THE LEFT MARGIN, VERTICAL DOTTED LINE OR DECIMAL POINT.



UNITED STATES STEEL

TUBULAR PRODUCTS

CERTIFIED TEST REPORT

(TYPE B - IN ACCORDANCE WITH ISO 10474/EN10204/DIN50049 3.1.b)

DATE: 11/08/05

TIME: 09:52:44

SERIAL NO:

27494

MILL ORDER/ITEM NO. DR33131 02	SHIPPER'S NO. R64708	P.O. NUMBER 2276	O.D.: 3.500 ( 88.900 )		WALL: 0.216 ( 5.486 )		in (mm)								
MATERIAL COND: AS ROLLED		CHARPY V-NOTCH IMPACT TESTING													
PRODUCT IDENTIFICATION	FLAT	BEND	GRAIN SIZE	MIN COLLAPSE	DIP	TEST LOC.	TEMP	SIZE	TEST COND.	FT-LBS			% SHEAR		
										1	2	3	1	2	3
B06713 B06716	OK OK														
LEGEND: L - LONGITUDINAL      T - TRANSVERSE      B - BODY      W - WELD      HAZ - HEAT AFFECTED ZONE															
TESTING / INSPECTION INFORMATION															
RESULTS / COMMENTS															
TEST / INSPECTION															
YES															
FULL LENGTH VISUAL															
X															
FULL LENGTH EMI															
OD _____ OD/ID _____ L/T _____															
FULL LENGTH MPI															
OD _____ OD/ID _____ L/T _____															
FULL LENGTH UT															
MPI _____ UT _____															
END AREA INSPECTION (PLAIN END)															
MPI _____ UT _____															
SPECIAL END AREA (SEA) INSP.															
DRIFT MANDREL SIZE:															
FULL LENGTH DRIFT															
ADDITIONAL NOTES/COMMENTS															
MELTED AND MANUFACTURED IN THE USA. NO REPAIRS BY WELDING. NO MERCURY OR MERCURY COMPOUNDS ARE ADDED TO THE STEEL AND ALL MERCURY BEARING EQUIPMENT IS PROTECTED BY A DOUBLE BOUNDARY OF CONTAINMENT.															
PIPE ALSO MEET THE REQUIREMENTS OF ASTM A106 GRADE C & ASME SA106 GRADE C															

THIS IS TO CERTIFY THAT THE PRODUCT DESCRIBED HEREIN WAS MANUFACTURED, SAMPLED, TESTED AND/OR INSPECTED IN ACCORDANCE WITH THE SPECIFICATION AND FULFILLS THE REQUIREMENTS IN SUCH RESPECTS.

PREPARED BY THE OFFICE OF: J. MAJKRZAK - MANAGER, Q.A.

DATE 11/08/05

MILL TEST REPORTS  
FOR PO# \_\_\_\_\_  
DIXIE PIPE SALES, LP05 16  
3-2-07

CHAPEL STEEL CO.  
OIL STATES-SKAGIT-SMATCO  
ASTM A36 PER CUSTOMER SPEC "M-36-PL C"  
1/2" X 96.0000" X 120.0000"  
PART NO.

PO/Rel 4060104 /ROBERT H.

Certificate of Mill Test Results  
SO HOU-031768-001  
17May07  
Pg 1/1

**NUCOR**  
PLATE MILL

P.O.Box 279  
Winton, NC 27986  
(252) 356-3700

## Mill Test Report

Page 2



Issuing Date : 03/12/2007 B/L No. : 158163 Load No. : 180083 Our Order No. : 51884/2 Cust. Order No. : HOU-3183  
Vehicle No. : TTPX 80655 Sold To : CHAPEL STEEL CO Ship To : CHAPEL STEEL  
Specification : 0.5000" x 96.000" x 120.000" P O Box 1000 6605 N. HOUSTON ROSSLYN ROAD  
ASTM A36-05/ABS Grade A/ABS Grade B/ASME SA36-03a/A709 36-06a FAX# 215-793-9415 RAIL SITE 720703  
SPRINGHOUSE, PA 19477 HOUSTON, TX 77091

Marking :

Heat No	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Alz	V	Nb	Ti	N	Ca	B	Sn	CEQ	PCM
7101673	0.05	0.88	0.016	0.004	0.29	0.20	0.08	0.13	0.01	0.024	0.002	0.001	0.001	0.001	0.0009	0.0001	0.008	0.25	0.13
Plate Serial No	Pieces	Dir.	Yield	Tensile	Elongation % in 2"	Elongation % in 8"	Dir.	Charpy Impacts											
								(%) shear	(%) shear	(%) shear	(%) shear	(%) shear	(%) shear	(%) shear	(%) shear	(%) shear	(%) shear	Min Temp	Ave.
7101673-03	2	T	44,000	62,600	26.9	26.9													
		T	44,500	61,000	28.0	28.0													
7101673-04	5	T	44,000	62,600	26.9	26.9													
		T	44,500	61,000	28.0	28.0													
7101673-06	1	T	44,000	62,600	26.9	26.9													
		T	44,500	61,000	28.0	28.0													

OSI  
15  
APR 2007  
W5-24-07

Manufactured to fully killed fine grain practice by Electric Arc Furnace. Welding or weld repair was not performed on this material. We hereby certify that the contents of this report are accurate and correct. All test results and operations performed by the material manufacturer are in compliance with the applicable specifications.

Post = C-(S30303)-Mn20H-Cu20H-Ni80H-(Co20H-Mo15H-V10H)-6B  
Milled and manufactured in the USA. ISO 9001-2000 certified (#12443-0) by SRI Quality System Registrar (#0885-09). PED 97/23/EC Compliant.  
DIN 50048 3.1.B1EN 10204 3.1.B(2004) compliant. For ABS grades only. Quality Assurance certificate No. 03-MMPQA-182

T. A. Depretis, Metallurgist



Metallurgical Chemistry and Testing Laboratory

3204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
[metallab@an-tech.com](mailto:metallab@an-tech.com)

May 16, 2007

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/31768  
Report No. 07-1153-1

IDENTIFICATION: 1/2" x 4" x 6", HT# 7101673, SL# 06  
MATERIAL: ASTM A36, Mfg. NUC  
REFERENCE: HOU-31768

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
237.0	97	100
238.0	99	100
228.0	96	100



JP5-24-07

Donald Derrick  
Mechanical Testing Supervisor

Sc

Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.

03/22/2007 From: SABEL STEEL

To:

FAX #:

ATTN::

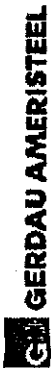
PO, #:

Page 4 of 5

C-502666

## Chemical and Physical Test Report

MADE IN UNITED STATES



CHARLOTTE STEEL MILL  
6601 LAKEVIEW ROAD  
CHARLOTTE NC 28269 USA  
(704) 596-0361

## PRODUCED IN: CHARLOTTE

SHIP TO  
SABEL INDUSTRIES  
1500 CHIPPEWA ST.  
877-797-8335  
BATON ROUGE, LA 70805

INVOICE TO  
SABEL STEEL SERVICE INC  
PO DRAWER 4747

MONTGOMERY, AL 36103-4747

SHIP DATE  
01/26/07CUST. ACCOUNT NO  
37835923SALES ORDER  
7010362-05CUST P.O. NUMBER  
50753-05

SHAPE + SIZE  
F1/4 X 1 1/2

GRADE  
A36

SPECIFICATION  
A36 ASTM A36-05

HEAT I.D.  
C608040

Yield 49432 PSI, 340.82 MPA  
Tensile: 68744 PSI, 473.97 MPA %El: 24.0/8in, 24.0/200MM Bend: OK Std Dev: 0 Idt Diam: .351

Customer Requirements CASTING: STRAND CAST

SHAPE + SIZE  
F1/4 X 2

GRADE  
A36

SPECIFICATION  
A36 ASTM A36-05

HEAT I.D.  
C608040

Yield 53546 PSI, 369.19 MPA  
Tensile: 72902 PSI, 502.64 MPA %El: 24.5/8in, 24.5/200MM Bend: OK Std Dev: 0 Idt Diam: .66

Customer Requirements CASTING: STRAND CAST

SHAPE + SIZE  
F3/8 X 1 1/2

GRADE  
A36

SPECIFICATION  
ASTM A36-05

HEAT I.D.  
C605433

Yield 47890 PSI, 330.19 MPA  
Tensile: 69529 PSI, 479.39 MPA %El: 25.0/8in, 25.0/200MM Bend: OK Std Dev: 0 Idt Diam: .609

Customer Requirements CASTING: STRAND CAST

This material, including the billets, was produced and manufactured in the United States of America

Bhaskar Yalamanchili  
Quality Director  
Gerdau Ameristeel

Mgr. Metallurg. Svcs.  
CHARLOTTE STEEL MILL



3-23-07

THE ABOVE FIGURES ARE CERTIFIED EXTRACTS FROM THE ORIGINAL CHEMICAL AND PHYSICAL TEST RECORDS AS CONTAINED IN THE PERMANENT RECORDS OF COMPANY.



**BAYOU STEEL CORPORATION**

RIVER ROAD P.O. BOX 5000  
LA PLACE, LOUISIANA 70069-1156  
Telephone (985) 652-4900

**MATERIAL CERTIFICATION REPORT**

SABEL STEEL SERVICES INC.  
P.O. DRAWER 4747  
MONTGOMERY, AL 36103-4747

SABEL STEEL SERVICES  
1500 CHIPPEWA DRIVE  
BATON ROUGE, LA 70892

TESTED IN **ASTM A6**  
ACCORDANCE  
WITH

INVOICE NO.  
PRODUCT **FLATS**  
HEAT NO. **53847**  
Length **20'0"**

DATE **03/28/07**  
Cust **S-0050 -0021**  
GRADE **A3652950**  
SIZE **F 6 X 1/2 X 10.21**

PO:51234

CHEMICAL ANALYSIS	
C	.13
Mn	.88
P	.012
S	.035
Si	.18
Cu	.31
Ni	.15
Cr	.14
Mo	.041
Cb	.019
V	.000
B	
Al	
Sn	.007
N	
TI	

MECHANICAL PROPERTIES	TEST 1		TEST 2		TEST 3	
	IMPERIAL	METRIC	IMPERIAL	METRIC	IMPERIAL	METRIC
YIELD STRENGTH	56,717 PSI	391 MPa	57,925 PSI	399 MPa	PSI	MPa
TENSILE STRENGTH	73,564 PSI	507 MPa	73,218 PSI	505 MPa	PSI	MPa
ELONGATION	36.0 %	36.0 %	33.0 %	33.0 %	%	%
GAUGE LENGTH	8 in	203 mm	8 in	203 mm	in	mm
BEND TEST DIAMETER	d	d	d	d	d	d
BEND TEST RESULTS						
SPECIMEN AREA						
REDUCTION OF AREA						
IMPACT STRENGTH	sq in % ft-lbs	sq mm % J	sq in % ft-lbs	sq mm % J	sq in % ft-lbs	sq mm % J

IMPACT STRENGTH	INTERNAL CLEANLINESS		GRAIN SIZE HARDNESS
	IMPERIAL	METRIC	
AVERAGE TEST TEMP	ft-lbs F	J C	
ORIENTATION			GRAIN PRACTICE REDUCTION RATIO

Customer Grade & Specs: **A36-04**  
**44W, CSA50W, A70936**  
**ASME SA36**

**A529-04 GRADE 50**

I HEREBY CERTIFY THAT THE MATERIAL TEST RESULTS PRESENTED HERE ARE FROM THE REPORTED HEAT AND ARE CORRECT. ALL TESTS WERE PERFORMED IN ACCORDANCE TO THE SPECIFICATIONS REPORTED ABOVE. ALL STEEL IS ELECTRIC FURNACE MELTED, MANUFACTURED, PROCESSED, AND TESTED IN THE U.S.A WITH SATISFACTORY RESULTS, AND IS FREE OF MERCURY CONTAMINATION IN THE PROCESS.

NOTARIZED UPON REQUEST:

SWORN TO AND SUBSCRIBED BEFORE ME IN AND FOR ST. JOHN

PARISH ON THIS \_\_\_\_\_ DAY OF \_\_\_\_\_, 20\_\_\_\_

SIGNED

*Mark Edwards*

MARK EDWARDS, QUALITY ASSURANCE SUPERVISOR

DIRECT ANY QUESTIONS OR NECESSARY CLARIFICATIONS CONCERNING THIS REPORT TO THE SALES DEPARTMENT.

1-800-535-7692 (USA)

Michael E. Soileau, # 81887, Notary Public



97-5-07

To:

06/28/2007 From: SABEL STEEL

PO # :  
ATTN: :  
FAX # :





REPORT NO. 418099

Houma, LA  
(985) 868-5097  
New Iberia, LA  
(337) 365-7102  
Ingleside, TX  
(361) 776-7251MAILING ADDRESS  
Sta. 1 Box 10267  
Houma, LA 70363(985) 868-5097  
DAILY WORK REPORT  
ISO 9002 Certified

Customer <b>OIL STATES</b>	Job Location <b>Houma LA</b>	Inspection Date / Time <b>8-18-07</b>
Billing Address	Project <b>23407.02</b>	Oil Job Number <b>57348</b>
	P.O. #	PKC/AFF # <b>LATEST EDITION</b>
	S.S. Procedure # <b>AS MT-02 Rev 1</b>	Acceptance Criteria <b>AS 8.1 6.1</b>

AD = Accumulations of Discontinuities  
BT = Burn Through  
BTA = Burn Through Area  
C = Crack/Cracks  
CP = Cluster Porosity  
ESI = Elongated Slag Inclusion  
EU = External Undercut  
HB = Hollow Seed  
IC = Internal Concavity  
IF = Incomplete Fusion  
IFD = Incomplete Fusion Due to Cold Lap  
IP = Inadequate Penetration  
IPD = Inadequate Penetration Due to High Low  
ISI = Isolated Slag Inclusions  
IU = Internal Undercut  
LC = Low Crown  
NW = Narrow Weld  
P = Porosity

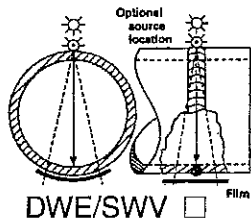
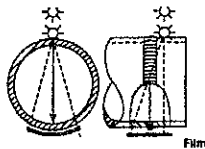
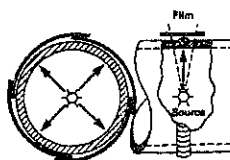
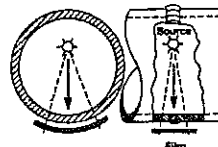
Job Description: **WET MT Exam of:**

WELD NO.	PIPE SIZE	RECOMMENDATION			WELD NO.	PIPE SIZE	RECOMMENDATION		
		✓	ACCEPT	REMARKS			✓	ACCEPT	REMARKS
1			REJECT		31				
2	<b>GATE</b>				32				
3					33				
4	<b>N 615 83 - 003</b>				34				
5					35				
6					36				
7					37				
8	<b>100% MT of All welds.</b>				38				
9					39				
10					40				
11					41				
12					42				
13					43				
14					44				
15					45				
16					46				
17					47				
18					48				
19					49				
20					50				
21					51				
22					52				
23					53				
24					54				
25					55				
26					56				
27					57				
28					58				
29					59				
30					60				

Technique: check exposure setup

SFD

Thickness

DWE/SWV ☐DWE/DWV ☐Panoramic ☐SWE/SWV ☐

Film Delivered to: SS Manager: \_\_\_\_\_ Client: \_\_\_\_\_

Customer Representative: **Corey Ford**

X-Ray: \_\_\_\_\_ MAK V: \_\_\_\_\_ Gamma Ray: \_\_\_\_\_ Curies: \_\_\_\_\_

Date: **8-18-07** Technician: **AL CARLOS**

No. of Welds Checked: \_\_\_\_\_ Focal Size: \_\_\_\_\_ Ug: \_\_\_\_\_

Assistant: \_\_\_\_\_ Assistant: \_\_\_\_\_

Linear Ft. Film: \_\_\_\_\_ Type: \_\_\_\_\_

Instrument: **ESR 11T**

Penetrameter-A \_\_\_\_\_ B \_\_\_\_\_ C \_\_\_\_\_ Required wire: \_\_\_\_\_

Angles Used: **3 to 6" space**Dye Penetrant: \_\_\_\_\_ Ultrasonic: \_\_\_\_\_ Magnetic Particle: ☒Freq: **110K** Cal Bloc: **1000**Hours Worked: **5** Travel Time: \_\_\_\_\_ Mileage: \_\_\_\_\_

Couplant: \_\_\_\_\_

Sheet # **1** of **1** Subsistence (check if applicable): \_\_\_\_\_Consumables: **2 paints**



Specifications: \_\_\_\_\_

Oceaneering Inspection has furnished this Examination Report of weldments as a good faith interpretation. Acceptance or rejection of welding discontinuities to the clients specific codes and/or standards shall not infer any warranty or liability on the part of Oceaneering Inspection as to the fitness for service of such weldments and their intended use by the client.

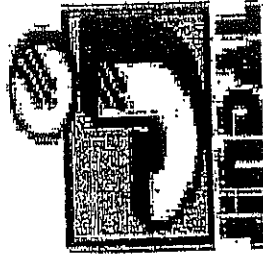


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# Material Traceability Log

CRANE WO. NO.:	23407
CUSTOMER:	PEMEX
WELDMENT PART NO.:	N61840-003
WELDMENT S/N:	C07169-02
DESCRIPTION:	Maintenance Jib Weldment
MODEL:	340LA-100
CHECKED BY:	
DATE:	8-14-07 

[illegible]



# Jindal United Steel Corporation

5200 E. McKinney Road

Baytown, TX 77520

## METALLURGICAL TEST REPORT

Sold To:  
CHAPAL STEEL CO.  
590 NORTH BETHLEHEM PIKE  
P.O. BOX 1000  
SPRING HOUSE, PA 19477-1000

Ship To:  
CHAPAL STEEL CO.  
5605 N. HOUSTON ROSSLYN RD.  
HOUSTON, TX 77091

This is to certify that the product described herein was manufactured, sampled, and tested in accordance with the specifications and requirements in such specifications: Fine Grain, Si-AL Fully Killed Steel

*Steven Green*

Approved By:

Order No: JUS2809-02

Date  
6/21/2007

P.O. Number  
HOU-3342

Shipping Mode: DIRECT TRUCK  
DIN 50049 3.1.B / EN 10204-2004 3.1

Bulletin Num. 103104

Plates Manufactured in the USA  
Certified by ISO 9001:2000

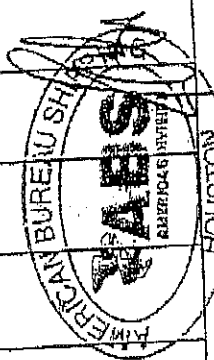
Specifications:

HOT ROLLED PLATE CUT EDGE ASTM/ASME A36-05 / ABS GR A / B & A709-05 GR 36 STRUCTURAL QUALITY

Insp.

"We hereby certify that the material described herein has been made to the application by the B.O.S. process and tested in accordance with the requirements of American Bureau of Shipping Rules with satisfactory results."

Item No.	Material Description			Bulletin		Heat No.	Gauge Tested	Test/Plate Identity	Test Cond	Yield Point (KSI)	Tensile Strength (KSI)	Elongation (%)		Yield Strength Determined at	
	Gauge	Width	Length	Qty	Wgt							in 8"	in 2"		
02	0.7500	96.0000	480.0000	4	39,204	S06847	0.500 1.000	01D 01B	AR AR	51 46	68 65	28 27		0.2% 0.2%	
21 Jun 2007															



Heat No. S06847 CE:031

Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Cb
LADLE	0.13	1.03	0.012	0.006	0.24	0.02	0.01	0.03	0.010	0.001	0.032	0.003	0.005	0.0005	0.005	0.010

OSI 15 INSPECTED  
7-10-07



Metallurgical Chemistry and Testing Laboratory

3204 BROADWAY (77017)  
POST OFFICE BOX 282285  
HOUSTON, TEXAS 77207-2285  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
metallab@an-tech.com

Page 1 of 1

July 6, 2007

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/32042  
Report No. 07-1660

IDENTIFICATION: 3/4" x 4" x 6", PLT# H21695, HT# S06847, SL# 09AA  
MATERIAL: ASTM A36, Mfg. JUS  
REFERENCE: HOU-32042

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
115.0	86	70
120.0	76	70
97.0	82	60

Donald Derrick  
Mechanical Testing Supervisor



PP 7-10-07

Sc

Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.

# METALLURGICAL TEST REPORT



<b>Sold To:</b> CHAPEL STEEL CO. 590 NORTH BETHLEHEM PIKE P.O. BOX 1000 SPRING HOUSE, PA 19477-1000						<b>Ship To:</b> CHAPEL STEEL CO. 6605 N. HOUSTON ROSSLYN RD. HOUSTON, TX 77091						This is to certify that the product described herein was manufactured, sampled, and tested in accordance with the specifications and requirements in such specifications, Fine Grain, Si-AL Fully Killed Steel						Bulletin Num. 103159																	
Plates Manufactured in the USA						Order No: JUS2772-01						Approved By: <i>Jacqueline / Amargo</i>																							
Certified by ISO 9001:2000						Date: 6/22/2007						Shipping Method: DIRECT TRUCK																							
						P.O. Number: HOU-3315						DIN 50049 3.1.B / EN 10204-2004 3.1																							
Specifications: HOT ROLLED PLATE CUT EDGE ASTM/ASME A36 -05 / ABSGR A / B & A709 - 05 GR 36 STRUCTURAL QUALITY																		Insp. " We hereby certify that the material described herein has been made to the application by the B.O.S. process and tested in accordance with the requirements of American Bureau of Shipping Rules with satisfactory results."																	
Material Description				Bulletin		Heat No.	Gauge Tested	Test/Plate Identity	Yield Point (KSI)	Tensile Strength (KSI)	Elongation (%)		Yield Strength Determined at																						
Item No.	Gauge	Width	Length	Qty	Wgt						In 8"	In 2"																							
01	0.5000	96.0000	480.0000	7	45,738	S06861	0.500	02A	47	65	30		0.2%																						
							0.500	02B	48	65	31		0.2%																						
														HS845634X																					

Heat No. 506861		CE:0.30														
Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mn	Sn	Al	N	V	B	Th	Cb
LADLE	0.11	1.04	0.014	0.010	0.25	0.03	0.02	0.04	0.010	0.001	0.035	0.004	0.005	0.0005	0.005	0.010

15  
INSPECTION  
ISO



Metallurgical Chemistry and Testing Laboratory

3204 BROADWAY (77017)  
POST OFFICE BOX 282265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
[meja@estars@msn.com](mailto:meja@estars@msn.com)

Page 1 of 1

July 6, 2007

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/32392  
Report No. 07-1698

IDENTIFICATION: 1/2" x 4" x 6", HT# S06861, SL# 07CB  
MATERIAL: ASTM A36  
REFERENCE: HOU-32392

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
111.0	86	80
165.0	94	100
110.0	86	80

Donald Derrick  
Mechanical Testing Supervisor



JP 7-12-07

Sc

Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.

## SHIP TO:

Longhorn Steel & Flamecutting  
Northwoods Industrial Park East  
11921 FM 529  
Houston, TX 77041

PAGE NO: 01 OF 01  
FILE NO: 3285-01-  
MILL ORDER NO: 38746-00  
MELT NO: U7246  
DATE: 08/30/05

## SOLD TO:

Longhorn Steel & Flamecutting  
Northwoods Industrial Park East  
11921 FM 529  
Houston, TX 77041

## SEND TO:

Longhorn Steel & Flamecutting  
Northwoods Industrial Park East  
11921 FM 529  
Houston, TX 77041

03

## PLATE DIMENSIONS / DESCRIPTION

TOTAL QTY	GAUGE	WIDTH	LENGTH	DESCRIPTION	PIECE WEIGHT
1	5"	120"	240"	RECTANGLE	40838#

## CUSTOMER INFORMATION

CUSTOMER PO: 200536

PART NO. 02

## SPECIFICATION(S)

THIS MATERIAL HAS BEEN MANUFACTURED AND TESTED IN ACCORDANCE WITH PURCHASE ORDER REQUIREMENTS AND SPECIFICATION(S).

ASME SA36 REV ED YR 04

ASTM A36 04

MATERIAL PRODUCED UNDER A CERTIFIED QUALITY MGMT SYSTEM COMPLYING WITH ISO 9001 ABS-QE CERT. NO. 30130

## CHEMICAL COMPOSITION

25673

	C	MN	P	S	CU	SI	NI	CR	MO
MELT:U7246	.15	.88	.013	.013	.22	.20	.16	.16	.05
	V	AL	CB						
MELT:U7246	.001	.033	.001						

## TENSILE PROPERTIES

LDC	DIR	YIELD STRENGTH PSI X 100	TENSILE STRENGTH PSI X 100	ELONGATION GAGE LGTH	%
BOT.	TRANS.	402	698	2.00"	24.0
BOT.	TRANS.	422	721	2.00"	26.0

## GENERAL INFORMATION

ALL STEEL HAS BEEN MELTED AND MANUFACTURED IN THE U.S.A.  
TEST CERTS. ARE PREPARED IN ACCORD. WITH PROCEDURES  
OUTLINED IN DIN 50049 3.1.B/EN 10204 3.1.B.

B/L #04534 SOU 114446

WE HEREBY CERTIFY THE ABOVE  
INFORMATION IS CORRECT:

QUALITY ASSURANCE LABORATORY  
COATESVILLE, PA 19320

*gpc*  
*3-17-06*  
*Elinore Zaplitny*  
SUPERVISOR - TEST REPORTING  
ELINORE ZAPLITNY





**Ryerson Tull**

Joseph T Ryerson & Son  
J.M. Tull Metals  
AFCO Metals

## Certification of Materials

SKAGIT-SMATCO  
MULBERRY ROAD OFF SOUTH VAN

HOUMA LA 70360

DATE 08/22/03

YOUR ORDER NO. 4023396

TULL INVOICE NO. 0726061

### Material

24087 5 DIA 1018 CF STEEL ROD

*JP 8-25-03*

### Certification

We certify that the ORDER ITEM described on this document was shipped in accordance with your order.  
The producer of the material has certified to us that it was produced in accordance with the following specifications:

ASTM-A108

QUALITY MANAGER

*Bradley W. Morgan*

10445 AIRLINE HIGHWAY  
ST ROSE LA 70087  
504-466-8855

**Quality Assurance Manager**

Additional copies call  
(830) 372-8485

**P. O. Box 911  
Seguin, Texas 78156-0911  
(830) 372-8200**



ASTM A36/A52950

L | MONTGOMERY, AL 36103-4747

**BATON ROUGE, LA 70805-7700**

# INV#

**CUST PO#: 51209**

[illegible]

100% MELTED AND MANUFACTURED IN THE USA AND FREE OF MERCURY CONTAMINATION IN THE PROCESS
REMARKS:

15-15-07

MAF-20-2007 20:07  
Page 1 OF 1

05/14/2007 From: SABEL STEEL  
FAX # :  
ATTN: :  
PO # :

PO/Rel  
INTSEL STEEL DISTRIBUTORS

Pg.1/1

PART NO.

Amm.

## Bill To:

INTSEL STEEL DISTRIBUTORS, LP  
11310 W. LITTLE YORK  
HOUSTON TX  
77041 US

Ship To: 1

INTSEL STEEL DISTRIBUTOR LP  
11310 WEST LITTLE YORK  
HOUSTON TX  
77040 US

Order Date: 11/03/2006

PO No: WLY-6154  
Mill Order No: 3217337  
Lead No: 1092314  
Manifest No: 1806665

## CERTIFIED MATERIAL TEST REPORT

**CHAPARRAL STEEL**  
300 Ward Rd.  
Midlothian, TX  
76065-9651  
(972) 775-8241

## SIZE

S 10 X 35.0# / S 250 X 52

## GRADE

A36/A57250

## LENGTH

40 FT / 12.192 M

## PRODUCT

STD BEAMS

## SPECIFICATIONS

ASTM A6-05, A36-05, A572-06, A992-06

HEAT NO: 22390920

C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	V	Al	Nb	CE
.10	.98	.006	.023	.26	.28	.12	.09	.028	.009	.001	.006	.015	.31

## CHEMICAL ANALYSIS

## Yield Strength

KSI	MPa
58.1	400.6
56.4	388.9

## Tensile Strength

KSI	MPa
76.8	529.5
75.2	518.5

## Specimen Area

Sq In	Sq Cm
0.939	6.06
0.951	6.14

## Elongation

%	Gage Length
23.6	8 In 200 mm
23.4	8 In 200 mm

## PHYSICAL PROPERTIES

## Bend Test

Dia - Result	ROA %

## Remarks

MEETS REQUIREMENTS OF AISC TECH BULLETIN #3 - MARCH, 1997; Portions of this heat were incorrectly die stamped as 2290920. Silver stickers with the correct heat number have been applied to each affected bar.

All manufacturing processes of this product, including electric arc melting and continuous casting, occurred in the U.S.A. CMTR complies with DIN EN 10204 3.1.B

"I hereby certify that the contents of this report are correct and accurate. All tests and operations performed by this material manufacturer or its sub-contractors, when applicable, are in compliance with the requirements of the material specifications and applicable purchaser designated requirements."

Signed: Tom L. Harrington Date: Feb. 19, 2007  
Tom L. Harrington: Quality Assurance Manager

Signed: \_\_\_\_\_ Date: \_\_\_\_\_  
Notary Public (if applicable)

Page: 1 of 1



**BAYOU STEEL CORPORATION**  
RIVER ROAD P.O. BOX 5000  
LA PLACE, LOUISIANA 70069-1156  
Telephone (985) 852-4900

**MATERIAL CERTIFICATION REPORT**  
NAMASCO CORPORATION  
500 COLONIAL CENTER PARKWAY  
SUITE 500  
ROSWELL, GA 30076

NAMASCO  
4501 N. MIRO @ THE INDUSTRIAL  
CANAL  
NEW ORLEANS, LA 70117  
PO: 6060546

TESTED IN **ASTM A6**  
ACCORDANCE  
WITH

INVOICE NO. BSLP07200622  
PRODUCT UNEQUAL ANGLES  
HEAT NO. 52714 40 PCS  
Length 40'0"

DATE 11/03/06  
Cust N-0112 -0003  
GRADE A36 -04  
SIZE U 5 X 3 X 1/4 X 6.6

CHEMICAL ANALYSIS	
C	.09
Mn	.72
P	.018
S	.034
Si	.18
Cu	.38
Ni	.26
Cr	.18
Mo	.072
Ch	.000
V	.000
B	
Al	
Sn	
N	
Ti	

MECHANICAL PROPERTIES	TEST 1		TEST 2		TEST 3	
	IMPERIAL	METRIC	IMPERIAL	METRIC	IMPERIAL	METRIC
YIELD STRENGTH	50,368 PSI	347 MPa	50,398 PSI	347 MPa	PSI	MPa
TENSILE STRENGTH	70,739 PSI	488 MPa	70,588 PSI	487 MPa	PSI	MPa
ELONGATION	38.0 %	38.0 %	38.0 %	38.0 %	%	%
GAUGE LENGTH	8 in	203 mm	8 in	203 mm	in	mm
BEND TEST DIAMETER	d	d	d	d	d	d
BEND TEST RESULTS	sq in	sq mm	sq in	sq mm	sq in	sq mm
SPECIMEN AREA	%	%	%	%	%	%
REDUCTION OF AREA	ft-lbs	J	ft-lbs	J	ft-lbs	J
IMPACT STRENGTH						

IMPACT STRENGTH	TEST 1		TEST 2		TEST 3	
	IMPERIAL	METRIC	IMPERIAL	METRIC	IMPERIAL	METRIC
AVERAGE	ft-lbs	J	ft-lbs	J	ft-lbs	J
TEST TEMP	F	C	F	C	F	C
ORIENTATION						

Customer Grade & Specs: ASME SA36

NO WELD REPAIR WAS PERFORMED ON THIS HEAT.

CI	.30
CE	

I HEREBY CERTIFY THAT THE MATERIAL TEST RESULTS PRESENTED HERE ARE FROM THE REPORTED HEAT AND ARE CORRECT. ALL TESTS WERE PERFORMED IN ACCORDANCE TO THE SPECIFICATIONS REPORTED ABOVE. ALL STEEL IS ELECTRIC FURNACE MELTED, MANUFACTURED, PROCESSED, AND TESTED IN THE U.S.A WITH SATISFACTORY RESULTS, AND IS FREE OF MERCURY CONTAMINATION IN THE PROCESS.

NOTARIZED UPON REQUEST:

SWORN TO AND SUBSCRIBED BEFORE ME IN AND FOR ST. JOHN

PARISH ON THIS \_\_\_\_\_ DAY OF \_\_\_\_\_, 20\_\_\_\_

SIGNED

*Mark Edwards*

MARK EDWARDS, QUALITY ASSURANCE SUPERVISOR

DIRECT ANY QUESTIONS OR NECESSARY CLARIFICATIONS CONCERNING  
THIS REPORT TO THE SALES DEPARTMENT.

1-800-535-7692 (USA)

Michael E. Soileau, # 81887, Notary Public

*gpc*  
*2-14-07*

# OCEANEERING<sup>®</sup> INSPECTION

REPORT NO. 417779

Houma, LA  
(985) 868-5097  
New Iberia, LA  
(337) 365-7102  
Ingleside, TX  
(361) 776-7251

MAILING ADDRESS  
Sta. 1 Box 10267  
Houma, LA 70363

(985) 868-5097  
DAILY WORK REPORT  
ISO 9002 Certified

Customer <b>OIL STATES</b>	Job Location <b>Houma LA</b>	Inspection Date / Time <b>8-11-07</b>
Billing Address	Project <b>23407.17</b>	OII Job Number <b>52348</b>
	P.O. #	PKG / AFE # <b>LATEST EDITION</b>
	S.S. Procedure # <b>AMS M-02 Rev1</b>	Acceptance Criteria <b>AMS 21.1 G-1</b>

AD = Accumulations of Discontinuities  
BT = Burn Through  
BTA = Burn Through Area  
C = Crack/Cracks  
CP = Cluster Porosity  
ESI = Elongated Slag Inclusion  
EU = External Undercut  
HB = Hollow Bead  
IC = Internal Concavity  
IF = Incomplete Fusion  
IFD = Incomplete Fusion Due to Cold Lap  
IP = Inadequate Penetration  
IPD = Inadequate Penetration Due to High Low  
ISI = Isolated Slag Inclusions  
IU = Internal Undercut  
LC = Low Crown  
NW = Narrow Weld  
P = Porosity

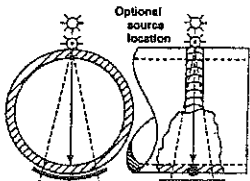
Job Description: **WET MAG Exam of:**

WELD NO.	PIPE SIZE	RECOMMENDATION			WELD NO.	PIPE SIZE	RECOMMENDATION		
		✓ X	ACCEPT REJECT	REMARKS			✓ X	ACCEPT REJECT	REMARKS
1					31				
2	JIB Boom + pole				32				
3					33				
4	N 61840-003				34				
5					35				
6					36				
7					37				
8	100% mag of all welds				38				
9					39				
10					40				
11					41				
12					42				
13					43				
14					44				
15					45				
16					46				
17					47				
18					48				
19					49				
20					50				
21					51				
22					52				
23					53				
24					54				
25					55				
26					56				
27					57				
28					58				
29					59				
30					60				

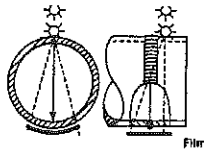
Technique: check exposure setup

SFD

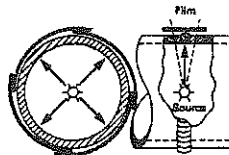
Thickness



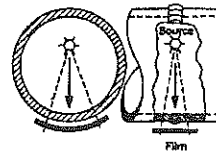
DWE/SWV ☐ Film



DWE/DWV ☐ Film



Panoramic ☐ Film



SWE/SWV ☐ Film

Film Delivered to: SS Manager: \_\_\_\_\_ Client: \_\_\_\_\_ Customer Representative: **Cory Ford**

X-Ray: \_\_\_\_\_ MAK V: \_\_\_\_\_ Gamma Ray: \_\_\_\_\_ Curies: \_\_\_\_\_ Date: **8-11-07** Technician: **AL CARLOS**

No. of Welds Checked: \_\_\_\_\_ Focal Size: \_\_\_\_\_ Ug: \_\_\_\_\_ Assistant: \_\_\_\_\_

Linear Ft. Film: \_\_\_\_\_ Type: \_\_\_\_\_ Instrument: **ESX 115**

Penetrometer-A \_\_\_\_\_ B \_\_\_\_\_ C \_\_\_\_\_ Required wire: \_\_\_\_\_ Angles Used: **3 to 6 3/4"**

Dye Penetrant: \_\_\_\_\_ Ultrasonic: \_\_\_\_\_ Magnetic Particle: ☒ Achieved wire: \_\_\_\_\_ Freq: **100K** Cal Bloc: **100B**

Hours Worked: **2** Travel Time: \_\_\_\_\_ Mileage: \_\_\_\_\_ Couplant: \_\_\_\_\_

Sheet # **1** of **1** Subsistence (check if applicable): \_\_\_\_\_ Consumables: **1 paint**



Specifications: \_\_\_\_\_

Oceaneering Inspection has furnished this Examination Report of weldments as a good faith interpretation. Acceptance of or rejection of welding discontinuities to the clients specific codes and/or standards shall not infer any warranty or liability on the part of Oceaneering Inspection as to the fitness for service of such weldments and their intended use by the client.



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# Material Traceability Log

CRANE WO. NO.:	23407
CUSTOMER:	PEMEX
WELDMENT PART NO.:	N61648-003
WELDMENT S/N:	C07169-01
DESCRIPTION:	Maintenance Jib Weldment
MODEL:	340LA-80
CHECKED BY:	
DATE:	8-16-07 

[illegible]

\_\_\_\_\_





*Metallurgical Chemistry and Testing Laboratory*

3204 BROADWAY (77017)  
POST OFFICE BOX 282285  
HOUSTON, TEXAS 77207-2285  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
metalltest@msn.com

May 23, 2007

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/31692  
Report No. 07-1207

IDENTIFICATION: 1-1/2" x 4" x 6", HT# S05762, SL# 05B1-A  
MATERIAL: ASTM A36  
REFERENCE: HOU31692

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
40.0	34	30
39.0	35	30
37.0	34	30



5-25-07

Donald Derrick  
Mechanical Testing Supervisor

Sc

Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.



Jindal United Steel Corporation  
5200 E. McKinney Road  
Baytown, TX 77520

MEJ-84  
TC No.: BR 102184-6320-01

## METALLURGICAL TEST REPORT

<b>Sold To:</b> CHAPEL STEEL CO. 590 NORTH BETHLEHEM PIKE P.O. BOX 1000 SPRING HOUSE, PA 19477-1000		<b>Ship To:</b> CHAPEL STEEL CO. 6605 N. HOUSTON ROSSLYN RD. HOUSTON, TX 77091		<b>This is to certify that the product described herein was manufactured, sampled, and tested in accordance with the specifications and requirements in such specifications: Fine Grain, Si-AL Fully Killed Steel</b>		<b>Bulletin Num.</b> 102184
<b>Order No:</b> JUS2664-10		<b>Date:</b> 5/9/2007		<b>Approved By:</b> <i>Helen Green</i>		
<b>Plates Manufactured in the USA</b>		<b>P.O. Number:</b> HOU-3266		<b>Shipping Mode:</b> DIRECT TRUCK		
<b>Certified by ISO 9001:2000</b>				<b>DIN 50049 3.1.B / EN 10204:2004 3.1</b>		
<b>Specifications:</b> HOT ROLLED PLATE CUT EDGE ASTM/ASME A36-05 / ABS GR A / B & A709 - 05 GR 36 STRUCTURAL QUALITY				<b>Insp.</b>		<b>"We hereby certify that the material described herein has been made to the application by the B.O.S. process and tested in accordance with the requirements of American Bureau of Shipping Rules with satisfactory results."</b>

Item No.	Material Description			Bulletin		Gauge Tested	Heat No.	Test/Plate Identity	Test Cond	Yield Point (KSI)	Tensile Strength (KSI)	Elongation (%)		Yield Strength Determined at	LCVN FULL min @ 32 DEG F
	Gauge	Width	Length	Qty	Wgt							in 8"	in 2"		
10	2.0000	120.0000	360.0000	1	24.503	2.000	S06320	01A	AR	42	69	36		0.2%	160 - 191 - 173 FULL min @ 32°F
AMERICAN BUREAU OF SHIPPING ABS HOUSTON															
MAY 10 2007															
HS823764AX															

Heat No. S06320 CE:0.34

Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Su	Al	N	V	B	Ti	Cb
LADLE	0.16	1.03	0.010	0.003	0.30	0.01	0.00	0.01	0.002	0.001	0.036	0.005	0.001	0.0001	0.003	0.002

081  
15  
INSPECTED

7-12-07



Metallurgical Chemistry and Testing Laboratory

3204 BROADWAY, (77017)  
POST OFFICE BOX 282265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
mailto:info@an.com

July 6, 2007

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647-32297  
Report No. 07-1661-3

IDENTIFICATION: 2" x 4" x 6", HT# S06320, SL# 05AA  
MATERIAL: ASTM A36, Mfg. Jus

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
69.0	59	40
73.0	65	40
86.0	74	50

Donald Derrick  
Mechanical Testing Supervisor

Sc

Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.



07-12-07

DATE	1/27/07
INVOICE NO.	113721
BILL OF LADING	829509
CUSTOMER NO.	7817
CUSTOMER P.O.	6068901

# **NUCOR-YAMATO STEEL CO.** P.O. BOX 1228 • BLYTHEVILLE, AR 72316

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NAMASCO- HOUSTON  
14200 ALMEDA ROAD  
ALMEDA, TX 77053

## **CERTIFIED MILL TEST REPORT**

100% MELTED AND MANUFACTURED IN U.S.A.  
All shapes produced by Nucor-Yamato Steel are cast and rolled to a fully killed and fine grain practice.

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ASTM A992/A992M-06a A572/A572M GR50-04  
ASTM A709/A709M-03a GR50 (345)  
ASTM A709/A709M-03a GR50S (345S)  
ASTM A6/A6M-05a

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KLOCKNER NAMASCO CORPORATION  
500 COLONIAL CENTER PKWY  
SUITE 500  
ROSWELL, GA 30076

ITEM #	ITEM DESCRIPTION	QTY	HEAT #	MECHANICAL PROPERTIES							CHEMICAL PROPERTIES												
				YIELD TO TENSILE RATIO	YIELD STRENGTH	TENSILE STRENGTH	ELONG	CHARPY IMPACT		C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Cb	CE		
					PSI	PSI		TEMP	IMPACT ENERGY														
					MPa	MPa		* F	FT-LBS													* C	JOULES
																Sn	Pcm		CI				
1	W14 - 43.0 40' W360 x 64.0 12.192 M	7	289444	.74	56000	76000	23			.08	1.26	.017	.036	.25	.29	.13	.11	.03	.00	.023	.35		
				.75	57000	76000	21											.01	.17				
					386	524	23																
					393	524	21																
2	W14 - 43.0 40' W360 x 64.0 12.192 M	9	289445	.75	57000	76000	25			.08	1.26	.019	.037	.28	.31	.12	.15	.04	.00	.024	.36		
				.74	55000	74000	25											.01	.18				
					393	524	25																
					379	510	25																
3	W14 - 43.0 40' W360 x 64.0 12.192 M	5	289447	.76	56000	74000	23			.08	1.22	.019	.039	.26	.30	.12	.13	.03	.00	.020	.34		
				.74	54000	73000	24											.01	.18				
					386	510	23																
					372	503	24																
4	W14 - 48.0 40' W360 x 72.0 12.192 M	2	290024	.76	55000	72000	26			.07	1.11	.009	.028	.28	.29	.16	.07	.04	.00	.020	.31		
				.75	53000	71000	25											.01	.15				
					379	496	26																
					365	490	25																
5	W14 - 48.0 40' W360 x 72.0 12.192 M	4	290029	.77	56000	73000	25			.06	1.11	.016	.032	.25	.29	.11	.10	.03	.00	.021	.31		
				.75	52000	69000	25											.01	.15				
					386	503	25																
					359	476	25																

Form 1 - 5 - 5a - 5b - 5c - 5d - 5e - 5f - 5g - 5h - 5i - 5j - 5k - 5l - 5m - 5n - 5o - 5p - 5q - 5r - 5s - 5t - 5u - 5v - 5w - 5x - 5y - 5z - 5aa - 5ab - 5ac - 5ad - 5ae - 5af - 5ag - 5ah - 5ai - 5aj - 5ak - 5al - 5am - 5an - 5ao - 5ap - 5aq - 5ar - 5as - 5at - 5au - 5av - 5aw - 5ax - 5ay - 5az - 5ba - 5bb - 5bc - 5bd - 5be - 5bf - 5bg - 5bh - 5bi - 5bj - 5bk - 5bl - 5bm - 5bn - 5bo - 5bp - 5bq - 5br - 5bs - 5bt - 5bu - 5bv - 5bw - 5bx - 5by - 5bz - 5ca - 5cb - 5cc - 5cd - 5ce - 5cf - 5cg - 5ch - 5ci - 5cj - 5ck - 5cl - 5cm - 5cn - 5co - 5cp - 5cq - 5cr - 5cs - 5ct - 5cu - 5cv - 5cw - 5cx - 5cy - 5cz - 5da - 5db - 5dc - 5dd - 5de - 5df - 5dg - 5dh - 5di - 5dj - 5dk - 5dl - 5dm - 5dn - 5do - 5dp - 5dq - 5dr - 5ds - 5dt - 5du - 5dv - 5dw - 5dx - 5dy - 5dz - 5ea - 5eb - 5ec - 5ed - 5ee - 5ef - 5eg - 5eh - 5ei - 5ej - 5ek - 5el - 5em - 5en - 5eo - 5ep - 5eq - 5er - 5es - 5et - 5eu - 5ev - 5ew - 5ex - 5ey - 5ez - 5fa - 5fb - 5fc - 5fd - 5fe - 5ff - 5fg - 5fh - 5fi - 5fj - 5fk - 5fl - 5fm - 5fn - 5fo - 5fp - 5fq - 5fr - 5fs - 5ft - 5fu - 5fv - 5fw - 5fx - 5fy - 5fz - 5ga - 5gb - 5gc - 5gd - 5ge - 5gf - 5gg - 5gh - 5gi - 5gj - 5gk - 5gl - 5gm - 5gn - 5go - 5gp - 5gq - 5gr - 5gs - 5gt - 5gu - 5gv - 5gw - 5gx - 5gy - 5gz - 5ha - 5hb - 5hc - 5hd - 5he - 5hf - 5hg - 5hh - 5hi - 5hj - 5hk - 5hl - 5hm - 5hn - 5ho - 5hp - 5hq - 5hr - 5hs - 5ht - 5hu - 5hv - 5hw - 5hx - 5hy - 5hz - 5ia - 5ib - 5ic - 5id - 5ie - 5if - 5ig - 5ih - 5ii - 5ij - 5ik - 5il - 5im - 5in - 5io - 5ip - 5iq - 5ir - 5is - 5it - 5iu - 5iv - 5iw - 5ix - 5iy - 5iz - 5ja - 5jb - 5jc - 5jd - 5je - 5jf - 5jg - 5jh - 5ji - 5jj - 5jk - 5jl - 5jm - 5jn - 5jo - 5jp - 5jq - 5jr - 5js - 5jt - 5ju - 5jv - 5jw - 5jx - 5jy - 5jz - 5ka - 5kb - 5kc - 5kd - 5ke - 5kf - 5kg - 5kh - 5ki - 5kj - 5kk - 5kl - 5km - 5kn - 5ko - 5kp - 5kq - 5kr - 5ks - 5kt - 5ku - 5kv - 5kw - 5kx - 5ky - 5kz - 5la - 5lb - 5lc - 5ld - 5le - 5lf - 5lg - 5lh - 5li - 5lj - 5lk - 5ll - 5lm - 5ln - 5lo - 5lp - 5lq - 5lr - 5ls - 5lt - 5lu - 5lv - 5lw - 5lx - 5ly - 5lz - 5ma - 5mb - 5mc - 5md - 5me - 5mf - 5mg - 5mh - 5mi - 5mj - 5mk - 5ml - 5mm - 5mn - 5mo - 5mp - 5mq - 5mr - 5ms - 5mt - 5mu - 5mv - 5mw - 5mx - 5my - 5mz - 5na - 5nb - 5nc - 5nd - 5ne - 5nf - 5ng - 5nh - 5ni - 5nj - 5nk - 5nl - 5no - 5np - 5nq - 5nr - 5ns - 5nt - 5nu - 5nv - 5nw - 5nx - 5ny - 5nz - 5oa - 5ob - 5oc - 5od - 5oe - 5of - 5og - 5oh - 5oi - 5oj - 5ok - 5ol - 5om - 5on - 5oo - 5op - 5oq - 5or - 5os - 5ot - 5ou - 5ov - 5ow - 5ox - 5oy - 5oz - 5pa - 5pb - 5pc - 5pd - 5pe - 5pf - 5pg - 5ph - 5pi - 5pj - 5pk - 5pl - 5pm - 5pn - 5po - 5pp - 5pq - 5pr - 5ps - 5pt - 5pu - 5pv - 5pw - 5px - 5py - 5pz - 5qa - 5qb - 5qc - 5qd - 5qe - 5qf - 5qg - 5qh - 5qi - 5qj - 5qk - 5ql - 5qm - 5qn - 5qo - 5qp - 5qq - 5qr - 5qs - 5qt - 5qu - 5qv - 5qw - 5qx - 5qy - 5qz - 5ra - 5rb - 5rc - 5rd - 5re - 5rf - 5rg - 5rh - 5ri - 5rj - 5rk - 5rl - 5rm - 5rn - 5ro - 5rp - 5rq - 5rr - 5rs - 5rt - 5ru - 5rv - 5rw - 5rx - 5ry - 5rz - 5sa - 5sb - 5sc - 5sd - 5se - 5sf - 5sg - 5sh - 5si - 5sj - 5sk - 5sl - 5sm - 5sn - 5so - 5sp - 5sq - 5sr - 5ss - 5st - 5su - 5sv - 5sw - 5sx - 5sy - 5sz - 5ta - 5tb - 5tc - 5td - 5te - 5tf - 5tg - 5th - 5ti - 5tj - 5tk - 5tl - 5tm - 5tn - 5to - 5tp - 5tq - 5tr - 5ts - 5tt - 5tu - 5tv - 5tw - 5tx - 5ty - 5tz - 5ua - 5ub - 5uc - 5ud - 5ue - 5uf - 5ug - 5uh - 5ui - 5uj - 5uk - 5ul - 5um - 5un - 5uo - 5up - 5uq - 5ur - 5us - 5ut - 5uu - 5uv - 5uw - 5ux - 5uy - 5uz - 5va - 5vb - 5vc - 5vd - 5ve - 5vf - 5vg - 5vh - 5vi - 5vj - 5vk - 5vl - 5vm - 5vn - 5vo - 5vp - 5vq - 5vr - 5vs - 5vt - 5vu - 5vv - 5vw - 5vx - 5vy - 5vz - 5wa - 5wb - 5wc - 5wd - 5we - 5wf - 5wg - 5wh - 5wi - 5wj - 5wk - 5wl - 5wm - 5wn - 5wo - 5wp - 5wq - 5wr - 5ws - 5wt - 5wu - 5wv - 5ww - 5wx - 5wy - 5wz - 5xa - 5xb - 5xc - 5xd - 5xe - 5xf - 5xg - 5xh - 5xi - 5xj - 5xk - 5xl - 5xm - 5xn - 5xo - 5xp - 5xq - 5xr - 5xs - 5xt - 5xu - 5xv - 5xw - 5xx - 5xy - 5xz - 5ya - 5yb - 5yc - 5yd - 5ye - 5yf - 5yg - 5yh - 5yi - 5yj - 5yk - 5yl - 5ym - 5yn - 5yo - 5yp - 5yq - 5yr - 5ys - 5yt - 5yu - 5yv - 5yw - 5yx - 5yz - 5za - 5zb - 5zc - 5zd - 5ze - 5zf - 5zg - 5zh - 5zi - 5zj - 5zk - 5zl - 5zm - 5zn - 5zo - 5zp - 5zq - 5zr - 5zs - 5zt - 5zu - 5zv - 5zw - 5zx - 5zy - 5zz

Carbon Equivalent: CE = CE(IIW) = C + Mn/6 + (Cr+Mo+V)/5 + (Ni+Cu)/15

Corrosion Index: CI = (P/100) + (S/100) + (Cu/100) + (Ni/100) + (Cr/100) + (Mo/100) + (V/100) + (Cb/100) + (CE/100)

ELONGATION BASED ON 8.00 INCH GAUGE LENGTH

I hereby certify that the contents of this report are accurate and correct. All test results and operations performed by this material manufacturer are in compliance with the requirements of the material specifications, and when designated by the purchaser, meet the applicable specifications.

QUALITY ASSURANCE

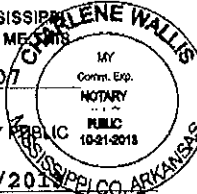
CUSTOMER COPY

STATE OF ARKANSAS COUNTY OF MISSISSIPPI  
SWORN TO AND SUBSCRIBED BEFORE ME

29 Day of 01/07

Charlene Wallis NOTARY PUBLIC

MY COMMISSION EXPIRES 10/21/2011



988  
8  
INSPECTED  
3-20-06



100

Jindal United Steel Corporation

5200 E. McKinney Road  
Baytown, TX 77520

# METALLURGICAL TEST REPORT

**MEET-04**

TC No.: BR102012-6409-01

[illegible]

HCHL No. S06409	CE: 0.30
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HCL No.2506409		CE-8.30														
Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Cb
LADLE	0.12	1.03	0.011	0.009	0.23	0.02	0.02	0.03	0.010	0.001	0.038	0.005	0.005	0.0005	0.005	0.010

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INSPECTED  
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5-150



*Metallurgical Chemistry and Testing Laboratory*

3204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2285  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
[metallab@an.com](mailto:metallab@an.com)

May 11, 2007

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/31692  
Report No. 07-1128

IDENTIFICATION: 1" x 4" x 6", HT# S06409, SL# 07BA  
MATERIAL: ASTM A36, Mfg. Jin  
REFERENCE: HOU-31646

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
115.0	92	70
111.0	96	70
107.0	94	70



5-15-07

Donald Derrick  
Mechanical Testing Supervisor

Sc

Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.



# BAYOU STEEL CORPORATION

RIVER ROAD P.O. BOX 5000  
LA PLACE, LOUISIANA 70069-1156  
Telephone (985) 682-4900

## MATERIAL CERTIFICATION REPORT

SABEL STEEL SERVICES INC.  
P.O. DRAWER 4747  
MONTGOMERY, AL 36103-4747

SABEL STEEL SERVICES  
1500 CHIPPEWA DRIVE  
BATON ROUGE, LA 70892

TESTED IN ASTM A6

ACCORDANCE  
WITH

INVOICE NO.

PRODUCT UNEQUAL ANGLES  
HEAT NO. 48199 30 Pcs  
Length 40'0"

DATE 04/14/06

Cust S-0050 -0021  
GRADE A36 -04  
SIZE U 6 X 4 X 1/2 X 16.2

PO:46640

CHEMICAL ANALYSIS	
C	.08
Mn	.91
P	.015
S	.032
Si	.18
Cu	.38
Ni	.16
Cr	.17
Mo	.045
Cb	.000
V	.000
B	
Al	
Sn	
N	
Ti	

MECHANICAL PROPERTIES	TEST 1		TEST 2		TEST 3	
	IMPERIAL	METRIC	IMPERIAL	METRIC	IMPERIAL	METRIC
YIELD STRENGTH	41,214 PSI	284 MPa	40,924 PSI	282 MPa	PSI	MPa
TENSILE STRENGTH	60,701 PSI	419 MPa	60,949 PSI	420 MPa	PSI	MPa
ELONGATION	30.0 %	30.0 %	34.0 %	34.0 %	%	%
GAUGE LENGTH	8 in	203 mm	8 in	203 mm	in	mm
BEND TEST DIAMETER	d	d	d	d	d	d
BEND TEST RESULTS						
SPECIMEN AREA	sq in	sq mm	sq in	sq mm	sq in	sq mm
REDUCTION OF AREA	%	%	%	%	%	%
IMPACT STRENGTH	ft-lbs	J	ft-lbs	J	ft-lbs	J

IMPACT STRENGTH	INTERNAL CLEANLINESS		GRAIN SIZE
	IMPERIAL	METRIC	
AVERAGE	ft-lbs	J	HARDNESS
TEST TEMP	F	C	
ORIENTATION			GRAIN PRACTICE
			REDUCTION RATIO

Customer Grade & Specs: ASME SA36

NO WELD REPAIR WAS PERFORMED ON THIS HEAT.

CI	.31
CE	

HEREBY CERTIFY THAT THE MATERIAL TEST RESULTS PRESENTED HERE ARE FROM THE REPORTED HEAT AND ARE CORRECT. ALL TESTS WERE PERFORMED IN ACCORDANCE TO THE SPECIFICATIONS REPORTED ABOVE. ALL STEEL IS ELECTRIC FURNACE MELTED, MANUFACTURED, PROCESSED, AND TESTED IN THE U.S.A WITH SATISFACTORY RESULTS, AND IS FREE OF MERCURY CONTAMINATION IN THE PROCESS.

NOTARIZED UPON REQUEST:

SWORN TO AND SUBSCRIBED BEFORE ME IN AND FOR ST. JOHN

PARISH ON THIS \_\_\_\_\_ DAY OF \_\_\_\_\_, 20\_\_\_\_

SIGNED

MARK EDWARDS, QUALITY ASSURANCE SUPERVISOR

*Mark Edwards*

DIRECT ANY QUESTIONS OR NECESSARY CLARIFICATIONS CONCERNING THIS REPORT TO THE SALES DEPARTMENT.

1-800-535-7692 (USA)

Michael E. Sollecito, # 81887, Notary Public



6-15-06

To:

06/13/2006 From: THOMAS PIPE & STEEL

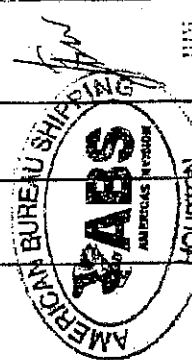
FAX # :  
ATTN :  
PO # :



# Jindal United Steel Corporation

5200 E. McKinney Road  
Baytown, TX 77520

# METALLURGICAL TEST REPORT

<b>Sold To:</b> CHAPEL STEEL CO. 590 NORTH BETHLEHEM PIKE P.O. BOX 1000 SPRING HOUSE, PA 19477-1000				<b>Ship To:</b> CHAPEL STEEL CO. 6605 N. HOUSTON ROSSLYN RD. HOUSTON, TX 77091				This is to certify that the product described herein was manufactured, sampled, and tested in accordance with the specifications and requirements in such specifications. <i>Five Grain, Si-AL Fully Killed Steel</i>				Bulletin Num. 103159			
Order No: JUS2772-01				P.O. Number HOU-3315				Approved By: <i>[Signature]</i>				Shipping Method: DIRECT TRUCK			
Plates Manufactured in the USA Certified by ISO 9001:2000				Date 6/22/2007				DIN 50499 3.1.D / EN 10204:2004 3.1				Insp.			
Specifications: HOT ROLLED PLATE CUT EDGE ASTM/ASME A36 -05 / ABSGR A / B & A709 - 05 GR 36 STRUCTURAL QUALITY												* We hereby certify that the material described herein has been made to the application by the B.O.S. process and tested in accordance with the requirements of American Bureau of Shipping Rules with satisfactory results.			
Material Description			Bulletin		Heat No.	Gauge Tested	Test/Plate Identity	Yield Point (KSI)	Tensile Strength (KSI)	Elongation (%)		Yield Strength Determined at			
Item No.	Gauge	Length	Qty	Wgt						In 8"	In 2"				
01	0.5000	96.0000	480.0000	7	45,738	S06861	0.500	02A	47	65	30	0.2%			
							0.500	02B	48	65	31	0.2%			
												HS845634X			
JUN 25 2007															

Heat No. 516861 CE:030

Heat No.-S06861 CE:0.30																
Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mn	Sn	Al	N	V	B	Ti	Cb
LADLE	0.11	1.04	0.014	0.010	0.25	0.03	0.02	0.04	0.010	0.001	0.035	0.004	0.005	0.0005	0.005	0.010

10-21-68

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INSPECTED  
ISO





Metallurgical Chemistry and Testing Laboratory

3204 BROADWAY (77017)  
POST OFFICE BOX 282265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
meja@estars@msn.com

Page 1 of 1

July 6, 2007

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/32392  
Report No. 07-1698

IDENTIFICATION: 1/2" x 4" x 6", HT# S06861, SL# 07CB  
MATERIAL: ASTM A36  
REFERENCE: HOU-32392

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
111.0	86	80
165.0	94	100
110.0	86	80

Donald Derrick  
Mechanical Testing Supervisor



JP 7-12-07

Sc

Our letters and reports are for the exclusive use of the client to whom they are addressed. Our reports apply only to the actual sample tested and are not necessarily indicative of the properties of other identical or similar materials.

# OCEANEERING<sup>®</sup>

## INSPECTION

REPORT NO. 417775

Houma, LA  
(985) 868-5097  
New Iberia, LA  
(337) 365-7102  
Ingleside, TX  
(361) 776-7251

MAILING ADDRESS  
Sta. 1 Box 10267  
Houma, LA 70363

(985) 868-5097  
**DAILY WORK REPORT**  
ISO 9002 Certified

Customer <b>OIL STATES</b>	Job Location <b>Houma LA</b>	Inspection Date / Time <b>8-11-07</b>
Billing Address	Project <b>23407.17</b>	Oil Job Number <b>52348</b>
	P.O. #	PKC / AFE # <b>LATEST EDITION</b>
	S.S. Procedure # <b>AWS mroa Rev1</b>	Acceptance Criteria <b>AWS D1.1 6.1</b>

AD = Accumulations of Discontinuities	ESI = Elongated Slag Inclusion	IFD = Incomplete Fusion Due to Cold Lap	LC = Low Crown
BT = Burn Through	EU = External Undercut	IP = Inadequate Penetration	NW = Narrow Weld
BTA = Burn Through Area	HB = Hollow Bead	IPD = Inadequate Penetration Due to High Low	P = Porosity
C = Crack/Cracks	IC = Internal Concavity	ISI = Isolated Slag Inclusions	
CP = Cluster Porosity	IF = Incomplete Fusion	IU = Internal Undercut	

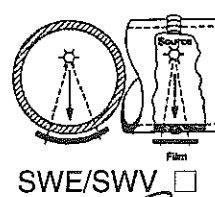
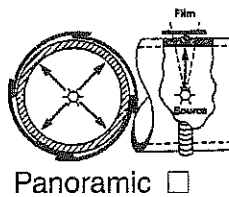
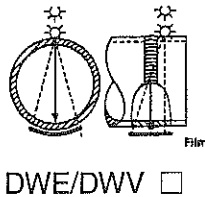
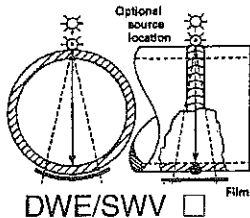
Job Description: **WET MAG Exam of:**

RECOMMENDATION				RECOMMENDATION					
WELD NO.	PIPE SIZE	✓ X	ACCEPT REJECT	REMARKS	WELD NO.	PIPE SIZE	✓ X	ACCEPT REJECT	REMARKS
1					31				
2	JIB Boom			340L	32				
3					33				
4	N 61648-003				34				
5					35				
6					36				
7					37				
8	1602 m. of All welds.				38				
9					39				
10					40				
11					41				
12					42				
13					43				
14		✓	Acc		44				
15					45				
16					46				
17					47				
18					48				
19					49				
20					50				
21					51				
22					52				
23					53				
24					54				
25					55				
26					56				
27					57				
28					58				
29					59				
30					60				

Technique: check exposure setup

SFD \_\_\_\_\_

Thickness \_\_\_\_\_



Film Delivered to: SS Manager: \_\_\_\_\_ Client: \_\_\_\_\_  
 X-Ray: \_\_\_\_\_ MAK V: \_\_\_\_\_ Gamma Ray: \_\_\_\_\_ Curies: \_\_\_\_\_  
 No. of Welds Checked: \_\_\_\_\_ Focal Size: \_\_\_\_\_ Ug: \_\_\_\_\_  
 Linear Ft. Film: \_\_\_\_\_ Type: \_\_\_\_\_  
 Penetrameter-A \_\_\_\_\_ B \_\_\_\_\_ C \_\_\_\_\_  
 Dye Penetrant: \_\_\_\_\_ Ultrasonic: \_\_\_\_\_ Magnetic Particle: \_\_\_\_\_  
 Hours Worked: **2** Travel Time: \_\_\_\_\_ Mileage: \_\_\_\_\_  
 Sheet # **1** of **1** Subsistence (check if applicable): \_\_\_\_\_

Customer Representative: **Corey Ford**  
 Date: **8-11-07** Technician: **AL CARLOS**  
 Assistant: \_\_\_\_\_ Assistant: \_\_\_\_\_  
 Instrument: **ESX 115**  
 Angles Used: **310 6" SPAN**  
 Freq: **110K** Cal Bloc: **1003**  
 Couplant: \_\_\_\_\_  
 Consumables: **1 PAINT**  
 Specifications: \_\_\_\_\_

Oceaneering Inspection has furnished this Examination Report of weldments as a good faith interpretation. Acceptance of or rejection of welding discontinuities to the clients specific codes and/or standards shall not infer any warranty or liability on the part of Oceaneering Inspection as to the fitness for service of such weldments and their intended use by the client.



ImXport Services  
Corp.

Pemex-PP LUM A  
Project

## Vendor Data Book

P.O. # 0018987

Serial # 23407

Volume 1

### Nautilus Crane Model 340LA-80

#### Section 2.0 Pin Certificates



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA



# Lattice Boom Style

## PIN CERTIFICATE SHEET

DATE: May 24, 2007      REV.:      WORK ORDER NO.: 23407

CUSTOMER: PEMEX      MODEL NO.: 340LA-80

MATERIAL: SS = Stainless Steel with 100,000 PSI Minimum Yield		4140 = 4140 with 100,000 PSI Minimum Yield						
COATING: U = Uncoated		F = Fluorocarbon Coated						
		S = Special						
COMPONENTS	PART NUMBER/REV.	PIN NO.*	HEAT NO.	MATERIAL			COATING (4140 Only)	
				SS	4140	U	F	S
BOOM FOOT PIN	N61595-001 (2) Rev. B	P1 P2	242410	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
GANTRY / UPPERSTRUCTURE PIN	N61596-001 (2) Rev. C	P3 P4	242410	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
MAIN IDLER PIN	N61604-001 (2) Rev. D	P5 P6	62949	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
LOWER AUXILIARY EXTENSION PIN	N61605-001 (1) Rev. D	P7	537700	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
BOOM CONNECTION PIN	N60986-004 (8) Rev. C	P8-P15	T1996-B10	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
BOOM LIFTING PADEYE PIN	N60986-005 (4) Rev. C	P16-P19	241409	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
BRIDLE / GANTRY PIN	N61603-001 (2) Rev. D	P20 P21	62949	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
MAIN EXTENDED WEDGE SOCKET PIN	N60645-001 (1) Rev. B	P22	S2925	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
LOAD CELL PIN	N60646-004 (2) Rev. C	P23 P24	S2925	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

NOTES: \* Pin number to be stamped on end of pin by machinist.  
 \*\* Heat Number to be recorded by machinist when material is pulled from inventory.

SPECIAL COATING REQUIREMENTS:

  
 R. H. Smith  
 5-24-07

**VALBRUNA**

**SLATER STAINLESS, INC.**  
 2400 Taylor Street West, P.O. Box 630  
 Fort Wayne, Indiana USA 46801  
 Phone: 260-434-2892 Fax: 260-434-2905

**Product Certification Report****Report Number: 4207400****Certified on Aug 02, 2006 Page 1 of 2**

Order I.D. <b>0601685 004</b>		Order Date <b>5/23/06</b>		Commodity Code	
Dim 1 <b>4.0000</b>	Dim 2 <b>.0000</b>	Dim 3 <b>.0000</b>	Heat I.D. <b>242410</b>	Customer I.D. <b>002524</b>	Customer Purchase Order <b>7284</b>
Product Shape <b>Rounds</b>			Product Surface <b>HR &amp; Rough Turned</b>		Customer Grade <b>17-4</b>
Length (Inches) <b>288.000 Min. 336.000 Max.</b>			Bill of Lading # <b>403671</b>	Weight	

**Ship To**  
**BEST STAINLESS & ALLOYS INC.**  
**3616 OLD SPANISH TRAIL**  
**HOUSTON, TX. 77021**

**Sold To**  
**VALBRUNA STAINLESS, INC.**  
**2400 TAYLOR STREET WEST**  
**FORT WAYNE, IN 46802**

**Lifts: 0041 0042 0043 0044 0045 0047**

CONDITION A	UNS S17400	ASTMA 484-03A
ASTMA 564-04	ASMESA 484 01 ED 2002 ADD	ASMESA 564 01 ED 2002 ADD
AMS 2303E	AMS 5643Q	

**CHEMICAL ANALYSIS**

C	Mn	P	S	Si	Cr	Ni	Mo	Cu	N	Cb	Ta	Cb+Ta
.04	.55	.025	.025	.36	15.50	4.87	.21	3.38	.04	.25	.001	.25
<b>HB</b>												
<b>363</b>												

**TENSILE PROPERTIES CAPABILITY**

HB	TS (PSI)	.2%YS (PSI)	%EL(2")	%RA	AGE(F)
423	193500	176300	15.5	50.4	900

**MAGNETIC PARTICLE TEST**

FREQ SEV  
 AVG .00 .00

**PRODUCTION HEAT TREATMENT**

SOL-ANN(F) SOL-ANN(HR) QUENCH  
 1900 7.75 Air

**GRAIN SIZE ASTM E112**

GRAIN SIZE  
 5

**PERCENT FERRITE**

% FERRITE  
 AVG .5

Reduction ratio 5 To 1 Min.  
 Electric Furnace melted; AOD refined.  
 Ultrasonic test OK.

We certify that the contents of this report are correct and that all operations performed by our company or subcontractors are in compliance with material specifications and the ASME Boiler & Pressure Code. Section III, Section III, Subsection NCA-3800, 2001 edition. 02 Addenda  
 Chemical testing performed to one or several of the following ASTM methods: E415, E572, E1019, E1085, E1086.  
 No mercury or low melting alloy contamination. No weld repair.  
 Material melted in Italy, manufactured in the United States.

Results relate only to the items tested. Certification shall not be reproduced except in full, without written approval of Valbruna Stainless Inc. The recording of false, fictitious, or fraudulent statements on this document may be punished as a felony under federal statutes, including Federal law, Title 18, Chapter 47. Consult material safety data sheet (MSDS) for hazard info.

I hereby certify that the reported figures are correct as contained in the records of the corporation.

Manager Laboratory Services

*Dennis Hackett*  
 Dennis Hackett

*gpc*  
 10-17-06

**VALBRUNA****SLATER STAINLESS, INC.**2400 Taylor Street West, P.O. Box 630  
Fort Wayne, Indiana USA 46801  
Phone: 260-434-2892 Fax: 260-434-2905**Product Certification Report****Report Number: 4207400**

Certified on Aug 02, 2006 Page 2 of 2

Order I.D. 0601685 004		Order Date 5/23/06		Commodity Code			
Dim 1 4.0000	Dim 2 .0000	Dim 3 .0000	Heat I.D. 242410	Customer I.D. 002524	Customer Purchase Order 7284		
Product Shape Rounds			Product Surface HR & Rough Turned			Customer Grade 17-4	
Length (Inches) 288.000 Min. 336.000 Max.			Bill of Lading # 403671	Weight			

**Ship  
To**BEST STAINLESS & ALLOYS INC.  
3616 OLD SPANISH TRAIL  
HOUSTON, TX. 77021**Sold  
To**VALBRUNA STAINLESS, INC.  
2400 TAYLOR STREET WEST  
FORT WAYNE, IN 46802

Material conforms to listed specifications.

Quality system is compliant with ISO 9001:2000. Produced in accordance with EN 10204 3.1B.

Results relate only to the items tested. Certification shall not be reproduced except in full, without written approval of Valbruna Stainless Inc. The recording of false, fictitious, or fraudulent statements on this document may be punished as a felony under federal statutes, including Federal law, Title 18, Chapter 47. Consult material safety data sheet (MSDS) for hazard info.

I hereby certify that the reported figures are correct as contained in the records of the corporation.

Manager Laboratory Services

Dennis Hackett

10/17/2006 14:50 FAX

001/001

**Bodycote****THERMAL PROCESSING - HOUSTON**PH: 713 - 691 - 4544  
FAX: 713 - 691 - 1923

Cert No. 61-60715



Certified: 10/2/06

Bill To

Ship To

Best Stainless & Alloys  
3616 Old Spanish Trail  
Houston, TX 77021Ship To: 61-5209-1  
Best Stainless & Alloys  
3616 Old Spanish Trail  
Houston, TX 77021

Order No 261710	PO Number 8168	PL Number	Received 9/27/06
2-HT# 242410 ROUND BARS 4" OD X 321" - 329-3/4" LONG			
1-HT# 242410 TEST BAR 4" OD X 6" LONG			
Qty 3	Wgt 2340	Part No. 17-4 H-1150 AGE OSL	Part Name 17-4 PH
Part Description			
3 2340 Total			

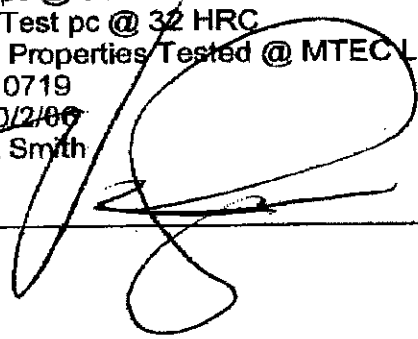
We hereby certify that the parts described above were given the following Heat Treatment and that temperatures and test results were obtained with the standard approved methods.

Specification:

Process	Furnace	Time	Temperature	Quenchant
Age	505/506	6.50Hrs	1150F	Air Cool

Inspection:

Checked 1 pc @ 34 HRC  
Checked 1 Test pc @ 32 HRC  
Mechanical Properties Tested @ MTEC Lab  
Lab# W0610719  
Certified: 10/2/06  
By: Vincent Smith



10-17-06

MTEC  
MECHANICAL  
TESTING  
SERVICES

ISO 9001-2000

## CERTIFICATE OF TEST

ATTENTION : KELVIN BROWN  
CUSTOMER :

LAB# : W0610719

DATE : 10/02/06 12:13:28  
PO NO : 261710  
CUST P/O# : 8168  
HEAT NO : 242410  
MATL. TYPE : 17-4PH  
QTC : 4"OD X 6"LG  
SPEC : CUST REQ  
CUSTOMER : BEST STAINLESS

---

---

TEST DATA

---

---

TENSILE

UTS PSI	YS.2%PSI	%EL 4D	%RA	BAR DIA.	ORIEN.	LOC.
142,300	116,800	20.70	58.90	0.502	LONG	MR

  
MTEC Representative

  
10-17-06





SEP 27 2025 11:33



EDELSTAHL WITTEN-KREFELD GMBH

Ausschuss 4  
D-58452 Witten  
Telefon: (02302)29-0  
Telefax: (02302)29-40 00  
Postanschrift: D-58449 Witten  
http://www.edelstahl-witten-krefeld.de

Datum/Date: 11.07.95

Seite/Page: 1 / 2

Zertifiziert nach:	ISO 9001 VDA 6. Teil I	Werkstofflieferant gemäß Druckgeräte- richtlinie 97/23 EG
	AD2000 W 0 TRD 100	

Abnahmeprüfzeugnis nach DIN EN 10204 3.1/01.05  
Inspection Certificate acc.to/Certificat de réception selon DIN EN 10204 3.1B/08.95  
Zeugnis-Nr./Certificat No./No.de Certificat 964679/704412/bll

Edelstahl Witten-Krefeld GmbH, D-58449 Witten  
ThyssenKrupp Specialty Steels  
NA, Inc.  
365 Village Drive  
US- Carol Stream, Illinois 60188

Herstellerzeichen/Supplier's Mark/Marké d'usine	
Prüfstempel/Inspector's stamp/Poignée de l'expert	

Werkzeugzeugnis  
Best Stainless & Alloys  
3616 Old Spanish Trail  
US-77021 Houston TX

Ihre Auftr.-Nr./von Your order No./date /No.de votre commande du 01D04567/RSS&A 22192 / 05.11.04	Your material No. 3309
Unsere Auftr.-Nr. Our order No./No.de notre commande 260345 / 1	Unsere Material-Nr. Our material No./No.de notre matériel 2219273
Unsere Abteilung/Our department/Notre département VERA	Telefon/Telephone/Téléphone 02302/294215

Produkt/Product/Produit

STAINLESS STEEL BARS  
TYPE 316, 17-4 PH  
HOT ROLLED, SOLUTION ANNEALED,  
STRAIGHTENED, PEELED  
ASTM A 310-02, ASTM A 564-02A,  
ASME SA 564-01, ASME SA 564.3 P, UNS-S-17400  
AMS 2303, ASTM A 484,

Fertigungsnummer/Production lot/No./Lot de fabrication No. : 62157  
Lieferschein-Nr./Delivery note/No. de l'avis de livraison :  
Schmelze-Nr./Heat No./No.de coulée : 537700  
Stückzahl/Piece No./Nombre des pièces :  
Gewicht/Weight/Masse :  
Zeichnungs-Nr./Drawing No./No.du dessin :  
Formal/Shape/Profil : rund / round / rond  
Durchm./Breite/Diameter/width/Diamètre/largeur : 77.216 [mm] / 3.040 [in]  
+0.508/-0.000 [mm] / +0.020 [in]  
Dicke/Thickness/Épaisseur :  
Länge/Length/Longueur : 6095 - 7315 [mm]  
239.961 - 287.992 [in]

Stückzahl und Gewicht siehe Rechnung. / Quantity and weight see delivery bill/invoice.  
Nombre des pièces et masse voir facture.

Lieferzustand/Condition as supplied/État de livraison: 1040 °C/Water  
NO WELDING HAS BEEN PERFORMED

Die Prüfergebnisse zu Ihrer Lieferung finden Sie auf der Rückseite bzw. den nächsten Seiten  
As for test results of your delivery see overleaf / Vous trouverez les résultats d'essais de votre livraison aux pages suivantes.

EDF1 STAHL WITTEN-KREFELD GMBH  
Abnahmetechnik/Inspection department/Département de Réception

Abnahmebeauftragter/Der Werkstattherr  
Test House Manager/Works' inspector/Responsable Réception/L'Agent Réceptionnaire de l'usine

3-7-06



## EDELSTAHL WITTEN-KREFELD GMBH

Auenstraße 4  
D-58452 Witten  
Telefon: (02302)29-0  
Telefax: (02302)29-40 00  
Postanschrift: D-58449 Witten  
<http://www.edelstahl-witten-krefeld.de>

Datum/Date: 11.07.05

Seite/Page: 2 / 2

Zugzeug-Nr. Certificate No./No. de Certificat	Unsere Auftr.-Nr. Our order No./No. de notre commande	Ihre Auftr.-Nr. vom Your order No. date /No. de votre commande du	Fertigungslof-Nr. Production lot-No./Lot de fabrication No.
904679/704412/bil	260345 / 1	01 D04367/1535dA 22192	42157

Schmelzen-Nr. Heat No./No. de coulée	Erstschmelzungsart Steelmaking process / Procédé d'élaboration	Sekundärschmelzungsart Secondary metallurgy / Métallurgie secondaire
537700	E	VOD

## Chemische Zusammensetzung / Chemical Composition / Composition chimique

	C	Si	Mn	P	S	Cr	Mo	Ni	Cu	Nb	
ist/Actual/Actuel	0.023	0.35	0.94	0.020	< 0.001	15.52	0.06	4.91	3.06	0.22	(%)

## Härte / Hardness / Dureté

Lieferzustand / Condition as supplied / Etat de livraison

Proben-Nr./Specimen-No./No. d'éprouvette	
ist/Actual/Actuel	58246
	361 (HB)

## Zugversuch / Tensile test / Essai de traction

Referenzzustand / Reference condition / Etat de référence: 1040 °C 60 min. / Water + 480 °C 60 min. / Air

Proben-Nr./Specimen dimension/Dimensions d'éprouvette	Probenrichtung/Specimen direction/Sens de Prélèvement	Prüftemp./Test temperature/Température d'essai				
Zugprobe: 12,5 mm $\phi$	Längs/longitudinal/longueur	23 [°C]				
Proben-Nr./Specimen-No./No. d'éprouvette	R <sub>p0.2</sub> [MPa (N/mm <sup>2</sup> )]	R <sub>p0.2</sub> [Ksi]	R <sub>m</sub> [MPa (N/mm <sup>2</sup> )]	R <sub>m</sub> [Ksi]	A <sub>2</sub> [%]	Z [%]
33641	1198	174	1329	193	13.0	41

Gefügeuntersuchung / Examination of microstructure / Examen de structure  
MICRO- AND MACROSTRUCTURE NO OBJECTIONS

## Ferritgehalt / Ferrite content / Contenu de ferrite

Proben-Nr./Specimen-No./No. d'éprouvette	Ferrit / Ferrite / Ferrite
58247	1 (%)

Delivery has been checked by US-Intsig

Identity has been checked (Specimen)

Visual inspection and control of dimensional accuracy have been performed

Das Material ist frei von Radioaktivität / The product is free from radioactivity / Le matériel n'est pas radioactif.  
El material es libre de radioactividad.

## Erläuterung / Explanations / Explications

- o Erstschmelzungsart / Steelmaking process / Procédé d'élaboration:
- E = Elektrosmelt / Electric-arc furnace steel / Acier électrique
- o Sekundärschmelzungsart / Secondary metallurgy / Métallurgie secondaire:
- VOD = Vakuum-Sauerstoff-Entkohlungs-Verfahren / Vacuum-Oxygen-Decarburization / Vacuum-Oxygène-Décarburation

Es wird bestätigt, daß die Lieferung geprüft wurde und den Vereinbarungen bei der Bestellungsannahme entspricht.  
We hereby certify that the material described above has been tested and complies with the terms of the order.  
Nous certifions que la livraison est vérifiée et est conforme aux stipulations de l'acceptation de la commande.

900  
3-7-06

# CERTIFICATION OF HEAT TREATMENT



2115 Humble Westfield  
Houston, Texas 77073  
(281) 821-0033 • 821-0066  
Fax: (281) 821-0072

Furnace calibration and surveys to MIL-H-6875

Quality Assurance Program meets ANSI/ASQC Q92, and ISO 9002.

Date: 11/3/2005  
Certification Number: K&D-30565  
Customer's Order Number: 5922  
Heat Number: 537700  
Quantity: 7  
Part Numbers:

(6) 3" OD X 11' R/L

(1) TEST PIECE: 3" OD X 6" LG BHN 321-321

Material: 17-4PH  
Spec: A564 / H1150

		Time at Heat	Coolant
Annealed	Deg. F		
Solution Annealed	Deg. F		
Preheat	Deg. F		
Normalized	Deg. F		
Quenched	Deg. F		
Temper	1150 Deg. F	4 hrs	Air
Temper	Deg. F		
Temper	Deg. F		
Stress Relieved	Deg. F		

Quench Media Temp Deg. F  
Hardness Test 311-321 43 % Pcs Tested

Times at temperature are determined by furnace atmosphere thermocouple.

We further certify that heat treatment described above is true and correct and that temperatures and test results were obtained with standard approved methods.

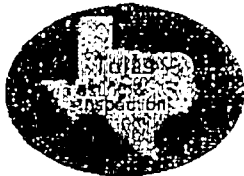
K & D HEAT TREAT, INC

By

Debbie Hoffart  
Debbie Hoffart

9/26/06  
3-7-06

# Tensile Certification Report



Tejas Testing & Inspection, Inc.  
4601 South Plinmont, Suite 136  
Houston, TX 77041  
Phone: (713) 939-0440 • Fax: (713) 939-0430

OK

Report: **T030875**

Customer: **K & D Heat Treat, Inc.**

PO Number **5922**

Material: **17-4PH**

HT No. **537700**

No. Pieces: **1**

Customer Info.: **TEST PIECE: 3"OD X 6"LG**

Specification: **TENSILE PER A564/H1150**

## Results

Unless otherwise stated, yield stress is 0.2% offset. Gauge length is 2" for a 0.5" specimen or 1" for a 0.25" specimen.

Number	1	2	3	4
Size (Inches):	<u>.505</u>			
Yield (PSI):	<u>118,000</u>			
Tensile (PSI)	<u>141,500</u>			
Elongation (%)	<u>24</u>			
Reduction (%)	<u>62</u>			
Hardness				

Comments:

Submitted by:

**Randall Tippit**

TPI Representative

Date: 11/3/2005

*gpc*  
3-7-06



# GLORIA MATERIAL TECHNOLOGY CORP. INSPECTION CERTIFICATE

台南縣新營市新中路35號1樓  
TEL. NO. 34, Hsin Chung Rd., Hsin Ying,  
TAINAN, TAIWAN.  
TEL: (06) 6520000  
FAX: (06) 6520088

Messrs: VALBRUNA STAINLESS INC.

Order No: 2005008866

Grade: AISI 630(HH1150)

P.O. NO.: 17220

FILE NO: 2006001041-B

Size: 2.5"

Date: 02/28/2006

HEAT-Lot No: T1996-B10

Weight: 3184.0KG 7020.00LB

P'cs: 32

Condition: HR-Solution Annealed-Double Aged-Smooth Turned(-Stress Relief)

## Chemical Composition (wt%)

	C	Si	Mn	P	S	Ni	Cr	Mo	Cu	Nb+Ta
Min.						3.00	15.50		3.00	0.15
Max.	0.07	1.00	1.00	0.030	0.030	5.00	17.00	0.50	5.00	0.35
Result	0.03	0.38	0.62	0.026	0.021	4.68	15.83	0.13	3.33	0.29

	N	Nb	Ta
Min.		0.15	
Max.	0.050	0.45	
Result	0.048	0.29	0.00029

## Mechanical Properties Spec.

	Hardness 1/2R(1)	Hardness 1/2R(2)	Hardness Surface(1)	Hardness Surface(2)	Grain Size
Condition	29HRC	29HRC			
Spec.Min.	29HRC	29HRC			
Spec.Max.	33HRC	33HRC	33HRC	33HRC	
Result	32.3HRC	32.9HRC	32HRC	32HRC	7.5

	$\delta$ -Ferrite	Impact(1) -75°F	Impact(2) -75°F	Impact(3) -75°F	LE(1) -75°F
Condition		20Ft.Lbs	20Ft.Lbs	20Ft.Lbs	
Spec.Min.	5%				
Spec.Max.					
Result	0.3%	73Ft.Lbs	73Ft.Lbs	74Ft.Lbs	.83mm

	LE(2) -75°F	LE(3) -75°F	Shear%(1) -75°F	Shear%(2) -75°F	Shear%(3) -75°F
Condition					
Spec.Min.					
Spec.Max.					
Result	.84mm	.82mm	55%	55%	51%

## Tensile Test

	Elongation(A) %	Tensile Strength(Rm) KSI	Yield Strength(Rp) KSI	Reduction of Area(Z) %
Unit				
Min.	16	130	105	50
Max.				
Result	21	137	108	63

## Heat Treatment Condition

Condition	Temperature	Time/hour	Treatment
SOLUTION	1900°F	1.77	FAST AIR COOL TO BELOW 90°F
DOUBLE AGED	1150°F	5.9	COOL IN AIR

## Specification:

1. FMIGB 1.15.03.
2. ASTM A364M-04, A484M-05, A370-05, A388M-04.

ISO 9001

BSMI

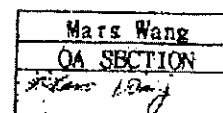
REGISTERED



Reg. No. 020005



CERT. No. 91051



Our quality and environment management systems have been certified by ISO 9001 QMS and 14001 EMS.  
We hereby certify that the material described herein has been manufactured and tested with satisfactory results in accordance with the requirement of the above material specification.  
We hereby the Inspection Certificate comply with EN10204 3.1.B.



# GLORIA MATERIAL TECHNOLOGY CORP. INSPECTION CERTIFICATE

台南縣新營市新中路35號1樓  
TEL. NO. 35, HEIN CHUNG RD, HEIN YING,  
TAINAN, TAIWAN.  
TEL: (06)6520000  
FAX: (06)6520088

Messrs: VALBRUNA STAINLESS INC.

Order No: 2005008866

Grade: AISI 630(HH1150)

P.O.NO.: 17220

FILE NO: 2006001041-B

Size: 2.5"

Date: 02/28/2006

HEAT-Lot No: T1996-B10

Weight: 3184.0KG 7020.00LB

P'cs: 32

Condition: HR-Solution Annealed-Double Aged-Smooth Turned(-Stress Relief)

3. ASME SA564M-02.

4. AMS 5643Q.

5. API 6A.

6. NACE MR0175-99 UNS S17400.

7. AISI 17400.

8. DIN 50049.

9. EN 10204 3.1b.

## Remark:

1. MANUFACTURING PROCESS: EAF+LHF+VOD, FORGED OR HOT ROLLED.

2. MATERIAL IS FREE FROM KNOWN CONTACT WITH MERCURY AND RAIUM.

3. MATERIAL IS FREE FROM WELDS OR WELD REPAIRS.

4. ULTRASONIC TEST: OK.

5. MACRO OK.

6. MICRO OK.

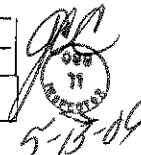
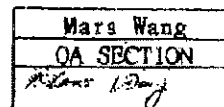
7. MINIMUM HOT WORK REDUCTION RATIO OF 4:1.

8. FURNACES CALIBRATED TO MIL-H-6875.

9. HEAT TREATMENT TO BE MONITORED BY FURNACE THERMOCOUPLE.

10. LONGITUDINAL IMPACT SPECIMEN SIZE IS 10mm\*10mm\*55mm.

11. LONGITUDINAL TENSILE SPECIMEN SIZE IS D (DIAMETER) : 6.25 ±0.12 mm, G (GAGE LENGTH) : 25.0 ±0.10 mm, TEST AT THE ROOM TEMPERATURE.



Our quality and environment management systems have been certified by ISO 9001 QMS and 14001 EMS.

We hereby certify that the material described herein has been manufactured and tested with satisfactory results in accordance with the requirement of the above material specification.

We hereby the Inspection Certificate comply with EN10204 3.1B.

**榮剛材料科技股份有限公司**  
**GLORIA MATERIAL TECHNOLOGY CORP.**

台灣省台南縣新營市新中路 35 號  
35 HSIN CHUNG ROAD, HSINYING CITY, TAINAN HSIEN, TAIWAN.  
TEL: (06) 6520000  
TELFAX: (06) 6520088/6520033

**ULTRASONIC EXAMINATION CERTIFICATE**



Messers: VALBRUNA STAINLESS INC.  
Order No: 2005008866 Grade: 630(HH1150) P.O.NO.: 17220  
FILE NO: 2006001041-B Size: 2.5" HEAT-Lot NO: T1996-B10

Equipment: USL32 KRAUTKRAMER  
Method: CONTACT, STRAIGHT BEAM  
Probe: B4S-E, 4MHZ, KRAUTKRAMER  
Couplant: PASTE  
Specitication: ASTM A388/A388M-95  
CAMCO NDE-31 UT REQUIREMENT

Examination data:

EVALUATION GAIN	40dB
SCANNING GAIN	60 dB
CALIBRATION	DGS METHOD
RESULT	NO FLAW ECHO WAS FOUND

Acceptance: ACCEPTABLE

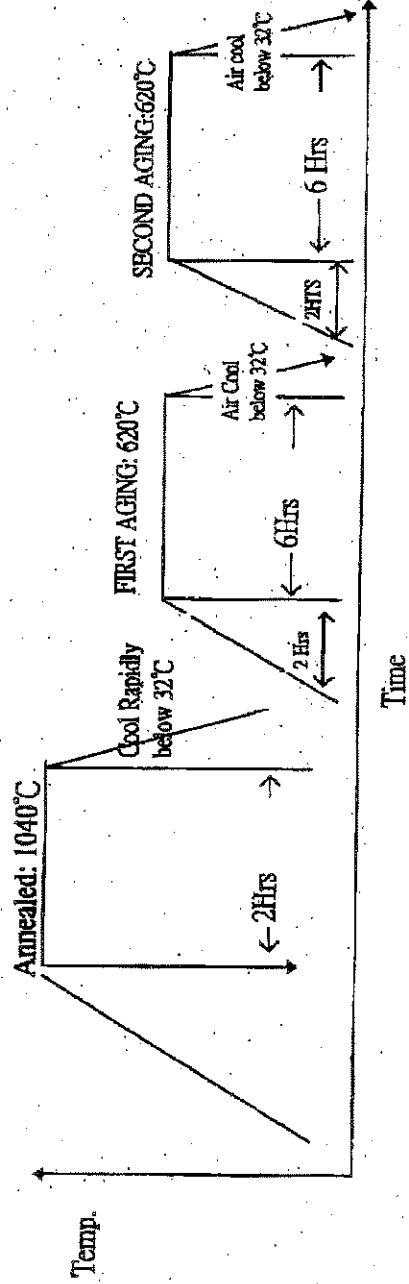
Date	Q.C. CHIEF	EVALUATOR LEVEL II-CTSNT	INSPECTOR LEVEL I-CTSNT
03/01/2006	Hsin-Jung Huang	Ru-Ching Tan	Jen-Chung Chen

*JCC*  
  
5-13-06



# GLORIA MATERIAL TECHNOLOGY CORP. HEAT - TREATMENT CHART

Messrs: VALBRUNA STAINLESS INC.  
FILE No.: 2006001041-B  
Grade: 630(HH1150)  
HEAT-Lot No.: T1996-B10



Handwritten signature and date: 5-13-06

**VALBRUNA****SLATER STAINLESS, INC.**

2400 Taylor Street West, P.O. Box 630

Fort Wayne, Indiana USA 46801

Phone: 260-434-2892 Fax: 260-434-2905

**Product Certification Report****Report Number: 4190790****Certified on Jun 16, 2006 Page 1 of 2**

Order I.D. 0601114 017		Order Date 3/27/06		Commodity Code			
Dim 1 2.5000	Dim 2 .0000	Dim 3 .0000	Heat I.D. 241409	Customer I.D. 002471	Customer Purchase Order 18107		
Product Shape Rounds			Product Surface HR & Rough Turned			Customer Grade 630	
Length (Inches) 132.000 Min. 156.000 Max.			Bill of Lading # 403403	Weight			

**Ship To**

VALBRUNA STAINLESS, INC.  
4747 OATES ROAD  
HOUSTON, TX 77013

**Sold To**

VALBRUNA STAINLESS, INC.  
4747 OATES ROAD  
HOUSTON, TX. 77013

**Lifts: 0055 0056**

API 6A	API-14D	CONDITION DBL H-1150
NACE MR-0175 ISO 15156	7138-P	UNS S17400
ASTMA 564-04	ASMESA 564 01 ED 2002 ADD	AMS 5643Q

**CHEMICAL ANALYSIS**

C	Mn	P	S	Si	Cr	Ni	Mo	Cu	N	Cb	Ta
.033	.54	.025	.025	.47	15.53	4.89	.18	3.40	.037	.28	.00

HRC  
32.0  
33.0

**TENSILE PROPERTIES**

TS (PSI)	.2%YS (PSI)	%EL(2")	%RA
143700	125500	21.5	64.0

**CHARPY V NOTCH**

FT/LB	FT/LB	FT/LB	AVG FT LB	TEST(F)
60	53	52	55	- 75

**MAGNETIC PARTICLE TEST**

FREQ SEV  
AVG .00 .00

**PRODUCTION HEAT TREATMENT**

SOL-ANN(F)	SOL-ANN(HR)	AGE(F)	AGE(HR)	AGE(F)	AGE(HR)
1900	7.50	1150	4	1150	4.0

**MACRO ASTM E340/E381**

MACRO

OK

OK

OK

**PERCENT FERRITE**

% FERRITE

AVG .3

Free of mercury and low melting alloy contamination.

Forge reduction greater than 4:1.

Electric Furnace melted; AOD refined.

Tensile specimen size .505".

Results relate only to the items tested. Certification shall not be reproduced except in full, without written approval of Valbruna Stainless Inc. The recording of false, fictitious, or fraudulent statements on this document may be punished as a felony under federal statutes, including Federal law, Title 18, Chapter 47. Consult material safety data sheet (MSDS) for hazard info.

I hereby certify that the reported figures are correct as contained in the records of the corporation.

Manager Laboratory Services

*Dennis Hackett*

Dennis Hackett

TO  
5  
7-19-06

**VALBRUNA**

SLATER STAINLESS, INC.  
2400 Taylor Street West, P.O. Box 630  
Fort Wayne, Indiana USA 46801  
Phone: 260-434-2892 Fax: 260-434-2905

**Product Certification Report****Report Number: 4190790**

Certified on Jun 16, 2006 Page 2 of 2

Order I.D. 0601114 017		Order Date 3/27/06		Commodity Code	
Dim 1 2.5000	Dim 2 .0000	Dim 3 .0000	Heat I.D. 241409	Customer I.D. 002471	Customer Purchase Order 18107
Product Shape Rounds			Product Surface HR & Rough Turned		Customer Grade 630
Length (Inches) 132.000 Min. 156.000 Max.			Bill of Lading # 403403	Weight	

**Ship  
To**

VALBRUNA STAINLESS, INC  
4747 OATES ROAD  
HOUSTON, TX 77013

**Sold  
To**

VALBRUNA STAINLESS, INC.  
4747 OATES ROAD  
HOUSTON, TX. 77013

No welding or weld repair done.

Furnaces are calibrated per the requirements of API 6A PSL 3 (APP. H).

Hardness is mid-radius location unless otherwise stated.

Chemical testing performed to one or several of the following ASTM methods: E415, E572, E1019, E1085, E1086.

No mercury or low melting alloy contamination. No weld repair.

Material melted in Italy, manufactured in the United States.

Material conforms to listed specifications.

Quality system is compliant with ISO 9001:2000. Produced in accordance with EN 10204 3.1B.

Results relate only to the items tested. Certification shall not be reproduced except in full, without written approval of Valbruna Stainless Inc. The recording of false, fictitious, or fraudulent statements on this document may be punished as a felony under federal statutes, including Federal law, Title 18, Chapter 47. Consult material safety data sheet (MSDS) for hazard info. I hereby certify that the reported figures are correct as contained in the records of the corporation.

Manager Laboratory Services

Dennis Hackett

TD  
5  
INSPECTED  
7-19-06



# GLORIA MATERIAL TECHNOLOGY CORP.

## INSPECTION CERTIFICATE

台南縣新營市新中路35號1樓  
IFL NO.35,HSIN CHUNG RD.,HSIN YING,  
TAINAN,TAIWAN,R.O.C.  
TEL: (06)6520000  
FAX: (06)6520088

### MILL TEST CERTIFICATE

Messrs: BEST STAINLESS

Order No: 2004007916

Grade: AISI 630

P.O.NO.: 52345/3327

FILE NO: 2005001425-A

Size: 1.25"

Date: 03/30/2005

HEAT-Lot No: S2925-D10

Weight: 685.0KG

P'cs: 17

Condition: HR-Solution Annealed-Ground

#### Chemical Composition (wt%)

	C	Si	Mn	P	S	Ni	Cr	Mo	Cu	Nb+Ta
Min.					0.015	3.00	15.00		3.00	0.15
Max.	0.07	1.00	1.00	0.040		5.00	17.50	0.50	5.00	0.45
Result	0.02	0.36	0.64	0.023	0.026	4.45	15.03	0.13	3.23	0.28

#### Mechanical Properties Spec.

	Hardness(1/2R)	Grain Size	$\delta$ -Ferrite	H900-Hardness(Avg.)
Spec.Min.				40HRC
Spec.Max.	363HBW		5%	47HRC
Result	316HBW	7.5	1.2%	44.8HRC

#### Tensile Test

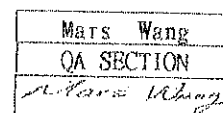
Unit	Elongation(A) %	Tensile Strength(Rm) KSI	Yield Strength(Rp) KSI	Reduction of Area(Z) %
Min.	10	190	170	40
Max.				
Result	15	203	177	53

#### Specification:

1.ASTM A564-04. 2.AMS 5643P,

#### Remark:

1.MELTING PROCESS:BAF+LHF+VOD., 2.MATERIAL IS FREE FROM KNOWN CONTACT WITH MERCURY & RADIUM., 3.MATERIAL IS FREE FROM WELDS OR WELD REPAIRS., 4.MACRO/MICRO STRUCTURE:OK., 5.ULTRASONIC TEST:OK. 6.MECHANICAL PROPERTIES TESTED AS PER H900 CONDITION., 7.SOLUTION TREATMENT: SOLUTION TREATMENT:1900°F×30 MIN/INCH, RAPIDLY COOLED TO BELOW 90°F



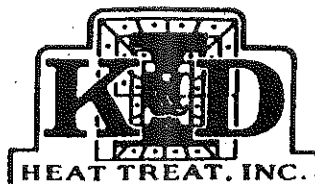
Our quality and environment management systems have been certified by ISO 9001 QMS and 14001 EMS.

We hereby certify that the material described herein has been manufactured and tested with satisfactory results in accordance with the requirement of the above material specification.

We hereby the Inspection Certificate comply with EN10204 3.1 B

1/17/07

**CERTIFICATION OF  
HEAT TREATMENT**



2115 Humble Westfield  
Houston, Texas 77073  
(281) 821-0033 • 821-0066  
Fax: (281) 821-0072

Furnace calibration and surveys to MIL-H-6875

Quality Assurance Program is registered to ISO 9001:2000

Date: 1/10/2007  
Certification Number: K&D-33642  
Customer's Order Number: 8717  
Heat Number: S2925-D10  
Quantity: 5  
Part Numbers:

(3) 1 1/4" OD X 20' R/L

(1) TEST PIECE: 1 1/4" OD X 6" LG

BHN 321-321

(1) TEST PIECE: 1 1/4" OD X 7" LG

BHN 321-321

Material: 17-4PH

Spec: H1150

		Time at Heat	Coolant
Annealed	Deg. F		
Solution Annealed	Deg. F		
Preheat	Deg. F		
Normalized	Deg. F		
Quenched	Deg. F		
Temper	1150 Deg. F	4 hrs	Air
Temper	Deg. F		
Temper	Deg. F		
Stress Relieved	Deg. F		

Quench Media Temp

Deg. F

Hardness Test 321-332

80 % Pcs Tested

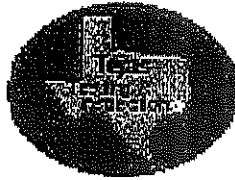
Times at temperature are determined by furnace atmosphere thermocouple.

We further certify that heat treatment described above is true and correct and that temperatures and test results were obtained with standard approved methods.

K & D HEAT TREAT, INC

By Debbie Hoffart  
Debbie Hoffart

# Tensile & Charpy Certification Report



Tejas Testing & Inspection, Inc.

4601 South Pinemont, Suite 136

Houston, TX 77041

Phone: (713) 939-0440 • Fax: (713) 939-0430

Report: T041331

Customer: K & D HEAT TREAT, INC.

PO Number 8717

Material: 17-4PH

HT No. S2925-D10

No. Pieces: 2

Customer Info.: 1 1/4" OD X 13" LG

Specification: TENSILE, LCVN @ -76°F PER H1150

**Tensile Results** Unless otherwise stated, yield stress is 0.2% offset. Gauge length is 2" for a 0.5" specimen or 1" for a 0.25" specimen.

Number	1	2	3	4
Size (Inches):	.505			
Yield (PSI):	119,000			
Tensile (PSI)	139,000			
Elongation (%)	23			
Reduction (%)	62			
Hardness				

**Charpy Results** Unless otherwise stated, specimens are full size, i. e. 10 mm x 10 mm

Number	1	2	3	4
Temperature:	-76°F			
Location:	LCVN			
Ft/Lbs	64 54 51			
% Shear	50 50 50			
MLE	27 26 26			

Comments:

Submitted by:

Randall Tippit

Date: 1/9/2007

TEI Representative

10  
1/17/07



ImXport Services  
Corp.

Pemex-PP LUM A  
Project

## Vendor Data Book

P.O. # 0018987

Serial # 23407

Volume 1

### Nautilus Crane Model 340LA-80

#### Section 3.0 Ballring Certificates



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA



REV: 1

Cert Number: 133

## Certificate of Compliance

This is to certify that Rotek Incorporated has inspected and/or tested the product listed below, in accordance with the requirements of:

Vendor Code: N/A  
Customer: OILSTATES SKAGIT SMATCO  
Contract No: N/A  
Customer Purchase Order: 4043981  
Customer Part Number: N46397-002  
Model No: A22-80E3  
OIS Number: CO1030900  
Quantity: 1  
Bearing S/N: 301575-A3  
Inner S/N: 18661-1 Inner Cert No.: 380967388E18661  
Outer S/N: 18650-3 Outer Cert No.: 380967386E18650



<u>PRINT REQUIREMENT:</u>	<u>ACTUAL</u>
7.00 +.040/-.060 OVERALL HT.	7.018
85.500 +/- .022 OUTER B.C.	85.494
73.000 +/- .022 INNER B.C.	73.014
91.682 / 91.650 (1.000) GEAR P.D.	91.640
RADIAL CL .008 / .014	.010

Comments: We certify that the records are on file which contain objective evidence of conformance, and that the records are available upon request.

*David J. Rose* A18

Authorized Representative: DAVID J. ROSE

**ROTEK Inc.**

1400 S. Chillicothe Rd.

P.O. Box 312

Aurora, Oh 44202

ph. (330) 562-4000

fax (330) 562-2021

Title: QC MGR. AURORA BRG. PLANT

Date: 10-Jul-07



**CERTIFICATION OF TEST**

CERTIFICATION NO. 380967388E18661



ThyssenKrupp

Customer Order no.	Rotek Order no.	Specification	Certification Date
AUR	E18661	AISI 4140 PER API-2C	7/3/2007

Customer Name AUR

Part No.	PCS	Rotek Heat Code
ROUGH RINGS A2280A2 79.57 X 69.48 X 6.49	2	C337
Heat No. B1164	Material Vendor ELLWOOD STEEL BELGIUM	

**CHEMICAL ANALYSIS**

C	MN	P	S	SI	NI	CR	MO	CU	V	CB
.410	.960	.008	.014	.240	.130	1.060	.190	.140	.004	.000

Per EPCRA section 313 chemical notice, this Rotek product contains the above chemical mixture by weight to facilitate your Form A and / or R reporting if so required

**MECHANICAL PROPERTIES OF TEST RING**

BHN	TENSILE STRENGTH PSI	YIELD STRENGTH PSI	ELONG % IN 4D	%RED. OF AREA	GRAIN SIZE
321	137,000	112,900	18	55	5 SIZE = .501

**CLEANLINESS RATING PER E-45**

A		B		C		D	
T	H	T	H	T	H	T	H
1.00	0.50	0.00	0.00	0.00	0.00	1.00	0.00

**CHARPY IMPACT TEST RESULTS (FT. LBS)**

TEMP °	#1	#2	#3
-20C	034.0	034.0	037.0

**ULTRASONIC INSPECTED**

**HEAT TREATMENT** AUST. 1125 DEG.F. 5 HOURS AIR COOL

**NOTES**

FORGINGS YIELDS 1 PIECE

WE HEREBY CERTIFY THE ABOVE RESULTS ARE CORRECT AS REPORTED AND CONTAINED WITHIN COMPANY RECORDS. Testing, inspection and documentation law EN10204-3.1 B

*Harry Friedman*

**AUTHORIZED SIGNATURE**



ImXport Services  
Corp.

Pemex-PP LUM A  
Project

## Vendor Data Book

P.O. # 0018987

Serial # 23407

Volume 1

### Nautilus Crane Model 340LA-80

#### Section 4.0 Ballring Clearance Reports

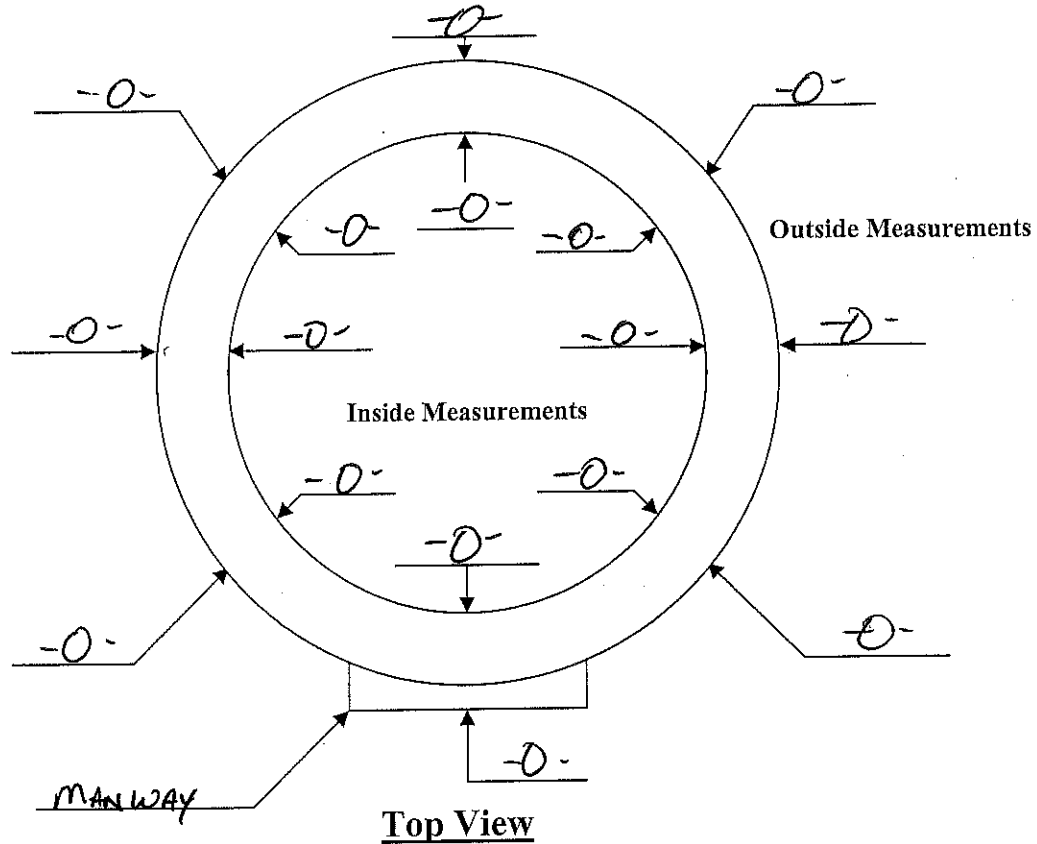


SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA





## BALLRING TO PEDESTAL CLEARANCE REPORT



Weldment Serial Number: C07171-01

Weldment Part Number: N20075K1-132

Crane Model Number: 340L

Crane Serial Number: 23407

Customer: PEMEX

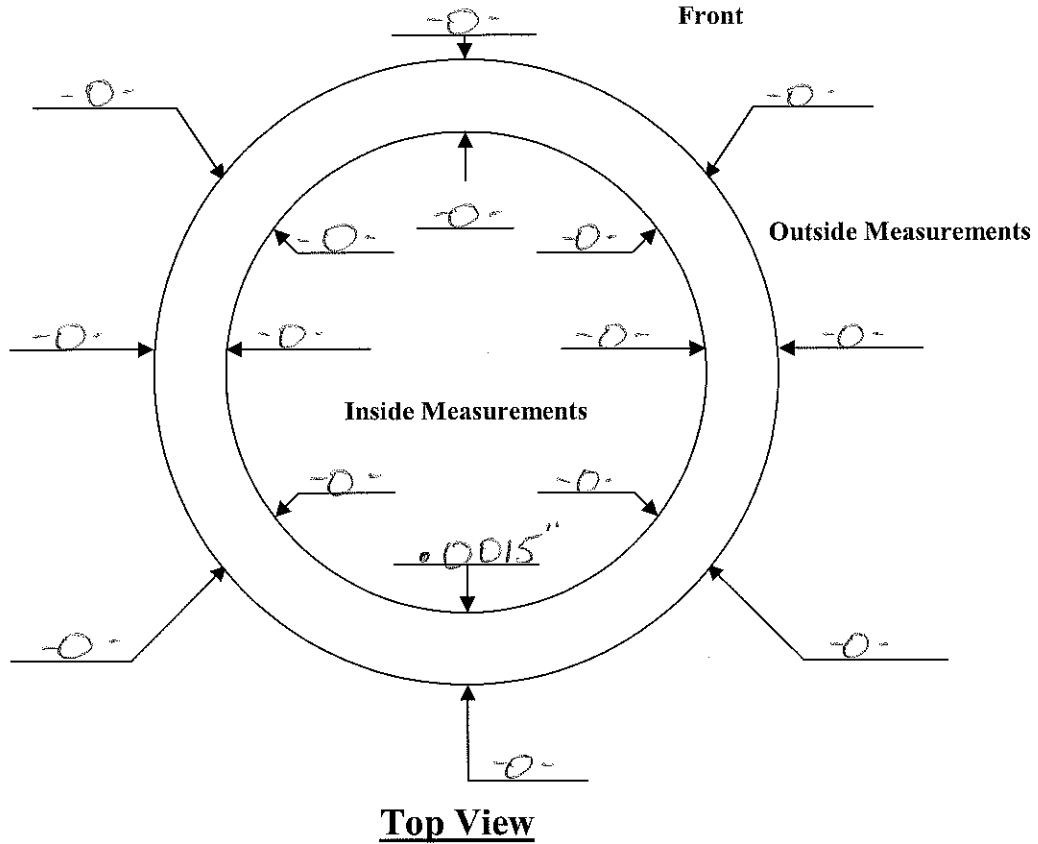
Remarks: All bolts F.T.

Inspector: B. J. RAL

Date Inspected: 10/1/07



## BALLRING TO TURRET/UPPER STRUCTURE CLEARANCE REPORT



Weldment Serial Number: C07101-01

Weldment Part Number: N61584-001

Crane Model Number: 340LA-80

Crane Serial Number: 23407

Customer: Pemex

Remarks: All bolts fit

Inspector: 

Date Inspected: 9/25/07



ImXport Services  
Corp.

Pemex-PP LUM A  
Project

## Vendor Data Book

P.O. # 0018987

Serial # 23407

Volume 1

### Nautilus Crane Model 340LA-80

#### Section 5.0 Bolt Certificates



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA



# Cardinal Fastener Test Certification

Reported: 5/25/2007

Certification No.:	28688	Shop Order#:	252132
Order No.:	124658 1	Heat No.:	M21394
Customer PO:	SM320-REPLACE	Grade:	Gr.8
Customer No.:	000000071290	Thread Class:	2A
Customer:	SOUTHERN FASTENER HOUMA	Shipped Qty:	223
Address:	112 Menard Road	Heat Treat Spec:	
	Houma, LA 70363	Supplier:	
		Finish Spec.:	
Manufacturer:	Cardinal Fastener & Specialty Co.,	Supplier:	
Address:	5185 Richmond Road	Item description:	5/8 - 11 X 3: GR8 HEX BOLT
	Bedford Height, Ohio 44146	Headmark:	ZINC & YELLOW / CHARPY TESTED
Laboratory:	Cardinal Fastener & Specialty Co.,		
Address:	5185 Richmond Road		
	Bedford Heights, Ohio 44146		
Notes:			



5-29-07

Test No.:	38931	Order No.:	M21394 0	Test Date:	1/2/2007	Test Disposition:	PASS
Specification:	CHEM_GRADE 4140			Test Facility:	MACSTEEL		
Tech. Name:	C EASTEN	Tech. Title:	QA	LotSize(pcs/lbs):	20000		
Notes:	S=1 R=1 C=1			Sample Size:	1		

Inspection (min. - max.) units	Disposition	Sample Values:
CARBON (0, 999) %	PASS	0.42
MANGANESE (0, 999) %	PASS	0.85
PHOSPHORUS (0, 999) %	PASS	0.016
SULFUR (0, 999) %	PASS	0.03
SILICON (0, 999) %	PASS	0.27
COPPER (0, 999) %	PASS	0.21
NICKEL (0, 999) %	PASS	0.1
CHROMIUM (0, 999) %	PASS	0.97
MOLYBDENUM (0, 999) %	PASS	0.17
ALUMINUM (0, 999) %	PASS	0.024
VANADIUM (0, 999) %	PASS	0.006

Test No.:	39906	Order No.:	252132 0	Test Date:	4/20/2007	Test Disposition:	PASS
Specification:	MET_FASTENAL NON STANDARD BEFORE CAD PLATE			Test Facility:	CFS		
Tech. Name:	DFD	Tech. Title:	LT	LotSize(pcs/lbs):		233	
Notes:	HARDNESS PER ASTM E18; MAG. PARTICLE INSP. - ACCEPT.				Sample Size: 3		
WEDGE TEST PER SAE J429; WEDGE ANGLE 10 DEGREES							
CHARPY V-NOTCH @ 0 DEGREES F. RESULTS: 1] 49 FT. LBS., 2] 56 FT. LBS.,							
3] 52 FT. LBS. - AVG. - 52 FT. LBS. - ACCEPT.							

Inspection (min. - max.) units	Disposition	Sample Values:		
TENSILE (150000, 999999) PSI	PASS	162280	165250	165370
HARDNESS (33, 39) RC	PASS	36	36	36
SURFACE HADNESS (0, 58.6) 30N	PASS	55	56	56

Cert No: 28688

ALL MANUFACTURING AND MATERIAL PROCESSES IN THIS PRODUCT HAVE OCCURED WITHIN THE U.S.A. IN COMPLIANCE WITH THE BUY AMERICA PROVISIONS OF THE SURFACE TRANSPORTATION ACT OF 1982

All data represented on this report relates only to the item(s) tested, which have been sampled in order to represent the processed lot identified in the description.

Information and data in the report is correct and reliable to the best of our knowledge; however, results are not guaranteed and no responsibility is assumed.

All items furnished on the above referenced Purchase Order are in full conformance with all Purchase Order and Specification Requirements. Test values, either provided by our supplier or generated in Cardinal's Laboratory, represent actual attributes of the items furnished and the test results are in full compliance with all applicable specification and order requirements. All manufacturing, testing, sampling and inspections have been performed in accordance with Cardinal's Quality Assurance Program. All applicable tests are in accordance with the Quality Control Manual dated 4/24/98. The product was manufactured and supplied free from mercury contamination. This document may only be reproduced unaltered and only for the purpose of certifying the same or lesser quality of the product specified herein. Reproduction or alteration of this document for any other purpose is prohibited.

*Dennis L. Mutha*  
(Approval)

Q.A.  
(Title)

5/25/2007  
(Date Approved)



5-29-07

# Cardinal Fastener Test Certification

Reported: 4/5/2006

**Certification No.:** 25556  
**Order No.:** 115847 1  
**Customer PO:** 4044756  
**Customer No.:** 000000071290  
**Customer:** SOUTHERN FASTENER HOUMA  
**Address:** 112 Menard Road  
 Houma, LA 70363  
**Manufacturer:** Cardinal Fastener & Specialty Co.,  
**Address:** 5185 Richmond Road  
 Bedford Heights, Ohio 44146  
**Laboratory:** Cardinal Fastener & Specialty Co.,  
**Address:** 5185 Richmond Road  
 Bedford Heights, Ohio 44146

**Shop Order#:** 00239898  
**Heat No.:** 501432  
**Grade:** GR8  
**Thread Class:** 2A  
**Shipped Qty:** 636  
**Heat Treat Spec:**  
**Supplier:**  
**Finish Spec.:**  
**Supplier:**  
**Item description:** 1 1/2 - 6 x 5 : GR8 HHCS / CAD  
**Headmark:** FLATED / CHARPY / HT# HEAD



Notes:

**Test No.:** 34889    **Order No.:** 501432 0    **Test Date:** 10/31/2005    **Test Disposition:** PASS  
**Specification:** CHEM\_GRADE 4140 HR    **Test Facility:** ALTON  
**Tech. Name:** CAULEY    **Tech. Title:** QA    **Lot Size (pcs/lbs):** 20000  
**Notes:**    **Sample Size:** 1

Inspection (min. - max.) units	Disposition	Sample Values:
CARBON (0, 999) %	PASS	0.4
MANGANESE (0, 999) %	PASS	0.81
PHOSPHORUS (0, 999) %	PASS	0.001
SULFUR (0, 999) %	PASS	0.019
SILICON (0, 999) %	PASS	0.25
COPPER (0, 999) %	PASS	0.24
NICKEL (0, 999) %	PASS	0.091
CHROMIUM (0, 999) %	PASS	0.951
MOLYBDENUM (0, 999) %	PASS	0.156
ALUMINUM (0, 999) %	PASS	0.004
VANADIUM (0, 999) %	PASS	0.035

This report shall not be reproduced except in full, without the written approval of Cardinal Fastener & Specialty Co., Inc.

Pg 1

CARDINAL FASTENER & SPECIALTY CO., INC. / 5185 RICHMOND RD. BEDFORD HEIGHTS, OHIO 44146 / 216-831-3651



Test No.: 36186 Order No.: 239898 0 Test Date: 3/15/2006 Test Disposition: PASS  
 Specification: MET\_SAEJ429\_GR8[1/2"TO1 1/2"&>2 1/2D] May 98 Test Facility: CFS  
 Tech. Name: DFD Tech. Title: LT LotSize(pcs/lbs): 648  
 Notes: Wedge Test Per SAE J429; WEDGE ANGLE 6 DEGREES Sample Size: 5  
 Hardness Per ASTM E18; MAG. PARTICLE INSP. - ACCEPT.  
 CHARPY V-NOTCH @ 0 DEGREES F. - RESULT: 1) 33 FT. LBS., 2) 32 FT. LBS.,  
 3) 30 FT. LBS. - AVG. - 32 FT. LBS. - ACCEPT.

Inspection (min. - max.) units	Disposition	Sample Values:				
HARDNESS (33, 39) Rc	PASS	35	35	34	35	35
SURFACE HARDNESS (0, 58.6) 30N	PASS	54	54	56	56	56
TENSILE (150000, 999999) PSI	PASS	163644	162093	159089	162391	159629

Test No.: 36432 Order No.: 239898 0 Test Date: 4/5/2006 Test Disposition: PASS  
 Specification: MET\_SAEJ429\_GR8[1/2"TO1 1/2"&>2 1/2D] May 98 Test Facility: CFS  
 Tech. Name: DFD Tech. Title: LT LotSize(pcs/lbs): 641  
 Notes: Wedge Test Per SAE J429; WEDGE ANGLE 6 DEGREES Sample Size: 5  
 Hardness Per ASTM E18  
 CHARPY V-NOTCH @ 0 DEGREES F. - RESULTS: 1) 34 FT. LBS., 2) 33 FT. LBS.,  
 3) 32 FT. LBS. - AVG. - 33 FT. LBS. ACCEPT.

Inspection (min. - max.) units	Disposition	Sample Values:				
HARDNESS (33, 39) Rc	PASS	36	36	36	36	36
SURFACE HARDNESS (0, 58.6) 30N	PASS	57	56	57	56	56
TENSILE (150000, 999999) PSI	PASS	165338	163986	165979	164555	163687

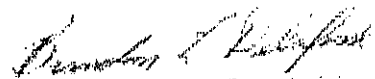
Cert No: 25656

ALL MANUFACTURING AND MATERIAL PROCESSES IN THIS PRODUCT HAVE OCCURED WITHIN THE U.S.A. IN  
 COMPLIANCE WITH THE BUY AMERICA PROVISIONS OF THE SURFACE TRANSPORTATION ACT OF 1982

All data represented on this report relates only to the item(s) tested, which have been sampled in order to represent the  
 processed lot identified in the description.

Information and data in the report is correct and reliable to the best of our knowledge; however, results are not  
 guaranteed and no responsibility is assumed.

All items furnished on the above referenced Purchase Order are in full  
 conformance with all Purchase Order and Specification Requirements. Test  
 values, either provided by our supplier or generated in Cardinal's Laboratory,  
 represent actual attributes of the items furnished and the test results are in  
 full compliance with all applicable specification and order requirements. All  
 manufacturing, testing, sampling and inspections have been performed in  
 accordance with Cardinal's Quality Assurance Program. All applicable tests  
 are in accordance with the Quality Control Manual dated 4/24/98. The  
 product was manufactured and supplied free from mercury contamination.  
 This document may only be reproduced unaltered and only for the purpose  
 of certifying the same or lesser quality of the product specified herein.  
 Reproduction or alteration of this document for any other purpose is  
 prohibited.

  
 (Approval)

Q.A.  
 (Title)

4/5/2006  
 (Date Approved)



# CERTIFIED MILL TEST REPORT

Alton Steel Test Lab  
#5 Cut Street  
Alton, IL 62002-9011  
(618) 463-4490 EXT 2486  
(618) 463-4491 (Fax)

1 1/2 4140TP  
36184

4-28-06  
BILL TO

Turret Steel Industries, Inc.  
P.O. Box 55  
Leetsdale, PA 15056

SHIP TO

Turret Steel Industries, Inc.  
CWC-Delivered To Customers Trucks  
Alton, IL 62002

Date	05/20/2005	Customer PO	18027-3	Specifications
ASI Ord No.	5452	Customer PT.		SAE 4140H
ASI Ord Line Item	1			ASTM A 322-91, ASTM A 304-05

## Item Description

Steel Bar, Hot Rolled, 1.5620, 20' 0"

Heat Number	Yield PSI	Tensile PSI	% Elongation	% ROA	Bend Test
-------------	-----------	-------------	--------------	-------	-----------

## CHEMICAL ANALYSIS TEST METHODS ASTM E-415 & E-1019

Heat Number	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	Cb	V	B	N
501432	0.40	0.81	0.011	0.019	0.25	0.24	0.091	0.951	0.156	0.072	0.004	0.010	0.035	0.0002	0.0024

## JOMINY HARDENABILITY USING ASTM A-255 CALCULATED FROM CHEMICAL DI

Heat Number	GS	DI	J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J12	J14	J16	J18	J20	J24	J28	J32
501432	7	5.04	56	56	56	56	56	55	54	52	51	50	47	45	43	42	41	39	37	35

## SPECIAL TEST RESULTS

Heat Number	TA	TB	TC	TD	HA	HB	HC	HD	S	O	S	O	S	R	C	A	B	RC	RS	BHN
501432														1	1	1				279

## ADDITIONAL COMMENTS

RR=25.55:1

No mercury, lead, radium, or alpha containing material or equipment is used or deliberately added in the production of this steel. No weld or weld repairs were performed on this material. This Steel is 100% Electric Arc Furnace Melted and Rolled in the U.S.A.

Subscribed and sworn to before me, a Notary Public, in and for the county of Madison, State of Illinois

this \_\_\_\_\_ Day of \_\_\_\_\_

My commission expires \_\_\_\_\_

(Notary Public)

Alteration or reproduction of this report, except in full, is not allowed without written approval by a representative of Alton Steel Incorporated.

I hereby certify that the above tests are correct as contained in the records of ALTON STEEL INCORPORATED

(Approved) Robert Cauley

*R Cauley*

FEB 23 2006

# Cardinal Fastener Test Certification

Reported: 2/28/2006

Certification No.:	25213	Shop Order#:	00240234
Order No.:	116038 1	Heat No.:	400860
Customer PO:	4045134	Grade:	GR8
Customer No.:	000000071290	Thread Class:	2A
Customer:	SOUTHERN FASTENER HOUMA	Shipped Qty:	26
Address:	112 Menard Road	Heat Treat Spec:	
	Houma, LA 70363	Supplier:	
		Finish Spec:	
Manufacturer:	Cardinal Fastener & Specialty Co.,	Supplier:	
Address:	5185 Richmond Road	Item description:	1-1/4 - 7 X 6-1/2: GR8 HHCS ZN
	Bedford Heights, Ohio 44146	Headmark:	& YELLOW / CHARPY / HT# HEAD
Laboratory:	Cardinal Fastener & Specialty Co.,		
Address:	5185 Richmond Road		
	Bedford Heights, Ohio 44146		



Notes:



5-29-07

Test No.:	30575	Order No.:	227208 0	Test Date:	1/4/2005	Test Disposition:	PASS
Specification:	MET_SAEJ429_GR8[1/2"TO1 1/2">2 1/2D] May 98			Test Facility:	CFS	LotSize(pcs/lbs):	521
Tech. Name:	DFD	Tech. Title:	LT	Sample Size:	5		
Notes:	Wedge Test Per SAE J429, Wedge Angle 6 Degrees						
	Hardness Per ASTM E13						
	CHARPY V-NOTCH @ 0 DEGREES F. RESULTS: 1] 43 FT. LBS., 2] 38 FT. LBS.,						
	3] 35 FT. LBS. AVG. - 39 FT. LBS. ACCEPT.						

Inspection (min. - max.) units	Disposition	Sample Values:				
HARDNESS (33, 39) Rc	PASS	33	33	33	33	33
SURFACE HARDNESS (0, 58.6) 30N	PASS	55	54	56	56	55
TENSILE (150000, 999999) PSI	PASS	155831	156656	159298	155913	152425

Test No.:	32416	Order No.:	400860 0	Test Date:	7/19/2005	Test Disposition:	PASS
Specification:	CHEM_GRADE 4140			Test Facility:	ALTON STEEL	LotSize(pcs/lbs):	20000
Tech. Name:	R CAULEY	Tech. Title:	QA	Sample Size:	1		
Notes:	S2 R2 C1						

Inspection (min. - max.) %	Disposition	Sample Values:
CARBON (0, 999) %	PASS	0.42
MANGANESE (0, 999) %	PASS	0.82
PHOSPHORUS (0, 999) %	PASS	0.011
SULFUR (0, 999) %	PASS	0.029
SILICON (0, 999) %	PASS	0.26
COPPER (0, 999) %	PASS	0.25
NICKEL (0, 999) %	PASS	0.09

CHROMIUM (0.999) %
MOLYBDENUM (0.999) %
ALUMINUM (0.999) %
VANADIUM (0.999) %

PASS	0.921
PASS	0.183
PASS	0.005
PASS	0.037

Cert No: 25213

ALL MANUFACTURING AND MATERIAL PROCESSES IN THIS PRODUCT HAVE OCCURED WITHIN THE U.S.A. IN COMPLIANCE WITH THE BUY AMERICA PROVISIONS OF THE SURFACE TRANSPORTATION ACT OF 1982

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*[Signature]*  
(Approval)

Q.A.  
(Title)

2/28/2006  
(Date Approved)



5-29-07

# Cardinal Fastener Test Certification

Reported: 7/24/2007

Certification No.:	29060	Shop Order#:	00254565
Order No.:	125066 1	Heat No.:	M23969
Customer PO:	SM613	Grade:	GR. 8
Customer No.:	000000071290	Thread Class:	2A
Customer:	SOUTHERN FASTENER HOUMA	Shipped Qty:	1444
Address:	112 Menard Road	Heat Treat Spec:	
	Houma, LA 70363	Supplier:	
		Finish Spec.:	
Manufacturer:	Cardinal Fastener & Specialty Co.,	Supplier:	
Address:	5185 Richmond Road	Item description:	1 1/4 - 7 X 4 1/2: GR8 HHCS
	Bedford Heights, Ohio 44146	Headmark:	CAD / CHARPY / HT# / HYDR EMB
Laboratory:	Cardinal Fastener & Specialty Co.,		
Address:	5185 Richmond Road		
	Bedford Heights, Ohio 44146		
Notes:			



Test No.:	40717	Order No.:	M23969 0	Test Date:	7/20/2007	Test Disposition:	PASS
Specification:	CHEM_GRADE 4140			Test Facility:	MACSTEEL		
Tech. Name:	CHRIS EASTER	Tech. Title:	QA	LotSize(pcs/lbs):	20000		
Notes:	S1R1C1			Sample Size:	1		

VP  
10  
INSPECT  
7-27-07

Inspection (min. - max.) units	Disposition	Sample Values:
CARBON (0, 999) %	PASS	0.4
MANGANESE (0, 999) %	PASS	0.88
PHOSPHORUS (0, 999) %	PASS	0.018
SULFUR (0, 999) %	PASS	0.032
SILICON (0, 999) %	PASS	0.26
COPPER (0, 999) %	PASS	0.26
NICKEL (0, 999) %	PASS	0.08
CHROMIUM (0, 999) %	PASS	0.92
MOLYBDENUM (0, 999) %	PASS	0.17
ALUMINUM (0, 999) %	PASS	0.028
VANADIUM (0, 999) %	PASS	0.006

Test No.: 40763	Order No.: 254565 0	Test Date: 7/24/2007	Test Disposition: PASS
Specification: MET_SAEJ429_GR8[1/2"TO1 1/2">2 1/2D] May 98		Test Facility: CFS	
Tech. Name: DFD	Tech. Title: LT	LotSize(pcs/lbs): 1435	
Notes: Hydrogen Embrittlement Test Per NASM 1312 #5- Hardness Per ASTM E18; Tensile Test Per SAE J429, Wedge Angle 6 Degrees Results- 3-Bolts Torqued to 1135 ft. lbs. for 48 hrs. then Retorqued with no Breakage; Charpy V-Notch @ 0 Deg. F. Results: 1] 48 ft. lbs., 2] 48 ft. lbs., 3] 44 ft. lbs. - Avg. - 47 ft. lbs. - Accept		Sample Size: 5	
Inspection (min. - max.) units	Disposition	Sample Values:	
HARDNESS (33, 39) Rc	PASS	33 37 37 36 36	
SURFACE HARDNESS (0. 58.6) 30N	PASS	54 58 56 57 56	
TENSILE (150000, 999999) PSI	PASS	154501 169301 167698 158218 167628	

Cert No: 29060

ALL MANUFACTURING AND MATERIAL PROCESSES IN THIS PRODUCT HAVE OCCURED WITHIN THE U.S.A. IN COMPLIANCE WITH THE BUY AMERICA PROVISIONS OF THE SURFACE TRANSPORTATION ACT OF 1982

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*Dennis E. Mahan*  
(Approval)

Q.A.  
(Title)

7/24/2007  
(Date Approved)



I hereby certify that this data is correct as  
 contained in the records of this company.



MacSteel

ONE JACKSON SQUARE  
 SUITE 500  
 JACKSON, MICHIGAN 48201

CERTIFIED MATERIAL TEST REPORT

CUSTOMER ORDER NUMBER	CUSTOMER PART NUMBER	HEAT NUMBER	WORK ORDER NUMBER	DATE
11903	4811	M23969	207389 101	3/19/07

REPORT TO  
 ERIN  
 KREHER STEEL

1550 N. 25TH AVE  
 MELROSE PARK, IL 60160

SRPT TO

KREHER STEEL  
 1550 N. 25TH AVE.

MELROSE PARK, IL 60160

ORDERED

GRADE	SIZE	LENGTH
4140 ✓	✓ 1 1/4" RND	24' 3"
CUSTOMER SPECIFICATIONS ASTM A29-05, A322-06, E381-01, JDM AO QL-2; ALUM FINE GRAIN		

CHEMICAL ANALYSIS - (BAR AVERAGE)

C ✓	Mn	P	S	Si	Ni	Cr	Mo	Cu	Sn	Al
0.40	0.88	0.018	0.032	0.26	0.08	0.92	0.17	0.26	0.009	0.028
V	Nb									
0.006	0.002									

GRAIN SIZE SPECIFICATION ASTM E112 FINE GRAIN 5-8

HARDENABILITY SPECIFICATION ASTM A255/A304

THEORETICAL ✓

J1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	22	24	26	28	30	32	34
PRT	58	57	56	55	54	53	51	50	49	47	44	43	42	43	39	40	40	39	40	36	35	37		

MACROCLEANLINESS SPECIFICATION ASTM E381 JDM AO QL-2 ✓

PLATE I

PLATE II

AVERAGE	S	R	C		
	1	1	1	NONE	

PAGE 1

We certify that these data are correct and in compliance with specified requirements.

MacSteel Monroe  
 3000 East Front Street  
 Monroe, MI 48161

Chris Kott  
 Quality Assurance Manager

CONTINUED ON PAGE 2

7-2707



**ImXport Services  
Corp.**

**Pemex-PP LUM A  
Project**

# **Vendor Data Book**

**P.O. # 0018987**

**Serial # 23407**

**Volume 1**

## **Nautilus Crane Model 340LA-80**

### **Section 6.0 Wire Rope Certificates**



*SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA*





SO # 1211953

362 FT

**BRIDON**  
AMERICAN**CERTIFICATE OF EXAMINATION OR TEST OF WIRE ROPE**

WIRE ROPE DESCRIPTION: 5/8" 18X19 DY18 RREG DPTP

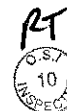
CUSTOMER: CERTEX USA/HARAHAN, LA

CUSTOMER ORDER NO: 1201543-00PT

BRIDON AMERICAN ORDER NO.: 51587

DATE TESTED: 8/23/07

REEL NUMBER: 070638A00



MINIMUM BREAKING FORCE: 45,400 LBS. 20,593 KGS.

ACTUAL BREAKING FORCE: 46,000 LBS. 20,865 KGS.

DATE: 8/27/07 CO# 10 CHECK BY: DC

SIGNED: *David M. Sleight* TECHNICAL DIRECTOR

## Bridon American Quality Program Certificates:

American Petroleum Institute Spec Q1 and 9A, License #9A0058

Lloyds Register Quality Assurance - ISO 9001:2000, License #101907

Bridon American wire ropes are manufactured to the applicable requirements of API 9A and ASTM1023.

**WARNING:** Any warranties, expressed or implied, concerning the use of this product apply only to the nominal strength of new, unused wire rope. All equipment using this product must be properly used and maintained. Wire rope must be properly stored, handled, used and maintained. Most importantly, wire rope must be regularly inspected during use. Damage, abuse or improper maintenance can cause rope failure. Consult the AISI Wire Rope Users Manual, ASME or ANSI Standards, or Bridon American Corporation before usage. Wire rope removal criteria are based on the use of steel sheaves. If synthetic sheaves are used, consult the sheave equipment manufacturer. **WARNING!**

## BRIDON American Corporation

280 New Commerce Boulevard Wilkes-Barre Pennsylvania 18705 570 822 3349 Fax 570 822 9180

50 #1211953

840 FT

**BRIDON**

**AMERICAN**

**CERTIFICATE OF EXAMINATION OR TEST OF WIRE ROPE**

WIRE ROPE DESCRIPTION: 3/4" 6X26 EIP 1W RREG BRZ

CUSTOMER: CERTEX USA/HARAHAN, LA

CUSTOMER ORDER NO: 1201555/PT

BRIDON AMERICAN ORDER NO.: 51782

DATE TESTED: 6/29/07

REEL NUMBER: 070303B00

MINIMUM BREAKING FORCE: 58,800 LBS.

26,671 KGS.

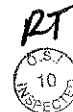
ACTUAL BREAKING FORCE: 62,400 LBS.

28,304 KGS.

DATE: 7/19/07

CO# 10

CHECK BY:



SIGNED:

*David M. Sleight*

TECHNICAL DIRECTOR

Bridon American Quality Program Certificates:

American Petroleum Institute Spec Q1 and 9A, License #9A0058

Lloyds Register Quality Assurance - ISO 9001:2000, License #101907

Bridon American wire ropes are manufactured to the applicable requirements of API 9A and ASTM1023.

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**BRIDON American Corporation**

260 New Commerce Boulevard Wilkes-Barre Pennsylvania 18706 570 822 3349 Fax 570 822 9180

50#1211953

1608 FT

**BRIDON**

AMERICAN

**CERTIFICATE OF EXAMINATION OR TEST OF WIRE ROPE**

WIRE ROPE DESCRIPTION: 7/8" 18X19 DY18 RREG DPTP

CUSTOMER: CERTEX USA/HARAHAN, LA

CUSTOMER ORDER NO: 1201577

BRIDON AMERICAN ORDER NO.: 52112

DATE TESTED: 8/07/07

REEL NUMBER: 070717A00

MINIMUM BREAKING FORCE: 87,600 LBS.

39,735 KGS.

ACTUAL BREAKING FORCE: 95,400 LBS.

43,273 KGS.

DATE: 8/13/07

CO# 10

CHECK BY:



SIGNED:

*David M. Sleight*

TECHNICAL DIRECTOR

Bridon American Quality Program Certificates:

American Petroleum Institute Spec Q1 and 9A, License #9A0058

Lloyds Register Quality Assurance - ISO 9001:2000, License #101907

Bridon American wire ropes are manufactured to the applicable requirements of API 9A and ASTM1023.

**WARNING:** Any warranties, expressed or implied, concerning the use of this product apply only to the nominal strength of new, unused wire rope. All equipment using this product must be properly used and maintained. Wire rope must be properly stored, handled, used and maintained. Most importantly, wire rope must be regularly inspected during use. Damage, abuse or improper maintenance can cause rope failure. Consult the AISI Wire Rope Users Manual, ASME or ANSI Standards, or Bridon American Corporation before usage. Wire rope removal criteria are based on the use of steel sheaves. If synthetic sheaves are used, consult the sheave equipment manufacturer. **WARNING!**

**BRIDON American Corporation**

280 New Commerce Boulevard Wilkes-Barre Pennsylvania 18706 570 822 3349 Fax 570 822 9180



**ImXport Services  
Corp.**

**Pemex-PP LUM A  
Project**

# **Vendor Data Book**

**P.O. # 0018987**

**Serial # 23407**

**Volume 1**

## **Nautilus Crane Model 340LA-80**

### **Section 7.0 Load Block Certificates**



*SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA*



OIL STATES SKAGIT-SMATCO LLC  
1180 MULBERRY RD  
HOUMA, LA 70363

the Crosby<sup>®</sup> group  
inc.

Certificate Form No. 705933 Line 2  
Customer Purchase Order No. 4059438  
Crosby Group Order No. 705933

**CERTIFICATE OF CONFORMANCE OF CHAINS, RINGS, HOOKS, SHACKLES,  
SWIVELS AND PULLEY BLOCKS**

(1) Distinguishing number or mark (if any)	(2) Description of gear	(3) Number	(4) Date	(5) Working Load Limit
SERIAL NO. 07-547-04  PART NO. 8014180	M045T18H 18" 45 TON API 2C CRANE BLOCK W/.875" WIRE LINE  PICS: HUB: HFHP WEB: HEDR TRUNNION: U8H HOOK: 5GI SIDES: HHBB PIN: HDDM DEAD END: GHDM	1	08/23/07	90,000 Lbs

(7) Name and address of makers or suppliers The Crosby Group / McKissick Products  
2801 Dawson Road, Tulsa, Ok 74110-5040 U.S.A.

(8) Name and address of public service, association, company or firm making the test and examination \_\_\_\_\_  
SAME

(9) Position of signatory in public service, association, company or firm \_\_\_\_\_  
QUALITY ASSURANCE INSPECTOR

We hereby certify that the above described material was manufactured and processed in a manner compatible to meeting the specified load ratings when used under normal and proper applications.

August 23, 2007

(Date) \_\_\_\_\_ (Signature) Mark A. Taylor  
MARK A. TAYLOR

OB0005.03 1 Order Inquiry 14:59:25 CROSBY  
Regular Order Discounted Order- 4 % Entered By DOUG 8/23/07  
Customer No. 2980 Order Number 705933 Last maintained by DOUG 5/04/07  
OIL STATES SKAGIT-SMATCO LLC, AHSC OIL STATES SKAGIT-SMATCO LLC, AHS

1180 MULBERRY RD  
HOUMA LA

70363

1180 MULBERRY RD  
HOUMA LA

70363

Customer PO # Ship Via SCHEDULE Order Date Ship-to PO # Whse SR DR  
4059438 4/26/07 4/26/07 MK 52 - 12

Inv#: Ship: Frt Amt: Pick: Acct#:

Inv Date: 0/00/00 Frt Code: 2 Ship Info.: 0000000 00

Line Qty Qty Invoice Priority: 1

# Ordered Alloca Prod. # WH U Sts Ctlg and Description Sell Price C M R

SH- WO 23407.12.00 LINE 1

1 1 0 7777777 MK CNL PART #\*\*\* CANCELLED\*\*\*

SH- M045T18EH

2 1 1 8014180 MK PKP 383 CRANE BLK 7/8L SP

SE YELLOW

HB YELLOW

LA YELLOW

CH AM FRT

Records to Roll (1-24): 8 Total Weight 1278.00 Order Total:

F1=End F3=Fold F4=Prt Inquiry F6=New Inquiry

F24=More keys

06/06/2007 From: MARMON/KEYSTONE  
M/K OR: 30-004257  
C P.O. M-0708091  
C PART: 91243

INIT: BP

To: CROSBY GROUP/MC KISSICK PROD  
BR. OR:

## Steel Certificate of Test

1835 DUEBER AVE. S.W.  
CANTON, OHIO 44706  
ID #0142985-1

Page 1 of 2

**TIMKEN**  
Where You Turn  
07/29/2006

S Marmon/Keystone Corporation  
O T 10700 MARMON DRIVE  
L O  
D BOLINGBROOK IL 60440 USA

S MARMON/KEYSTONE CORPORATION  
K T 10700 MARMON DRIVE  
I O  
P BOLINGBROOK IL 60440 USA

Customer Order: 60-021061-015 Customer Part Number: 5.51.5130  
Timken Order: 44700-C (1355940) Heat Number(s): X6863

### Description of Material

OD: 5.500 in (139.700 mm) WALL: 1.500 in (38.100 mm) ID: 2.500 in (63.500 mm)  
Shape: RD  
Sales Type: 1026  
Int Quality: ELECTRIC FURNACE-ULTRASONIC  
Condition: HOT ROLL

### Specification

- ASTM A 106 / A 106M Grades B and C Rev. 06 EXCEPT AS NOTED; EXCEPT WEIGHING OF INDIVIDUAL TUBES
- ASME SA-106 Rev. 2004 EDITION GRADES B & C; EXCEPT WEIGHING OF INDIVIDUAL TUBES
- ASTM E 213 Rev. 04 FOR NONDESTRUCTIVE ELECTRIC TESTING
- ASTM A 519 Rev. 03
- NACE MR0175 Rev. 97 1/1/1997
- BRITISH STANDARD BS EN 10204 1/1/1991 SECTION 3.1.B
- DIN EN 10204 1/1/1991 SECTION 3.1.B

### Chemistry Information

	%C	%Mn	%P	%S	%Si	%Cr	%Ni	%Mo	%Cu	%Al	%V
SPEC Ladle Min:	.22	.60			.10						
SPEC Ladle Max:	.28	.90	.025	.025		.40	.40	.15	.40		.080
X6863 Ladle:	.26	.68	.006	.018	.26	.07	.09	.03	.23	.036	.001

When shipping document is attached it becomes part of this certification.

We certify the above materials have been inspected and tested in accordance with the methods prescribed in the governing specifications and consistent with our Standard Commercial Terms and Conditions for Sale, Manufacture, and Shipping, which are incorporated into and made part of this certification. The results of such inspections and tests conform with the applicable requirements. This certificate or report shall not be reproduced except in full, without the written approval of the Timken Corporation.

Approved: \_\_\_\_\_  
NOTARY PUBLIC

by

  
Essie Billard, CERTIFICATION PROCESSOR

THE TIMKEN CORPORATION

T 5.51.5 130

06/06/2007 From: MARMON/KEYSTONE  
M/K OR:30-004257  
C P.O. #M-0708091  
C PART:91243

INIT: BP

To: CROSBY GROUP/MC KISSICK PROD  
BR. OR:

## Steel Certificate of Test

1835 DUEBER AVE. S.W.  
CANTON, OHIO 44706

**TIMKEN**  
Where You Turn

ID #0142983-1

Page 2 of 2

07/29/2006

Customer Order: 60-021061-015 Customer Part Number: 5.51.5130  
Timken Order: 44700-C (1355940) Heat Number(s): X6863

### Metallurgy Information

SPEC: Hardness MIDWALL 22 Max UOM ROCKWELL C

Heat	Pieces		UOM
X6863	A	MIDWALL 88 / 90	ROCKWELL C

SPEC: Tensile TENSILE 70,000.00 Min STRENGTH UOM PSI YIELD .2 40,000.00 Min  
MIN ELONGATION 22 Min

Heat	Pieces	Tensile Strength	UOM	.2t Yld Strength	Elong %	Red tRed	Gauge Length	Specimen	Direction
X6863	A	75,890	PSI	52,420	25.3	53.6	2 IN	0.505 in RD	LONG.

Heat X6863 Melt Source: USA

Flattening test - Satisfactory

Ultrasonic in lieu of hydrostatic testing - Satisfactory.

The Timken Company certifies that there is no mercury or radio-active material used in the melting or processing.

Q. C. REVIEWED

THE TIMKEN CORPORATION





# Mill Test Report

Page 3

NUCOR P.O. Box 279  
Winston, NC 27968  
(252) 366-3700

Issuing Date : 06/18/2007 EOL No. : 163766 Our Order No. : 534467 Cust. Order No. : MUS-224637  
Vehicle No : LW 62109 Sold To : METALS USA - SOUTH CENTRAL Ship To : METALS USA - PLATES AND SHAPES  
Specification : 0.5250" x 36.000" x 252.000" 2800 N 43RD STREET EAST TRACK 747  
AISI 1035 ASTM A830-06 G1035 MUSKOGEE, OK 74403 MUSKOGEE, OK 74401

## Marking :

Heat No	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Alz	V	Nb	Ti	N	Ca	B	Sn	CEQ	PCM
7103490	0.36	0.65	0.013	0.003	0.17	0.27	0.08	0.11	0.00	0.005	0.003	0.001					0.011	0.51	0.42

Plate Serial No	Tensile Test				Charpy Impacts				Min	
	Pieces	Tons	Dir.	Yield	Dir.	1	2	3	Temp	Ave.
7103490-02	7	15.00	T	57,300	88,300					

Elongation % in 2" 16.1  
Elongation % in 8" 16.2

MILL TEST REPORTS FURNISHED  
BY UNI-STEEL, INC.  
DATE 6-13-07  
CUSTOMER NUCOR  
CUSTOMER P.O. # N-0708431  
CUSTOMER PART # 94090  
HEAT # 7103490 PCS 2  
WEAT # PCS

Manufactured to fully welded practice by Electric Arc Furnace, Welding or weld repair was not performed on this material.  
Mercury has not been used in the direct manufacturing of this material. Produced as continuous cast as-rolled discrete plate.  
Yield by 0.5EL, method unless otherwise specified. Ceq = C+(Mn/5)+(Cr+Mo+V/5)+(Cu+Ni/15)  
Pcm = C+5Si/20+(Mn/20)+(Cu/20)+(Ni/20)+(Mo/15)+(V/10)+Sb  
Metall and manufactured in the USA. ISO 9001-2008 certified (#12443-0) by SRI Quality System Registrar (#0585-03). PED 97/23/EC 7/2 Annex 1, Para. 4.3 Conformity.  
DIN 50049 3.1 B1EN 10204 3.1 B1(2004) compliant. For ABS grades only. Quality Assurance certificate No. 03-MMPQA-182  
We hereby certify that the contents of this report are accurate and correct. All test results and operations performed by the material manufacturer are in compliance with the applicable specifications.  
T. A. Depietri  
T. A. Depietri, Metallurgist  
05/18/2007 11:16:20 AM

MST1201

6/12/07

Michigan Steel, Inc.  
CHEMICAL AND PHYSICAL ANALYSISPage 1  
10:41:05

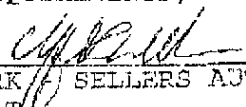
Product# . . . : M241625  
 Customer Part#: 2003625  
 Pattern Number: 30-Q-6  
 Customer. . . : THE CROSBY GROUP INC  
 MCKISSICK DIVISION  
 PO BOX 3128  
 TULSA OK 74101-3128

Order/Item# . . : 37032 / 1  
 Customer P.O.#: M-0614120

3

THIS MATERIAL WAS MANUFACTURED IN ACCORDANCE WITH MICHIGAN STEEL'S  
 ISO 9001:2000 QUALITY MANAGEMENT SYSTEM (CERTIFICATE # 03.203.1),  
 TESTED, AND INSPECTED IN ACCORDANCE WITH THE MATERIAL SPECIFICATION  
 AND WAS FOUND TO MEET THE REQUIREMENTS, AND IS MERCURY FREE.

SIGNATURE:

CERTIFICATION CLERK  SELLERS AUTHORIZED SIGNATURE

SHIPMENT MADE FROM THIS HEAT

QTY: 2 DATE: 6-2-07 P.O.: M-614120 S.O.: 37032  
 of 2 pcs shipped. BHN : \_\_\_\_\_

VISUAL INSPECTION TO THE REQUIREMENTS OF MSS-SP-55  
 MELTED AND MANUFACTURED IN THE U.S.A. by MICHIGAN STEEL, INC.  
 INSPECTION CERTIFICATE PER EN 10204:2004-3.1" & DIN 50049-3.1.8


Melt#	Date	Heat Treat	Heat Code	Specification
ACF87	2/20/07	USH	- -	ASTM A487-03 4B / S4 & S8

## C H E M I C A L S

C : .2800	MN : .7800	SI : .4490	P : .0280
S : .0270	NI : .4730	CR : .6230	MO : .1860
CU : .1310	V : .0150	CE : .6140	

## P H Y S I C A L S

Brinell(HBW) 217-269	Yield (PSI) 92000
Tensile(PSI) 110500	%El (in 2") 20
%Red of Area 44.0	Charpy FT-LB 41-39-43
Charpy Temp. @ -40°F	

WET MAG. PER ASTM E709,  
 MT DATE & STATEMENT BY: 

09Aug06 9:21

TEST CERTIFICATE

No: 1 77345

**KREHER STEEL COMPANY, LLC**

312 LIDINGTON, STE. #100, PLANO, TEXAS 75075  
(972) 575-9115  
(972) 575-7814  
FAX (972) 423-8890

Sold To: ( 376 )  
CROSBY-LEBUS MFG.  
P.O. BOX 271  
LONGVIEW, TX 75606

P/D No 36315

Rel

S/D No 1 141172-001

B/L No 1 123261-001

Inv No

Shp 09Aug06

Inv

Ship To: (001)  
CROSBY-LEBUS MFG.  
900 FISHER ROAD  
LONGVIEW, TX 75606

Tel: 903-759-4424 Fax: 903-759-4499

CERTIFICATE of ANALYSIS and TESTS

Cert. No: 1 77345

09Aug06

Part No  
HOT ROLLED ROUNDS 8630  
4.7500 X 20'

EDP# 0092858

Heat Number  
A051942

\*\*\* Chemical Analysis \*\*\*

C=0.2900 Mn=0.8100 P=0.0090 S=0.0150 Si=0.2800 Ni=0.4700  
Cr=0.5000 Mo=0.1800 Al=<.028> Cu=<.25> Sn=<.009> N=<.0106>  
V=<.002> Nb=<.001> Ti=<.001> W=<.010> B=<.0001> Ca=<.0012>  
Co=<.007> BR=<FINE>

\*\*\* Jominy Tests \*\*\*

1=50 2=50 3=48 4=45 5=41 6=37 7=35 8=33  
9=32 10=30 12=27 14=26 16=25 18=24 20=23 24=22  
28=21 32=30

C=0.3200 Mn=0.8700 P=0.0110 S=0.0160 Si=0.2900 Ni=0.4200  
Cr=0.5200 Mo=0.1600 Al=<.027> Cu=<.21> Sn=<.01> N=<.0061>  
V=<.007> Nb=<.007> W=<.010> Ti=<.001> B=<.0006> Ca=<.0010>  
Co=<.008> BR=<FINE>

\*\*\* Jominy Tests \*\*\*

1=52 2=52 3=52 4=48 5=45 6=42 7=40 8=38  
9=36 10=35 12=32 14=30 16=28 18=28 20=27 24=25  
28=24 32=23

I hereby certify that this data is correct as  
contained in the records of this company.

*M. Potter*



12400 Highway 43 North, Azle, Alabama 36505

# Test Certificate

Form TCI: Revision 1: Date 31 Oct 2000

Customer: METALS USA PLATES & SHAPES SOU P.O. BOX 3528 101 EAST ILLINOIS ENID OK 73702		Customer P.O. No.: MUS-223414		MILL Order No.: 41-156265-01		Shipping Manifest: AR830114	
Product Description: ASTM A516-70(94)/ASME SA516-70(94ED.) LCVN 15/12 FT.LRS.@-50F/A673-P		Ship Date: 12 Nov 06		Cert No: 081061480		(Page 1 of 1)	
NORMALIZED		Size: 1.000 X 96.00 X 480.0 (IN)					
Tensiles		Charpy Impact Tests					
Heat Id	YS (PSI)	UTS (PSI)	%RA	Avg Hardness	Abs. Energy (FTLB)	% Shear	Tst Tst Tst
E6J107	151000	74000	29	88 80 84 87.3	1 2 3 Avg	1 2 3 Avg	Temp Temp Temp
Chemical Analysis		Tensiles					
C	Mn	P	S	Si	Test Al	Sei Al	Ca
.18	1.15	.013	.004	.19	.026	.023	.29
Cr		Ni		Mo		Cb	
.17		.17		.05		.003	
V		Ti		CEV		ORGN	
.45						USA	

MERCURY IS NOT A METALLURGICAL COMPONENT OF THE STEEL AND NO MERCURY WAS INTENTIONALLY ADDED DURING THE MANUFACTURE OF THIS PRODUCT

KILLED STEEL, PRODUCED TO A FINE GRAIN PRACTICE

CEV (IIR) = C + MN/6 + (CR+MO+V)/5 + (NI+CU)/15

100% MELTED AND MANUFACTURED IN THE USA. MTR DIN EN10204 TYPE 3.1 COMPLIANT.

NORMALIZED PLATES. HEATED AT 1650F FOR 41 MINUTES.

E6J107 A11 6010204 PCES: 1, WGT: 13285

E6J107 A11 6010206 PCES: 1, WGT: 13265

MILL TEST REPORTS FURNISHED  
BY UAH STEEL, INC.  
DATE 12-10-07  
CUSTOMER: McMissick  
CUSTOMER P.O. # M-07000940  
CUSTOMER PART # 2068045  
HEAT E6J107 A11  
PCES: 1, WGT: 13265

WE HEREBY CERTIFY THAT THIS MATERIAL WAS TESTED IN ACCORDANCE WITH THE APPROPRIATE SPECIFICATION

Cust Part #: Jason Thomas  
SENIOR METALLURGIST



# CERTIFICATE OF TEST

Page 01 of 02

Certification Date  
30-MAR-2007

## CUSTOMER ORDER NUMBER

M-0703561

7311 E. PINE STREET  
TULSA OK 74115

Invoice Number  
T543024

## CUSTOMER PART NUMBER

2000868

Ship# T298832

SOLD TO: MCKISSICK PRODUCTS CO

SHIP TO:

MCKISSICK PRODUCTS CO

P O BOX 3128  
TULSA OK 741013128

2801 DAWSON RD GATE 5  
TULSA OK 74110

Description: 4340/4340H HR ANN STRA ASTM A322 A304

3-1/4 RD X 20' R/L

Line Total: 1440 IN

HEAT: B10532

ITEM: 506741

Specifications:

ASTM A322 04

ASTM A29 04

ASTM A304 04

## CHEMICAL ANALYSIS

C	SI	MN	P	S	CR	NI	MO
0.4	0.29	0.71	0.018	0.008	0.8	1.8	0.24
AL	CU	V	W	TI			
0.036	0.18	0.01	0.06	0.002			

RCPT: R129408

MILL : STEMCOR USA INC (HR BAR)

COUNTRY OF ORIGIN : UKRAINE

## MECHANICAL PROPERTIES

DESCRIPTION	YLD STR	ULT TEN	%ELONG	%RED IN AREA	HARDNESS BHN 187
-------------	---------	---------	--------	-----------------	------------------------

The above data were transcribed from the manufacturer's Certificate of Test after verification for completeness and specification requirements of the information on the certificate. All test results remain on file subject to examination.

We hereby certify that the material covered by this report will meet the applicable requirements described herein, including any specification forming a part of the description.

The willful recording of false, fictitious, or fraudulent statements in connection with test results may be punishable as a felony under federal statutes.

Material did not come in contact with mercury while in our possession.

MARVIN FOSTER

  
MANAGER, QUALITY ASSURANCE

# CERTIFICATE OF TEST



Page 02 of 02

Certification Date  
30-MAR-2007**CUSTOMER ORDER NUMBER**

M-0703561

7311 E. PINE STREET  
TULSA OK 74115Invoice Number  
T543024**CUSTOMER PART NUMBER**

2000868

Ship# T298832

**SOLD TO:** MCKISSICK PRODUCTS CO**SHIP TO:**

MCKISSICK PRODUCTS CO

P O BOX 3128  
TULSA OK 7410131282801 DAWSON RD GATE 5  
TULSA OK 74110

Description: 4340/4340H HR ANN STRA ASTM A322 A304

3-1/4 RD X 20' R/L

Line Total: 1440 IN

HEAT: B10532

ITEM: 506741

END-QUENCH HARDENABILITY (JOMINY - RC) IN

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
57	55	54	54	54	54	53	53	53	53	52	52	52	52	51
16	18	20	22	24	25	28	30	32						
51	51	51	51	50	50	50	50	50						

IDEAL DIAMETER : 7.42 IN GRAIN SIZE : 9

**CLEANLINESS**

	A		B		C		D	
	THIN MAX	THICK MAX	THIN MAX	THICK MAX	THIN MAX	THICK MAX	THIN MAX	THICK MAX
E45	2.0	1.5	2.0	1.0	0.0	0.0	1.0	1.0

STRAND CAST REDUCTION RATIO 16.0 TO 1  
MATERIAL IS FREE FROM MERCURY CONTAMINATION  
NO WELD REPAIR PERFORMED ON MATERIAL  
ULTRASONIC: Y  
THERMAL TREATMENT: OK  
NORM 870 DEG 120' AIR  
QUENCH 845 DEG 30' WATER  
MACRO: OK  
MICRO: OK

**COMMENTS**

MACRO S1 R1 C1

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MARVIN FOSTER

  
MANAGER, QUALITY ASSURANCE



# CERTIFICATE OF TEST

Page 01 of 02

Certification Date  
30-MAR-2007

## CUSTOMER ORDER NUMBER

M-0703561

7311 E. PINE STREET  
TULSA OK 74115

Invoice Number  
T543024

## CUSTOMER PART NUMBER

2000868

Ship# T298832

SOLD TO: MCKISSICK PRODUCTS CO

SHIP TO:

MCKISSICK PRODUCTS CO

P O BOX 3128  
TULSA OK 741013128

2801 DAWSON RD GATE 5  
TULSA OK 74110

Description: 4340/4340H HR ANN STRA ASTM A322 A304

3-1/4 RD X 20' R/L

Line Total: 1440 IN

HEAT: B10608

ITEM: 506741

## Specifications:

ASTM A322 01

ASTM A29 04

ASTM A304 04

## CHEMICAL ANALYSIS

C	SI	MN	P	S	CR	NI	MO
0.39	0.22	0.78	0.014	0.005	0.77	1.72	0.25
AL	CU	V	W	TI			
0.024	0.19	0.02	0.04	0.001			

RCPT: R129408

MILL : STEMCOR USA INC (HR BAR)

COUNTRY OF ORIGIN : UKRAINE

## MECHANICAL PROPERTIES

DESCRIPTION	YLD STR	ULT TEN	%ELONG	%RED IN AREA	HARDNESS BHN
					187

The above data were transcribed from the manufacturer's Certificate of Test after verification for completeness and specification requirements of the information on the certificate. All test results remain on file subject to examination.

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MARVIN FOSTER

  
MANAGER, QUALITY ASSURANCE

# CERTIFICATE OF TEST



Page 02 of 02

Certification Date  
30-MAR-2007**CUSTOMER ORDER NUMBER**

M-0703561

7311 E. PINE STREET  
TULSA OK 74115Invoice Number  
T543024**CUSTOMER PART NUMBER**

2000868

Ship# T298832

**SOLD TO:** MCKISSICK PRODUCTS COP O BOX 3128  
TULSA OK 741013128**SHIP TO:**

MCKISSICK PRODUCTS CO

2801 DAWSON RD GATE 5  
TULSA OK 74110

Description: 4340/4340H HR ANN STRA ASTM A322 A304

3-1/4 RD X 20' R/L

Line Total: 1440 IN

HEAT: B10608

ITEM: 506741

END-QUENCH HARDENABILITY (JOMINY - RC): IN

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
54	54	53	53	53	53	53	52	52	52	51	51	51	51	50
16	18	20	22	24	26	28	30	32						
50	50	49	49	47	46	45	45	44						

IDEAL DIAMETER : 7.42 IN GRAIN SIZE : 5

**CLEANLINESS**

	A		B		C		D	
	THIN MAX	THICK MAX	THIN MAX	THICK MAX	THIN MAX	THICK MAX	THIN MAX	THICK MAX
E45	2.0	1.5	1.0	1.5	0.0	0.0	1.0	1.0

MATERIAL IS FREE FROM MERCURY CONTAMINATION

NO WELD REPAIR PERFORMED ON MATERIAL

ULTRASONIC: Y

THERMAL TREATMENT: OK

NORM 870 DEG 120' AIR

QUENCHING 845 DEG 30' WATER

MACRO: OK

MICRO: OK

**COMMENTS**

MACRO S1 R1 C1

The above data were transcribed from the manufacturer's Certificate of Test after verification for completeness and specification requirements of the information on the certificate. All test results remain on file subject to examination.

We hereby certify that the material covered by this report will meet the applicable requirements described herein, including any specification forming a part of the description.

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Material did not come in contact with mercury while in our possession.

MARVIN FOSTER

  
MANAGER, QUALITY ASSURANCE





# INSPEKČNÍ CERTIFIKÁT 3.1

## INSPECTION CERTIFICATE, ABNAHMEPRÜFZEUGNIS, CERTIFICAT DE RÉCEPTION

**VÍTKOVICE STEEL, a.s.**

AD1/AD5: VÍTKOVICE STEEL, a.s.  
Ostrava-Hulvásky Štramberská 2871/47, PSČ 705 00  
ČESKÁ REPUBLIKA

EN 10204:2004

AD1/Číslo dokladu, No. Nr. 207/Datum, Date 804/Přes. Page, Seite

44884/2005 18.11.2005 1/1

AD6: Odběratel/Client, Customer/consommateur, Besteller/Bestandiger, Acheteur/destinataire

**FERROSTAAL INCORPORATED**  
16510 Northchase Drive

Houston, Texas 77060  
US

AD3/Číslo základy výrobce, Manufacturer's works order No., Werksauftragssnr., Num. de la commande de l'usine productrice

161169/2005

AD7/Číslo objednávky odběratele, Purchaser's order No., Kundenbestellnr., Numéro de la commande du client

503378/008  
1050055400

AD10/Arvo. J., Advice Note No., Aviso Nr., Aviso No.: B14/Vagon č., Wagon No., Wagon Nr.: B13/St. hr., Act. mass (st.)/Masse, Masse etc.

634892 815439430464 14 816 kg

Hot rolled steel plates in the quality ASTM A516/ASME SA 516 Gr. 70.



EN ISO 9001:2000 / EN ISO 14001:1996  
Certifikáty č. 041992144000-01, 041943144000-01

Vyrobeno a systémově zkoušeno dle EN ISO 9001.  
Made in quality system according to EN ISO 9001.  
Hergestellt im Qualitätssicherungssystem laut EN ISO 9001.  
Fabriqué au système qualité conformément à la EN ISO 9001.

B01: Vyroba, Product, Erzeugnis, Produit, B08/ Počet ks, No. of pieces, Stückzahl, B09: B11/Barmetry/Dimensions, Maße, B12/Typ, Typ, Th. mass, Th. Masse, Masse etc.		B02: Číslo oceli, Steel designation, Stahlbezeichnung, Designation de l'acier		B03: Dodací podmínky, Terms of Delivery, Lieferbedingungen, Conditions de livraison	
31.75-2438-12192 mm 11/4"x96"x480" 14 816 kg 2 plates		A516GR70LTV N A516GR70LTV N		ASTM A516-01,ED.03 GR.70/ASME SA516 ED01 ASTM A20-01b,ED.2003 ASME SA20,ED.01,AD 02	

B14/ Tavoč. / Fusil No. Schweiß Nr. No de la soudure		B04/ Počet ks / No. of pieces Stückzahl Identification Identifizierung Identification		Zkouška tahem, Tensile test, Zugversuch, Essai de traction		Zkouška sžem v ohybu (1), Impact test (1), Kerbschlagversuch (1), Essai de résilience (1)	
C70		C01 C02 C03 C10 C11 C12 C13 C14 C15 C16 C17 C18 C19 C20 C21 C22 C23 C24 C25 C26 C27 C28 C29 C30 C31 C32 C33 C34 C35 C36 C37 C38 C39 C40 C41 C42 C43 C44 C45 C46 C47 C48 C49 C50 C51 C52 C53 C54 C55 C56 C57 C58 C59 C60 C61 C62 C63 C64 C65 C66 C67 C68 C69 C70 C71 C72 C73 C74 C75 C76 C77 C78 C79 C80 C81 C82 C83 C84 C85 C86 C87 C88 C89 C90 C91 C92 C93 C94 C95 C96 C97 C98 C99 C100		C01 C02 C03 C10 C11 C12 C13 C14 C15 C16 C17 C18 C19 C20 C21 C22 C23 C24 C25 C26 C27 C28 C29 C30 C31 C32 C33 C34 C35 C36 C37 C38 C39 C40 C41 C42 C43 C44 C45 C46 C47 C48 C49 C50 C51 C52 C53 C54 C55 C56 C57 C58 C59 C60 C61 C62 C63 C64 C65 C66 C67 C68 C69 C70 C71 C72 C73 C74 C75 C76 C77 C78 C79 C80 C81 C82 C83 C84 C85 C86 C87 C88 C89 C90 C91 C92 C93 C94 C95 C96 C97 C98 C99 C100		C01 C02 C03 C10 C11 C12 C13 C14 C15 C16 C17 C18 C19 C20 C21 C22 C23 C24 C25 C26 C27 C28 C29 C30 C31 C32 C33 C34 C35 C36 C37 C38 C39 C40 C41 C42 C43 C44 C45 C46 C47 C48 C49 C50 C51 C52 C53 C54 C55 C56 C57 C58 C59 C60 C61 C62 C63 C64 C65 C66 C67 C68 C69 C70 C71 C72 C73 C74 C75 C76 C77 C78 C79 C80 C81 C82 C83 C84 C85 C86 C87 C88 C89 C90 C91 C92 C93 C94 C95 C96 C97 C98 C99 C100	

5529	Y	1	2547	A T	20 C	Rp0.2	A50	337	528	31.4	L -40	KV	28	62	92	61
		1	2548	A T	20 C	Rp0.2	A50	298	496	38.4	L -40	KV	74	70	60	68

C70-C92: Chemical composition

Heat	C	Mn	Si	P	S	Cu	Ni	Cr	Mo	V	Ti	Al	Nb
5529	0.17	1.08	0.34	0.014	0.005	0.02	0.02	0.04	0.01	0.004	0.004	0.036	0.009

B07: Identification of the product

Heat	Test	plates
5529	2547	25250 001
	2548	25251 001

NORMALIZED: walking beam furnace-length 70m, temperature 900°C/dwell 17min.

In ultrasonic test the plates complied with ASTM/ASME A/SA435.

Internal homogeneity is guaranteed acc. to US test ASTM A435.

**ALL TEST REPORTS FURNISHED**

BY UNI-STEEL, INC.

DATE 11/16/06

CUSTOMER Nicklissick

CUSTOMER P.O. #1-0613340

CUSTOMER PART 6022008030

HEAT 6529 254801

HEAT PCS

ZD1: Tento prohlášení na svou výhradní odpovědnost, že uvedené výrobky na nás se vztahují toto prohlášení jsou ve shodě s předpisy, které jsou specificky kupní smlouvou a je na výrobky vydáno prohlášení o shodě podle zákona č. 22/1997 Sb., o technických požadavcích na výrobky a o změně a doplnění některých zákonů, ve znění pozdějších předpisů a nařízení vlády č. 163/2002 Sb., its wird hiermit auf ausschließliche Verantwortlichkeit erklärt, dass die hier angeführten Erzeugnisse auf die sich diese Erklärung bezieht, entsprechen den im Kaufvertrag spezifizierten Vorschriften. Thereby we declare to our exclusive responsibility that the mentioned products to which this declaration is in accordance with regulations, which are specified by the contract. Nous déclarons à notre responsabilité exclusive que les produits mentionnés se réfèrent à cette déclaration sont conformes aux prescriptions spécifiées par le contrat d'achat.

AD4/ Značka výrobce:  
Manufacturer's mark:  
Zeichen des Herstellers:  
Marque du producteur:



ZD2/ Ověření platnosti  
203/ Razbho aaiuace kontroly

C01: Umístění vlny, Wavelength, A - šířka, Top, Kopf, Lte. Z - pás, Bottom, Fuss, pied  
C02: Směr zkoušebního vlnění, Direction of test, longitudinal, längs, Y - příčno, transverse, quer, transversal  
C03: Zkoušební teplota, Test temperature, Prüftemperatur, Température d'essai  
C10: Tvrdost zkoušebního vlnění, Hardness, Prüfdruck, Prüfdruck, C - cylindrický, cylindric, zylindrich  
C11: Výdržná nebo smyková síla, Yield or proof strength, Strella oder Dehnungssgrenze, limite d'élasticité  
C12: Síla přetržení, Tensile strength, Zugfestigkeit, Résistance à la traction  
C13: Tácnost, Elongation after fracture, Bruchdehnung, Allongement après rupture  
C42: Tvrdost zkoušebního vlnění, C41/Síla zkoušebního vlnění, C42/Jeinlichá hodnota, C43/ Síla d'essai  
C70: Způsob výroby oceli, Steelmaking process, Stahlherstellungsverfahren, Mode d'élaboration de l'acier, B0=V

# DREYFUS CORTNEY LOWERY

A division of Dreyfus-Cortney, Inc.



New Orleans  
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New Orleans, LA 70117  
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FAX: (504) 947-8557

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PH: (337) 839-0226  
FAX: (337) 839-0229

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Houma, LA 70363  
PH: (985) 851-5159  
FAX: (985) 851-5987

TOLL FREE 1-800-228-7660  
E-MAIL: [sales@dcl-usa.com](mailto:sales@dcl-usa.com)  
WEB SITE: [www.dcl-usa.com](http://www.dcl-usa.com)

## Certificate of Proof Test

*This is to certify that the product described herein has been subjected to the following test and has successfully withstood same. However, in subjecting this product to the test, Dreyfus Cortney Lowery, a division of Dreyfus-Cortney, Inc., does not warrant the product in any manner or certify it for any specific use whatsoever.*

CUSTOMER NAME	CUSTOMER ORDER NUMBER	DCL ORDER NUMBER
OIL STATES SKAGIT-SMATCO	4059683	187351
PROOF TEST PER LEG	NUMBER OF ASSEMBLY(S) COVERED BY THIS CERTIFICATE	
62,000 LBS	1	
ASSEMBLY(S) SERIAL NUMBER(S)		
187351-1-1 through 187351-1-1		
ASSEMBLY(S) DESCRIPTION		
1-3/4" X 35 ' 6X37 IWRC EIP BRT RRL BOOM PENDANT W/OPEN SWG SKT EA OPPOSITE PLANE		
RATED CAPACITY PER ASSEMBLY(S)	DEGREE ANGLE AT HORIZONTAL	
31,000 LBS	at VERT	

All slings are fabricated, inspected, tested and certified according to, and rated capacities are based upon the following (as applicable).  
Federal Specifications RR-W-410D, ASME B30.9, API 9A, 9B&2D, The Wire Rope Technical Board's "Wire Rope Users Manual"  
and "Wire Ropes Sling Users Manual", and the Occupational Safety and Health Administration's "Industrial Slings". Dreyfus-Cortney, Inc.  
has no control over the use of this product. The usability and suitability of this product for use is the sole responsibility of the purchaser  
and/or end user. Never exceed the rated capacities!

ISO 9001 and  
Q9001-20  
Registered Firm

I hereby certify that the above particulars are correct.

DATE 6/05/07

SIGNATURE



# DREYFUS CORTNEY LOWERY

A division of Dreyfus-Cortney, Inc.



New Orleans  
4400 N. Galvez St.  
New Orleans, LA 70117  
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FAX: (337) 839-0229

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2120 Grand Caillou Rd.  
Houma, LA 70363  
PH: (985) 851-5159  
FAX: (985) 851-5987

TOLL FREE 1-800-228-7660  
E-MAIL: sales@dcl-usa.com  
WEB SITE: www.dcl-usa.com

## Certificate of Proof Test

*This is to certify that the product described herein has been subjected to the following test and has successfully withstood same. However, in subjecting this product to the test, Dreyfus Cortney Lowery, a division of Dreyfus-Cortney, Inc., does not warrant the product in any manner or certify it for any specific use whatsoever.*

CUSTOMER NAME	CUSTOMER ORDER NUMBER	DCL ORDER NUMBER
OIL STATES SKAGIT-SMATCO	4059683	187351
PROOF TEST PER LEG	NUMBER OF ASSEMBLY(S) COVERED BY THIS CERTIFICATE	
62,000 LBS	1	
ASSEMBLY(S) SERIAL NUMBER(S)		
187351-1-2 through 187351-1-2		
ASSEMBLY(S) DESCRIPTION		
1-3/4" X 35' 6X37 IWRC EIP BRT RRL BOOM PENDANT W/OPEN SWG SKT EA OPPOSITE PLANE		
RATED CAPACITY PER ASSEMBLY(S)	DEGREE ANGLE AT HORIZONTAL	
31,000 LBS	at VERT	

All slings are fabricated, inspected, tested and certified according to, and rated capacities are based upon the following (as applicable).  
Federal Specifications RR-W-410D, ASME B30.9, API 9A, 9B&2D, The Wire Rope Technical Board's "Wire Rope Users Manual"  
and "Wire Ropes Sling Users Manual", and the Occupational Safety and Health Administration's "Industrial Slings". Dreyfus-Cortney, Inc.  
has no control over the use of this product. The usability and suitability of this product for use is the sole responsibility of the purchaser  
and/or end user. Never exceed the rated capacities!

ISO 9001 and  
Q9001-20  
Registered Firm

I hereby certify that the above particulars are correct.

DATE 6/05/07

SIGNATURE





ImXport Services  
Corp.

Pemex-PP LUM A  
Project

## Vendor Data Book

P.O. # 0018987

Serial # 23407

Volume 1

### Nautilus Crane Model 340LA-80

#### Section 8.0 Overhaul Ball Certificates



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA



OIL STATES SKAGIT-SMATCO LLC  
1180 MULBERRY RD  
HOUMA, LA 70363

648828 Line 4

Certificate Form No. \_\_\_\_\_ 4051637

Customer Purchase Order No. \_\_\_\_\_ 648828

Crosby Group Order No. \_\_\_\_\_

the Crosby Group  
INC.

**CERTIFICATE OF CONFORMANCE OF CHAINS, RINGS, HOOKS, SHACKLES,  
SWIVELS AND PULLEY BLOCKS**

(1) Distinguishing number or mark (if any)	(2) Description of gear	(3) Number	(4) Date	(5) Working Load Limit
SERIAL NO. 07-497-05 Thru 07-497-09  PART NO. 8009632	MB07T200E 7 TON API 2C OVERHAUL BALL  PICS: HOOK - 5GH PLATES - HHBC LARGE & SMALL BOLT - GBGJ SWIVEL PICS: UPPER EYE - 79H LOWER EYE - 010, 012, 014 NUT - 002	5	05/21/07	14,000 Lbs

(7) Name and address of makers or suppliers \_\_\_\_\_  
The Crosby Group / McKissick Products  
2801 Dawson Road, Tulsa, Ok 74110-5040 U.S.A.

(8) Name and address of public service, association, company or firm making the test and examination \_\_\_\_\_  
SAME

(9) Position of signatory in public service, association, company or firm \_\_\_\_\_  
QUALITY ASSURANCE ASSISTANT

We hereby certify that the above described material was manufactured and processed in a manner compatible to meeting  
the specified load ratings when used under normal and proper applications.

May 25, 2007

(Date) \_\_\_\_\_ (Signature) Catherine Choate  
CATHERINE CHOATE

OB0005.05 1  
Back Order Discounted Order-  
Customer No. 2980 Order Number 648828  
OIL STATES SKAGIT-SMATCO LLC, AHSC

1180 MULBERRY RD  
HOUMA

LA

70363

Order Inquiry 5/21/07 13:45:08  
4 % Entered By DOUG CROSBY  
Last maintained by 0/00/00  
OIL STATES SKAGIT-SMATCO LLC, AHSC

1180 MULBERRY RD  
HOUMA

LA

70363

Customer PO #	Ship Via	SCHEDULE	Order Date	Ship-to PO #	Whse	SR	DR
4051637		8/21/06	8/21/06		MK	52	12
Inv#: 334963 Ship: 4/11/07 Frt Amt:				Pick: MKLTL Acct#:			
Inv Date: 4/11/07 Priority: 1 Frt Code: 1							
Line	Qty	Qty	Qty	Ship Info.: 0000001 01 WBX			
#	Ordered	Allocat	Shipped	Prod #.	Ctlg#	Description	Sell Price C M R
4	5	5	0	8009632	UB500	UTILITY OHB 7T 200	

SE YELLOW  
HB YELLOW  
LA YELLOW  
CH AM FRT  
LV SAIA  
MK SAIA

Records to Roll (1-24): 8 Total Weight 5000.00 Order Total:  
F1=End F3=Fold F4=Prt Inquiry F6=New Inquiry F7=Ship History F24=More keys

**Bill To:**  
 LEBUS MANUFACTURING  
 SUB CROSBY GROUP  
 P.O. BOX 271  
 LONGVIEW  
 75606  
 TX  
 US

**Ship To: 2**  
 LEBUS MANUFACTURING  
 900 FISHER ROAD  
 LONGVIEW  
 75604  
 TX  
 US

**Order Date:** 01/20/2006  
**PO No:** 569734  
**Mill Order No:** 3081303  
**Load No:** 1035098  
**Manifest No:** 1752654

**CERTIFIED MATERIAL TEST REPORT**  
**CHAPARRAL STEEL**  
 300 Ward Rd.  
 Midlothian, TX  
 76065-9651  
 (972) 775-8241

**CHAPARRAL**  
 300 Ward Rd.  
 Midlothian, TX  
 76065-9651  
 (972) 775-8241

**PRODUCT**  
 ROUNDS

**SIZE**  
 1 1/4 ROUNDS / N/A

**GRADE**  
 8630

**LENGTH**  
 19 FT / 5.791 M

**CHEMICAL ANALYSIS**

	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	V	Al	Nb	DI
	.30	.76	.004	.015	.27	.25	.50	.51	.173	.008	.002	.031	.000	2.81

**PHYSICAL PROPERTIES**

Grain Size Practice: FINE GRAIN  
 SOUNDNESS - E381 CLEANLINESS  
 S R C  
 1 1 1  
 C 0

**Remarks**

REDUCTION RATIO 36.2:1; Material meets requirements of ASTM A992

1320-AN 7 TON EYE HOOK  
 PIC: 5GH  
 HEAT: 11722030  
 P/N 2100400

All manufacturing processes of this product, including electric arc melting and continuous casting, occurred in the U.S.A. CMTR complies with DIN EN 10204 3.1.B

"I hereby certify that the contents of this report are correct and accurate. All tests and operations performed by this material manufacturer or its sub-contractors, when applicable, are in compliance with the requirements of the material specifications and applicable purchaser designated requirements."

Signed: *Tom L. Harrington*  
 Tom L. Harrington: Quality Assurance Manager

Date: May. 24, 2006

Signed: \_\_\_\_\_  
 Notary Public (if applicable)

Date: \_\_\_\_\_

Page: 1 of 1

Tulsa Materials  
3100 North Hemlock Circle  
Broken Arrow, OK 74012-1115 USA

## SHERRY Laboratories

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800-982-6378  
Fax: 918-258-1154

### LABORATORY REPORT

Attn: Bucky Weaver  
Crosby Group, Inc.  
P.O. Box 3128  
Tulsa, OK 74101

Report No.: 06100771-001-v1  
Date Received: 10/23/2006  
Date Reported: 10/26/2006  
P.O. No.: M-0612815

Sample Description: (1) 1320-AN 7 Ton Eye Hook, Order No.: 685449, Part No.: 2100400, P/c Code: 6GH

#### Rockwell Hardness Test per ASTM E18-05

Parameter	Result
Location	Charpy
Reading 1	HRC 24
Reading 2	HRC 25
Reading 3	HRC 25

#### Impact Test per ASTM A370-05/ASTM E23-06

Testing Machine Capacity, lbs: 300  
Specimen Type: Charpy V Notch  
Specimen Location: ASTM A370-05  
Notch Orientation: Perpendicular to Surface  
Specimen Orientation: Longitudinal at 4/5 Radius  
Specimen Size: 10mm X 10mm  
Test Temperature °F: -40

Notch Location	Impact Values (Ft.-Lbs)	Lateral Expansion (Mils)	Shear (%)
Base	102, 101, 81	60, 58, 54	100, 100, 95

Comments: Absorbed energy values above 80% of the scale range are approximate.

Approved by:

  
Jeffrey Simmons, Manager of Mechanical Testing  
Sherry Laboratories

Test results relate only to the items tested. This document shall not be reproduced, except in full, without the written approval of Sherry Laboratories. The recording of false, fictitious, or fraudulent statements or entries on this document may be a punishable offense under federal and state law. The electronic transmittal of a report on services provided by Sherry Laboratories is at the request of the client. The transmittal is NOT the official report of Sherry Laboratories, but is provided for the convenience of the recipient. Sherry Laboratories is not liable for any degradation or changes in information in the transmittal. The official report of Sherry Laboratories will be provided on Sherry Laboratories letterhead in hard copy form and shall control for all purposes.



# CERTIFICATE OF TEST



Page 01 of 02

Certification Date  
21-NOV-2006

## CUSTOMER ORDER NUMBER

M-0613590

7311 E. PINE STREET  
TULSA OK 74115

Invoice Number  
T533965

## CUSTOMER PART NUMBER

2017970

Ship# T585681

SOLD TO: MCKISSICK PRODUCTS CO

SHIP TO:

MCKISSICK PRODUCTS CO

P O BOX 3128  
TULSA OK 741013128

2801 DAWSON RD GATE 5  
TULSA OK 74110

Description: 4142 CP HEAT TREATED S/R OR STRESS FREE BAR  
1-1/4 RD S/C 12'0" (CUT ORDER!!!) Line Total: 3625 IN  
HEAT: M20687 ITEM: 506040

## Specifications:

ASTM A434 CL BC 04

ASTM A193 GR B7 05

## CHEMICAL ANALYSIS

C	MN	P	S	SI	NI	CR	MO
0.42	0.93	0.013	0.029	0.23	0.16	0.92	0.16
CU	SN	AL	V	NB			
0.22	0.008	0.026	0.006	0.002			

RCPT: R862696

MILL: MACSTEEL (CF ALLOY)

COUNTRY OF ORIGIN : USA

## MECHANICAL PROPERTIES

DESCRIPTION	YLD STR KSI	ULT TEN KSI	%ELONG IN 02 IN	%RED IN AREA	HARDNESS BHN
	139.0	148.0	38.3	55.0	317

|||||

BAR STOCK

PIC: GBGJ

HEAT: M20687

P/N 2017970

The above data were transcribed from the manufacturer's Certificate of Test after verification for completeness and specification requirements of the information on the certificate. All test results remain on file subject to examination.

We hereby certify that the material covered by this report will meet the applicable requirements described herein, including any specification forming a part of the description.

The willful recording of false, fictitious, or fraudulent statements in connection with test results may be punishable as a felony under federal statutes.

Material did not come in contact with mercury while in our possession.

MARVIN FOSTER

MANAGER, QUALITY ASSURANCE



# SHERRY Laboratories

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Tulsa Materials  
3100 North Hamlock Circle  
Broken Arrow, OK 74012-1115 USA

Tel: 918-258-6068  
800-982-8378  
Fax: 918-258-1154

## LABORATORY REPORT

Attn: Bucky Weaver  
Crosby Group, Inc.  
P.O. Box 3128  
Tulsa, OK 74101

Report No.: 06120249-001-v1  
Date Received: 12/11/2006  
Date Reported: 12/13/2006  
P.O. No.: M-0614968

Sample Description: (1) 1 Test Bar, Order No.:337679, Part No.:2015011, Pic Code:GBGJ, Description:1.25" Bar  
API 2C

### Tensile Test (Round) per ASTM E8-04

Parameter	Result
Orientation	Longitudinal at 4/5 Radius
Diameter, inch	0.353
Tensile Strength, psi	150,000
Yield Strength, psi at 0.2% offset	140,000
Elongation in 1.4 inch, %	20
Reduction of Area, %	61

### Rockwell Hardness Test per ASTM E18-05

Parameter	Result
Location	Charpy
Reading 1	HRC 32
Reading 2	HRC 32
Reading 3	HRC 32

### Impact Test per ASTM A370-05/ASTM E23-06

Testing Machine Capacity, lbs: 300  
Specimen Type: Charpy V Notch  
Specimen Location: ASTM A370-05  
Notch Orientation: Perpendicular to Surface  
Specimen Orientation: Longitudinal at 4/5 Radius  
Specimen Size: 10mm X 10mm  
Test Temperature °F: -25

Notch Location	Impact Values (Ft.-Lbs)	Lateral Expansion (Mils)	Shear (%)
Base	77, 64, 83	37, 33, 39	100, 100, 100

Comments: Absorbed energy values above 80% of the scale range are approximate.

Approved by:   
Jeffrey Simmons, Manager of Mechanical Testing  
Sherry Laboratories

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P.O. BOX 3128 TULSA, OK. 74101

**the Crosby group inc.**

TELEPHONE 918/834-4811  
TELEX 262569 CRSBY UR  
FAX 918/834-9447

**DESCRIPTION/SPECIFICATIONS:**

PLATE

P/N 9433H

PIC: RHBC

**CHEMICAL ANALYSIS**

HEAT NO: 525819	C. .17	Mn. .82	P .017	S .007	SI .26
	Cr .056	Mo .018	NI .003	Cu .002	V .045
	Nb .003	Sn .001	Ti .014	B .016	Al .036
	N .058	Ca .017	Sb .001		

**PHYSICAL PROPERTIES**

(P S I)

**YIELD STRENGTH**

117,000

**TENSILE STRENGTH**

126,000

**ELON %**

18

**CILAPY "V" NOTCH**

-25° F = (FT-LBS)

79 - 60 - 78

**SHIPPED TO MCKISSICK ON 01/08/07**

THE ABOVE DATA WAS TRANSCRIBED FROM THIS MANUFACTURER'S  
CERTIFICATE OF TEST AFTER A VERIFICATION FOR COMPLETENESS AND  
SPECIFICATION REQUIREMENTS OF THE INFORMATION ON THE CERTIFICATE.  
ALL ORIGINAL TEST RESULTS REMAIN ON FILE SUBJECT TO EXAMINATION.

THE WILLFUL RECORDING OF FALSE, FICTITIOUS, OR FRAUDULENT STATEMENTS  
IN CONNECTION WITH TEST RESULTS MAY BE PUNISHABLE AS A FELONY UNDER  
FEDERAL STATUTES.

  
QUALITY ASSURANCE ASSISTANT  
CATHERINE CHOATE

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SEVEN TWO TWENTY EIGHT BR  
OROS IL



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Broken Arrow, OK 74012-1115

Tel: 918-258-6068  
800-982-8378  
Fax: 918-258-1154

## LABORATORY REPORT

Attn: Bucky Weaver  
Crosby Group, Inc.  
P.O. Box 3128  
Tulsa, OK 74101

Report No.: 07010612-001-v1  
Date Received: 1/23/2007  
Date Reported: 1/29/2007  
P.O. No.: M-0701078

Sample Description: (1) Center Plate 8" x 8" x 3/4", Order No.: 338877, Part No.: 2027605, Plc Code: HHBC

### Tensile Test (Round) per ASTM E8-04

Parameter	Result
Orientation	Longitudinal at Just Below Surface
Diameter, inch	0.504
Tensile Strength, psi	126,000
Yield Strength, psi at 0.2% offset	117,000
Elongation in 2 inch, %	18
Reduction of Area, %	68

### Rockwell Hardness Test per ASTM E18-05

Parameter	Result
Location	Charpy
Reading 1	HRC 27
Reading 2	HRC 26
Reading 3	HRC 26


### Impact Test per ASTM A370-08/ASTM E23-08

Testing Machine Capacity, lbs: 264  
Specimen Type: Charpy V Notch  
Specimen Location: ASTM A370-08  
Notch Orientation: Perpendicular to Surface  
Specimen Orientation: Longitudinal at Just Below Surface  
Specimen Size: 10mm X 10mm  
Test Temperature °F: -25

Notch Location	Impact Values (Ft.-Lbs)	Lateral Expansion (Mils)	Shoar (%)
Base	79, 60, 78	47, 36, 47	100, 80, 100

Comments: Absorbed energy values above 80% of the scale range are approximate.

Approved by:

  
Jeffrey Simmons, Manager of Mechanical Testing  
Sherry Laboratories

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**GOLTRA CASTINGS COMPANY, INC.**

501 McIdyne STREET  
Golden, Colorado 80401  
PHONE 303-279-7818

DATE: 12/23/06

## ASTM SPECIFICATION

ASTM-A-487 4B

## CUSTOMER DESCRIPTION

MCKISSICK  
P/N: 7-S-4

**TENSILE TEST PER ASTM E 8**

HEAT CODE	YIELD PSI	TENSILE PSI	ELONGATION %	REDUCTION IN AREA %
79H	95,000	115,000	17	35.0

Brinell: 235

**QUENCH & TEMPER****CHEMICAL COMPOSITION**

Element	Carbon	Manganese	Phosphorous	Sulfur
Units	%	%	%	%
Average	0.3030	0.8800	0.0150	0.0096
	Silicon	Copper	Nickel	Chromium
	%	%	%	%
	0.5700	0.2040	0.5100	0.5800
	Molybdenum	Aluminum	Vanadium	Carbon Equiv.
	%	%	%	%
	0.2150	0.0051	0.0110	0.8800

**CHARPY IMPACT TEST PER ASTM A370 FIG. 1**

TYPE OF SPECIMEN: CHARPY V NOTCH

SPECIMEN	#1	#2	#3
----------	----	----	----

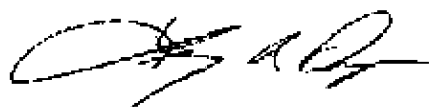
IMPACT VALUE

METHOD OF TEST ASTM E 23	18	29	32
--------------------------	----	----	----

TEST TEMPERATURE	-25 DEG F
------------------	-----------

MADE AND MELTED IN THE USA

I HEREBY CERTIFY THAT THE ABOVE INFORMATION IS CORRECT.



Swivel  
HEAT CODE: 79H  
P/N 2008346

GOLTRA CASTINGS COMPANY, INC.  
Larry Draper, General Manager

**EAGLE**

PRECISION CAST PARTS, INC.

**MATERIAL  
CERTIFICATION**5112 EVANSTON AVE.  
MUSKEGON, MI 49442  
PHONE: (231) 788-3318  
FAX: (231) 788-5409

DATE CERTIFIED: 09/19/2008

McKissick Products Company  
2857 Dawson Road  
  
Tulsa, OK 74101PART NUMBER: 230379  
DESCRIPTION: 5 TON TIMKEN SWIVEL  
METAL: 8620  
METAL SPEC: ASTM A487 4D  
P.O. NUMBER: M-0608403

HEAT#: A1089	Fe: 97.30	Cr: 0.57	P: 0.02	TENSILE STRENGTH: 115,240
QUANTITY: 90	C: 0.24	Mn: 0.23	Cu: 0.13	YIELD STRENGTH: 96,480
	Mn: 0.65	Al: 0.00	V: 0.00	ELONGATION: 17
	Si: 0.35	Ti: 0.01	Nb: 0.04	REDUCTION: 37
	Ni: 0.42	S: 0.02	W: 0.00	BHN: 227

**NOTES:** Lot code: # 013, 014, 015

Charpy results @ -25F: 18, 18, 17 ft-lbs. Average: 17.7 ft-lbs

HEAT#: A1100	Fe: 97.30	Cr: 0.81	P: 0.02	TENSILE STRENGTH: 110,828
QUANTITY: 78	C: 0.20	Mn: 0.23	Cu: 0.13	YIELD STRENGTH: 94,150
	Mn: 0.61	Al: 0.00	V: 0.00	ELONGATION: 18
	Si: 0.39	Ti: 0.01	Nb: 0.02	REDUCTION: 41
	Ni: 0.43	S: 0.02	W: 0.00	BHN: 231

**NOTES:** Lot code: # 016, 017, 018

Charpy results @ -25F: 20, 20, 23 ft-lbs. Average: 21 ft-lbs

Swivel Eye  
LOT CODE: 014  
P/N 230379  
Bruce Gilbert / J. Menefee 09/19/2008

# MATERIAL CERTIFICATION

5112 EVANSTON AVE  
MUSKEGON, IN 46442  
PHONE: (231) 788-3318  
FAX: (231) 788-5409



**EAGLE**

PRECISION CAST PARTS, INC.

DATE CERTIFIED: 08/09/2006

McKissick Products Company  
2857 Dawson Road  
Tulsa, OK 74101

PART NUMBER: 230379  
DESCRIPTION: 6 TON TIMKEN BWWEL  
METAL: 8620  
METAL SPEC: ASTM A487 4D  
P.O. NUMBER: M-0606134

HEAT#: A1038	Fe: 97.00	Mo: 0.22	Cu: 0.13	TENSILE STRENGTH: 103,078
QUANTITY: 87	C: 0.23	Al: 0.00	V: 0.00	YIELD STRENGTH: 86,640
	Mn: 0.90	Ti: 0.01	Nb: 0.04	ELONGATION: 25
	Si: 0.49	S: 0.02	Se: 0.00	REDUCTION: 50
	Ni: 0.43	P: 0.03	W: 0.03	BHN: 0
	Cr: 0.52			

**NOTES:** Lot codes: 008, 009, & 010

Charpy results: 18, 16, 18 ft-lbs. Average: 17.3 ft-lbs

HEAT#: A1039	Fe: 97.00	Mo: 0.22	Cu: 0.12	TENSILE STRENGTH: 109,450
QUANTITY: 77	C: 0.24	Al: 0.00	V: 0.00	YIELD STRENGTH: 92,793
	Mn: 0.85	Ti: 0.01	Nb: 0.03	ELONGATION: 24
	Si: 0.58	S: 0.02	Se: 0.00	REDUCTION: 48
	Ni: 0.44	P: 0.03	W: 0.02	BHN: 0
	Cr: 0.50			

**NOTES:** Lot Codes: 007, 011, 012

Charpy results: 15-19-12 ft-lbs. Average: 15.7 ft-lbs

Swivel  
Lot Code: 010  
P/N 230379



ASME

Page 1 of 1

FINER QUALITY RECORDS 36 - MATERIAL CERTIFICATION.RPT

Bruce Gilbert A.J. Mendez 08/09/2006





# Oklahoma Investment Casting Company

## CERTIFICATE OF CONFORMANCE

DATE: April 22, 2005

THIS IS TO CERTIFY THAT THE PARTS LISTED BELOW WERE MANUFACTURED TO THE SPECIFICATIONS AS INDICATED BELOW.

COMPANY:	McKissick
P.O. NUMBER:	M-0409988
PART NUMBER:	230379 5 Ton Eye Barrel
O.I.C.C. NUMBER:	142-006
ALLOY:	ASTM A487 Grade 4 Class B
HEAT NUMBER(S):	3/10/05 #7 thru 12
PIC CODE:	068

NUMBER OF PARTS ON THIS ORDER: 168

### CHEMICAL ANALYSIS

ELEMENT TESTED	RESULTS (%)
C	0.29
Mn	0.59
P	0.01
S	0.02
Si	0.68
Cu	0.16
Ni	0.49
Cr	0.50
Mo	0.20
Fe	BASE

QUALITY ASSURANCE:

  
STUART K. BENSCH

708 N. 29th Street • P.O. Box 580 • Blackwell, OK 74633 • (580) 363-5712 • FAX (580) 363-5717 • TOLL FREE 1-800-363-5712

Materials Testing  
3500 N. Hiwassee Circle  
Broken Arrow, OK 74012

# SHERRY Laboratories

Testing Today - Making Tomorrow

Tel: (918) 258-6066  
(800) 324-8378  
Fax: (918) 258-1154

## LABORATORY REPORT

Attn: Stuart Bensch  
Oklahoma Investment Castings Corp.  
708 N. 28th Street  
Blackwell, OK 74831

Report No: 2005040410-1  
Date Received: 04/18/2005  
Date Reported: 04/21/2005  
P.O. No: 3397B

Description S/N- 1: McKinick ST Eye Barrel, ASTM A487 Grade 4 CL. D Material, YB=MD7

### Room Temperature Tensile Test (ASTM E 8-04), Longitudinal

Parameter	Result
Diameter, in.	0.501
Tensile Strength, psi	108,400
Yield Strength, psi by 0.2% offset	85,900
Elongation in 2", %	18
Reduction of Area, %	33

→ Approved BRAD BENSCH 4-25-05  
→ Approved BRAD BENSCH 4-25-05

230379  
ST Eye Barrel  
M-0409988  
PIC 068

S&B  
22 APR 05

The elongation and reduction-of-area do not meet the minimum requirements of ASTM A487 Grade 4 Class D. The elongation is 18 short and the reduction-of-area is 20 short.

Approved by

Carol Juch, Manager of Material Testing  
Sherry Laboratories

Stuart Bensch  
OICC  
22 April 2005

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Broken Arrow, OK 74012

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(800) 324-8378  
Fax: (918) 258-1134

**LABORATORY REPORT**

Attn: Stuart Borach  
Oklahoma Investment Castings Corp.  
708 N. 29th Street  
Blackwell, OK 74831

Report No: 2005040410-2  
Date Received: 04/18/2005  
Date Reported: 04/21/2005  
P.O. No: 33879

Description: B/N-2: McKissick 9T Eye Barrel, ASTM A487 Grade 4 CL, D Material, TB=RD7

**Impact Test, ASTM A370-03a/ASTM E23-04**

Test Machine Capacity: 264 Ft-Lbs.  
Specimen Type: Charpy "V" Notch  
Specimen Location: ASTM A370 Longitudinal  
Notch Orientation: Perpendicular to Surface  
Specimen Size: 10mm X 10mm  
Test Temperature: -25 °F

Notch Location: Base  
Impact Values (Ft-Lbs.): 17, 18, 18  
Lateral Expansion (Mils): 13, 14, 12  
Shear (%): 40, 40, 40

Absorbed energy values above 80% of the scale range are approximate.

Approved by:   
Carol Judd, Manager of Material Testing  
Sherry Laboratories

Test results relate only to the items tested. This document shall not be reproduced, except in full, without the written approval of Sherry Laboratories. The recording of false, fictitious, or fraudulent statements or entries on this document may be a punishable offense under federal and state law. The electronic transmission of a report on services provided by Sherry Laboratories is at the request of the client. The transmission is NOT the official report of Sherry Laboratories, but is provided for the convenience of the recipient. Sherry Laboratories is not liable for any degradation or changes in information in the transmitted. The official report of Sherry Laboratories will be provided on Sherry Laboratories letterhead in hard copy form and shall control for all purposes.



# Oklahoma Investment Casting Company

## CERTIFICATE OF CONFORMANCE

DATE: July 17, 2009

SWIVEL LOWER EYE  
HEAT: 054 P/N 2009346

THIS IS TO CERTIFY THAT THE PARTS LISTED BELOW WERE MANUFACTURED TO THE SPECIFICATIONS AS INDICATED BELOW.

COMPANY:	McKibben
P.O. NUMBER:	16-030967
PART NUMBER:	237379 S Pin Eye Barrel
QALCC NUMBER:	142-005
ALLOY:	ASTM A487 Grade 4 Class B
HEAT NUMBER(S):	100677 - 16 (Rev 1)
PTC CODE:	054

NUMBER OF PARTS ON THIS ORDER: 154

### CHEMICAL ANALYSIS

ELEMENT TESTED	RESULTS (%)
C	0.21
Mn	0.48
P	0.02
S	0.02
Si	0.62
Cr	0.28
Ni	0.17
Co	0.12
Mo	0.19
Pb	0.005

QUALITY ASSURANCE:

STUART H. DENSCH

700 N. 25th Street • P.O. Box 600 • Muskogee, OK 74401 • (918) 263-2451 • (918) 263-2452 FAX

FORM NAME: CEN  
FILE NAME: FORM01

# ARROW LABORATORY, INC.

PO BOX 348  
 WICHITA KS 67201-0348  
 Phone (316) 267-8303

Metallurgical Analysis and Testing

1305 N. MARKET ST.  
 WICHITA, KS 67203  
 Fax (316) 267-6171

ATTN: PAUL HAYES  
 CENTRAL WACHING & TOOL  
 PO BOX 3808  
 WICHITA KS 67202-3808

07-23-83  
 Page 1 of 1

LABORATORY REPORT #P51dg355

## STEEL ANALYSIS

ASTM A487-82 (1980), Gr. 4, Ct. B  
 "AT 2"

A-0302967  
 230379 5TEB  
 Pic 054

	Area	Load, lbs.	Strength, ksi	Elong	R/A
Size	sq. in.	Tensile	Yield	Tensile	Yield %
0.495	0.1924	18,940	15,180	88	19 42
0.496	0.1932	18,340	14,170	88	20 47
Minimum requirements per Table 3:			105-130	85	27 55

Upper yield strength - Elongation in 4.4%

## CHARPY V NOTCH IMPACT TESTS

Three 10 in x 10 in longitudinal specimens were prepared so that the base of the notch would be perpendicular to the surface of the material. The specimens were cooled to -25° F. in an acetone dry ice cooling bath. The impact tests were made on our Tinius Olsen Model 84 Impact Testing Machine. ASTM A23-01 and A370-02 test procedures were used.

Specimen	Impact Value*	Fracture Appearance**	Lateral Expansion***
1	23	20% shear	13 mils
2	13	20	13
3	23	20	10
Average	23		
Min. Average Req.	13		
Min Specimen Req.	10		

\* Four pounds of energy absorbed by the specimen  
 \*\* Estimated to the nearest 10% by Fracture Appearance Chart ASTM A370-02  
 \*\*\* Reference ASTM A370-02 measuring procedure.

WCH/MS  
 Rec'd 07-15-83  
 P.O. #25156

Project Supervisor  
*Bill Bachman*  
 0117 Bachman

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# MATERIAL CERTIFICATION

5112 EVANSTON AVE.  
MUSKEGON, MI 49442  
PHONE: (231) 788-3318  
FAX: (231) 788-5409

DATE CERTIFIED: 07/10/2006



**EAGLE**

PRECISION CAST PARTS, INC.

**McKissick Products Company**  
**2857 Dawson Road**  
  
**Tulsa, OK 74101**

**PART NUMBER: 230379**  
**DESCRIPTION: 5 TON TIMKEN SWIVEL**  
**METAL: B520**  
**METAL SPEC: ASTM A487 4D**  
**P.O. NUMBER: M-0606133**

HEAT#: B514	Fe: 97.60	Mo: 0.18	Cu: 0.15	TENSILE STRENGTH: 105,690
QUANTITY: 30	C: 0.22	Al: 0.00	V: 0.00	YIELD STRENGTH: 95,934
	Mn: 0.72	Ti: 0.01	Nb: 0.02	ELONGATION: 20
	Si: 0.30	S: 0.03	Se: 0.00	REDUCTION: 41
	Ni: 0.42	P: 0.02	W: 0.02	BHN: 229
	Cr: 0.60			

**NOTES:** Lot code: #002

Charpy results @ -25F: 20, 21, 21 ft-lbs. Average: 20.6 ft-lbs

HEAT#: B315	Fe: 96.30	Mo: 0.29	Cu: 0.14	TENSILE STRENGTH: 107,864
QUANTITY: 30	C: 0.21	Al: 0.02	V: 0.00	YIELD STRENGTH: 91,740
	Mn: 0.57	Ti: 0.02	Nb: 0.03	ELONGATION: 20
	Si: 0.56	S: 0.03	Se: 0.00	REDUCTION: 36
	Ni: 0.43	P: 0.02	W: 0.03	BHN: 229
	Cr: 0.44			

**NOTES:** Lot code: #004

Charpy results @ -25F: 18, 17, 18 ft-lbs. Average: 17.7 ft-lbs

HEAT#: C1985	Fe: 97.20	Mo: 0.18	Cu: 0.14	TENSILE STRENGTH: 112,868
QUANTITY: 30	C: 0.20	Al: 0.00	V: 0.00	YIELD STRENGTH: 97,300
	Mn: 0.84	Ti: 0.01	Nb: 0.02	ELONGATION: 17
	Si: 0.47	S: 0.03	Se: 0.00	REDUCTION: 37
	Ni: 0.41	P: 0.02	W: 0.03	BHN: 235
	Cr: 0.50			

**NOTES:** Lot code: #001

Charpy results @ -25F: 17, 18, 16 ft-lbs. Average: 17 ft-lbs



**BARREL**  
**LOT CODE: 001, 002 & 004**  
**P/N 230379**

*[Signature]*  
RUCB Gilbert AJ Menefee 08/04/2006



# Oklahoma Investment Casting Company

## CERTIFICATE OF CONFORMANCE

DATE: August 22, 2005

THIS IS TO CERTIFY THAT THE PARTS LISTED BELOW WERE MANUFACTURED TO THE SPECIFICATIONS AS INDICATED BELOW.

COMPANY:	McKissick
P.O. NUMBER:	M-0502563
PART NUMBER:	2001076 5 Ton Base Plug w/ Chamfer
O.I.C.C NUMBER:	142-032
ALLOY:	ASTM A487 Gr 4 Cl B
HEAT NUMBER(S):	7/11/05 #1 thru 3
PIC CODE:	012

NUMBER OF PARTS ON THIS ORDER: 285

### CHEMICAL ANALYSIS

ELEMENT TESTED	RESULTS (%)
C	0.28
Mn	0.62
P	0.02
S	0.02
Si	0.61
Cu	0.14
Ni	0.41
Cr	0.56
Mo	0.19
Fe	BASE

QUALITY ASSURANCE:

STUART K. BENSCH

708 N. 29th Street \* P.O. Box 580 \* Blackwell, OK 74631 \* (580) 363-1412 \* (580) 363-5712 FAX



# SHERRY Laboratories

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3100 N. Hemlock Circle  
Broken Arrow, OK 74012

Tel: (918) 258-6866  
(800) 324-8378  
Fax: (918) 258-1154

## LABORATORY REPORT

Attn: Stuart Bensch  
Oklahoma Investment Castings Corp.  
708 N. 29th Street  
Blackwell, OK 74831

AUG 15 2005

Report No: 2005080276- 2  
Date Received: 08/09/2006  
Date Reported: 08/10/2006  
P.O. No: 34377

Description S/N- 2: McKissick 2001076, 5T Base Plug With Chamfer 142-032, ASTM A487 Grade 4 CL. B Material, TB=2QM7-3

### Room Temperature Tensile Test (ASTM E 8-04)

Parameter	Result
-----------	--------

Diameter, in.	0.502
---------------	-------

Tensile Strength, psi	99,000*
-----------------------	---------

Yield Strength, psi by 0.2% offset	79,100*
---------------------------------------	---------

Elongation in 2", %	22
---------------------	----

Reduction of Area, %	47
----------------------	----

Accepted by  
Brend Beall  
8/23/05

2001076  
5T Base Plug  
w/ Chamfer  
M-0502565  
PIC 012  
SKB  
22 Aug 05

\*Properties do not conform to ASTM A487, Grade 4, Class B, Rev. 93 (1998).

Approved by:

Carol Judd, Manager of Mechanical Testing  
Sherry Laboratories

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(800) 324-8378  
Fax: (918) 258-1154

## LABORATORY REPORT

Attn: Stuart Bensch  
Oklahoma Investment Castings Corp.  
708 N. 29th Street  
Blackwell, OK 74631

AUG 02 2005

Report No: 2005070651  
Date Received: 07/27/2005  
Date Reported: 07/29/2005  
P.O. No: 34324

Description: McKlasick 5T Base Plug, ASTM A487 Grade 4 CL. D Material, TB=OM7

### Impact Test, ASTM A370-03a/ASTM E23-02a

Test Machine Capacity: 300 Ft-Lbs.  
Specimen Type: Charpy "V" Notch  
Specimen Location: ASTM A370 Longitudinal  
Notch Orientation: Perpendicular to Surface  
Specimen Size: 10mm X 10mm  
Test Temperature: -25 °F

Notch Location: Base  
Impact Values (Ft-Lbs.): 20, 28, 22  
Lateral Expansion (Mils): 17, 25, 20  
Shear (%): 35, 45, 40

Absorbed energy values above 80% of the scale range are approximate.

Approved by:

Carol Judd, Manager of Mechanical Testing  
Sherry Laboratories

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2001076  
5T Base Plug  
w/ Chamfer  
M: 0502565  
PIC 012  
SKB  
3 Aug. 05



P.O. BOX 3128 TULSA, OK. 74101

OIL STATES SKAGIT-SMATCO LLC  
1180 MULBERRY RD  
HOUMA, LA 70363



TELEPHONE 918/834-4811  
TELEX 262569 CRSBY UR  
FAX 918/834-9447

## CERTIFICATE OF NONDESTRUCTIVE TESTING

\*\*\*\*\*

INSPECTION PERFORMED ON: 5 PC(S)- MB07T200E 7 TON API 2C OVERHAUL BALL.

TESTING SERIAL NO: 07-497-05 Thru 07-497-09

CUSTOMER PURCHASE ORDER NO: 4051637

CROSBY W/O ORDER NO: 677961

TEST PERFORMED:

\_\_\_\_\_ ULTRASONIC INSPECTION PER ASTM A-388.  
ACCEPTANCE CRITERIA:

\_\_\_\_\_/\_\_\_\_\_/\_\_\_\_\_ MAGNETIC PARTICLE INSPECTION PER ASTM E-709.  
\_\_\_\_\_/\_\_\_\_\_/\_\_\_\_\_ WET METHOD \_\_\_\_\_ DRY METHOD.

\_\_\_\_\_ DYE PENETRANT INSPECTION PER ASTM E-165.  
ALTERNATE SPECIFICATION:

DEFECTS AND DISPOSITION: NO REJECTABLE INDICATIONS  
PART NO: 8009632

PICS: HOOK - 5GH  
PLATES - HHBC  
LARGE & SMALL BOLT - GBGJ  
SWIVEL PICS:  
UPPER EYE - 79H  
LOWER EYE - 010, 012, 014  
NUT - 002

WE CERTIFY THAT THE INDICATED INSPECTIONS WERE PERFORMED ON THE  
DESCRIBED MATERIAL.

DATE: 05/07/07

BY:   
MARK TAYLOR, INSPECTOR LEVEL II

*products of uncompromising quality . . .*

CROSBY Clips & Fittings, LEBUS Load Binders, McKISSICK Blocks & Sheaves, CROSBY- WESTERN Blocks, NATIONAL Swaging Systems

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Dallas, Texas - Longview, Texas - Seattle, Washington - Toronto (Brampton), Ontario - Barnsley, England - Mechelen (Putte), Belgium - Cergy St. Christophe, France



ImXport Services  
Corp.

Pemex-PP LUM A  
Project

## Vendor Data Book

P.O. # 0018987

Serial # 23407

Volume 1

### Nautilus Crane Model 340LA-80

#### Section 9.0 Backlash Reports



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA





## BACKLASH REPORT

### PINION/BALLRING

Left side

CRANE SERIAL NUMBER: 23407



BACKLASH TOP: .025" BOTTOM: .025"

ALIGNMENT

X1	<u>2<sup>8</sup>/<sub>32</sub>"</u>	, X2	<u>2<sup>8</sup>/<sub>32</sub>"</u>	L	<u>11<sup>1</sup>/<sub>4</sub>"</u>	SLOPE X =	$\frac{X2-X1}{L}$	=	<u>0</u>
Y1	<u>2<sup>8</sup>/<sub>32</sub>"</u>	, Y2	<u>2<sup>8</sup>/<sub>32</sub>"</u>	L	<u>11<sup>1</sup>/<sub>4</sub>"</u>	SLOPE Y =	$\frac{Y2-Y1}{L}$	=	<u>0</u>

ARE BOLTS (TURRET OR UPPERSTRUCTURE/ BALLRING) IN PLACE? ☒ YES ☐ NO

DATE: 9/24/07

ACCEPTABLE:  

NOT ACCEPTABLE: \_\_\_\_\_



## BACKLASH REPORT

### PINION/BALLRING

Right side

CRANE SERIAL NUMBER: 23407

BACKLASH TOP: .026" BOTTOM: .026"

ALIGNMENT

X1 <u>2 9/32"</u>	X2 <u>2 9/32"</u>	L <u>1 1/4"</u>	SLOPE X = $\frac{X2-X1}{L}$	= <u>0</u>
Y1 <u>2 9/32"</u>	Y2 <u>2 9/32"</u>	L <u>1 1/4"</u>	SLOPE Y = $\frac{Y2-Y1}{L}$	= <u>0</u>

ARE BOLTS (TURRET OR UPPERSTRUCTURE/ BALLRING) IN PLACE? ☒ YES ☐ NO

DATE: 9/26/07

ACCEPTABLE: BjzARK

NOT ACCEPTABLE: \_\_\_\_\_



ImXport Services  
Corp.

Pemex-PP LUM A  
Project

## Vendor Data Book

P.O. # 0018987

Serial # 23407

Volume 1

### Nautilus Crane Model 340LA-80

#### Section 10.0 Miscellaneous

-Certificate of Leak Test

-Paint Logs

-Main Chord Straightness Checks

-Air Tank Data



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA

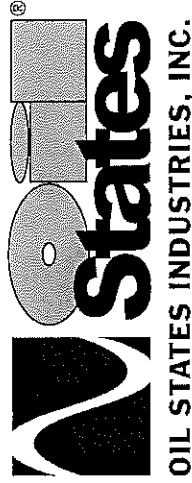


# Certificate of Leak Test

Oil States Industries, Inc. Vessel Description: 5-6" Suction lines (power unit)  
Work Order Number: 23407  
Test Pressure (PSIG): 2.5  
Test Date: 9/19/07

It is hereby certified that:

- The referenced vessel has been pressure tested to the recorded value in accordance with NES184-051 Vessel Leak Test work instruction (bubble method).
- The test has proven the vessel to be free of leaks.
- The test was performed correctly and it is accurately recorded.



*By [Signature]*  
Quality Inspector

# Certificate of Leak Test

Vessel Description:

*Refinery Piping*

Oil States Industries, Inc. Work Order Number:

*23407*

Test Pressure (PSIG):

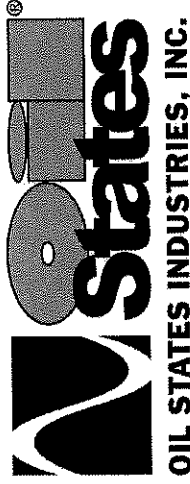
*45 psi*

Test Date:

*10-8-07*

It is hereby certified that:

- The referenced vessel has been pressure tested to the recorded value in accordance with NES184-051 Vessel Leak Test work instruction (bubble method).
- The test has proven the vessel to be free of leaks.
- The test was performed correctly and it is accurately recorded.



Quality Inspector

*[Signature]*



# Certificate of Leak Test

Vessel Description: Return Manifold

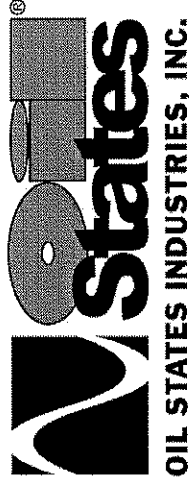
Oil States Industries, Inc. Work Order Number: 23407

Test Pressure (PSIG): 45 lbs.

Test Date: 10/9/07

It is hereby certified that:

- The referenced vessel has been pressure tested to the recorded value in accordance with NES184-051 Vessel Leak Test work instruction (bubble method).
- The test has proven the vessel to be free of leaks.
- The test was performed correctly and it is accurately recorded.



*Chung Fung*  
Quality Inspector

# Certificate of Leak Test

Vessel Description: Power Unit

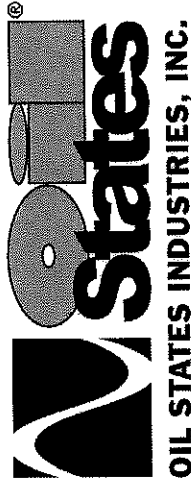
Oil States Industries, Inc. Work Order Number: 23407

Test Pressure (PSIG): 2.5

Test Date: 9/26/07

It is hereby certified that:

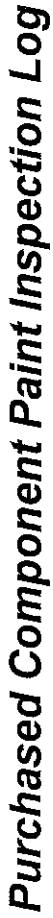
- The referenced vessel has been pressure tested to the recorded value in accordance with NES184-051 Vessel Leak Test work instruction (bubble method).
- The test has proven the vessel to be free of leaks.
- The test was performed correctly and it is accurately recorded.



  
Quality Inspector



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8/28/07 14:31

**Coat 4 N/A**

**Total Millage:** 8 - 11 MILS

Form No: SS3R-0081  
Date 3/1/05



8/28/07 14:31

11/15/07

NOTE: All items which are chromed and/or stainless steel (other than diesel and hydraulic reservoirs) will not be blasted or coated



8/28/07 14:31

**PRESS-O-FILM™**

No. 119

Reading  
Gage less 2.0 mils  
or 50  $\mu$ m

**TESTEX**  
NEWARK, DE 19715  
USA

**X COARSE** (1.5 to 4.5 mils) or (40 to 115  $\mu$ m)

**NOTE:** All items which are chromed and/or stainless steel (other than diesel and hydraulic reservoirs) will not be blasted or coated

Page 1 of 2



8/28/07 14:31

<u>Coat 1</u>	<u>Thermaline 4700 Alu</u>	<u>Coat 2</u>	<u>Thermaline 4700 Aluminum</u>	<u>Coat 3</u>	<u>N/A</u>	<u>Coat 4</u>	<u>N/A</u>
<u>Color</u>	0	0			0		0
<u>DFT</u>	1 - 1.5 Mills	1 - 1.5 Mills			0		N/A
<u>Surface Prep:</u> SP10		<u>Profile:</u>	1 - 1.5 Mills	<u>Total Millage:</u> 2 - 3 Mills			

**NOTE:** All items which are chromed and/or stainless steel (other than diesel and hydraulic reservoirs) will not be blasted or coated



Approved: CAT 8/28/07 14:31

**P.P. PRESS-O-FILM™**  
No. \_\_\_\_\_ **TESTEX**  
Reading 2.0 NEWARK, DE 19715  
Gage less 2.0 mils USA  
or 50  $\mu$ m  
**X COARSE (1.5 to 4.5 mils) or (40 to 115  $\mu$ m)**

**Total Millage: 8.5 - 12 Mils**

Form No: SS3R-0032  
Date 3/1/05

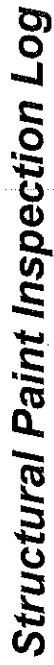




8/28/07 14:31


<u>Coat 1</u>	Carbozinc 859	<u>Coat 2</u>	Carboguard 893 SG	<u>Coat 3</u>	Carbothane 134 HG	<u>Coat 4</u>	N/A
<u>Color</u>					6666 YELLOW		
<u>DFT</u>	2.5 - 3 Mils		4 - 6 Mils		2 - 3 Mils		0
<u>Surface Prep:</u>	SP 10	<u>Profile:</u>	1 - 2 Mils	<u>Total Millage:</u> 8.5 - 12 Mils			

Form No: SS3R-0032  
Date 3/1/05



8/28/07 14:31

<u>Coat 1</u>	Carbozinc 859	<u>Coat 2</u>	Carboguard 893 SG	<u>Coat 3</u>	Carbothane 134 HG 6666 YELLOW 2 - 3 Mils	<u>Coat 4</u>	N/A
<u>Color</u>							
<u>DFT</u> 2.5 - 3 Mils		4 - 6 Mils					
Surface Prep: SP 10		<u>Profile:</u> 1 - 2 Mils		<u>Total Millage:</u> 8.5 - 12 Mils			



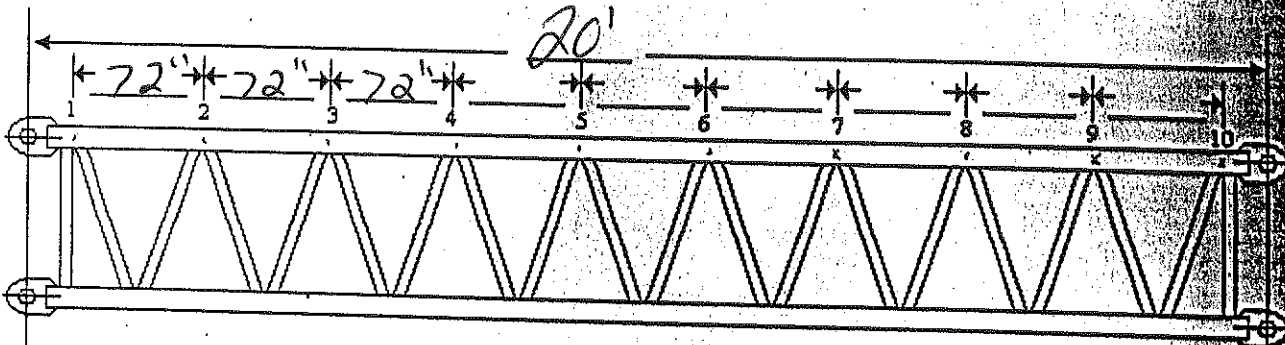
*NOTE: All items which are chromed and/or stainless steel (other than diesel and hydraulic reservoirs) will not be blasted or coated*



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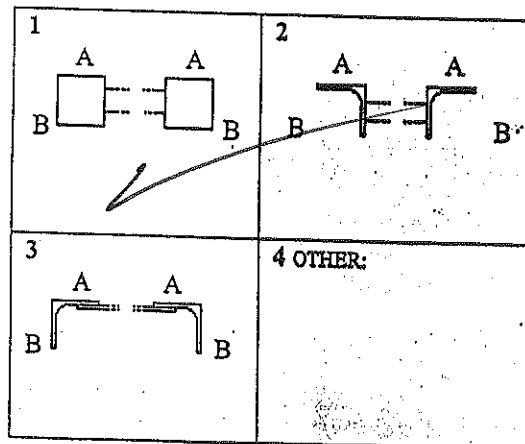


## MAIN CHORD STRAIGHTNESS CHECK



		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
TOP RIGHT	A	0	0	0	0	+1/32	0	+1/32									
	B	0	0	0	0	+1/64	+1/64	0									
TOP LEFT	A	0	+1/64	+1/64	0	+1/64	0	0									
	B	0	+1/32	+1/32	0	+1/64	+1/64	+1/32									
BOTTOM RIGHT	A	0	-1/32	-1/32	0	0	-1/32	-1/64									
	B	0	+1/16	+1/16	0	+1/64	+1/32	+1/32									
BOTTOM LEFT	A	0	-1/64	-1/32	0	-1/64	-1/32	0									
	B	0	+1/64	+1/64	0	+1/32	+1/32	+1/64									

BOOM  
CONSTRUCTION



Weldment Type: 20' Mid

Weldment Serial Number: C07101-03

Crane Serial Number: 23407.04

Crane Model Number: 340L

Inspected by: Brett B...

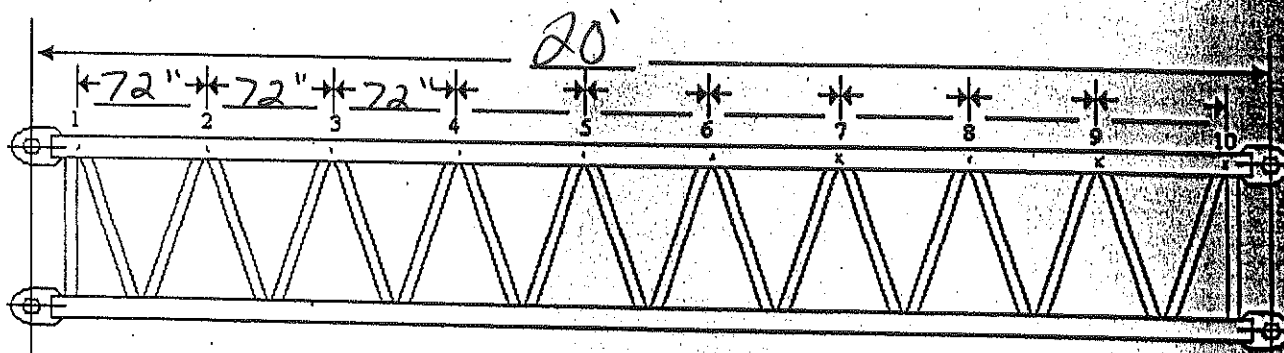
Date Inspected: 8/10/03

Form No: SS3R-0035

DATE: 8/28/03

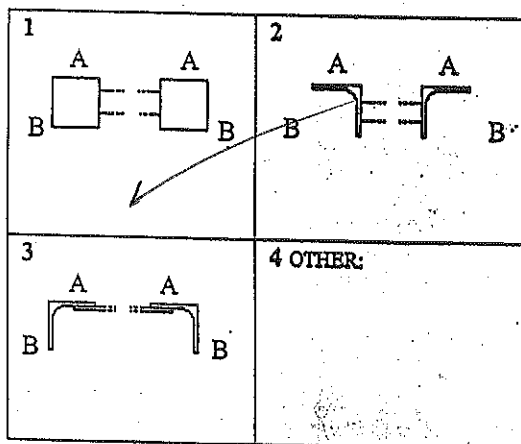


# MAIN CHORD STRAIGHTNESS CHECK



		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
TOP RIGHT	A	0	0	0	0	$+\frac{1}{64}$	$+\frac{1}{64}$	$+\frac{1}{32}$									
	B	0	$+\frac{1}{32}$	$+\frac{1}{32}$	0	$+\frac{1}{64}$	$+\frac{3}{64}$	$+\frac{1}{32}$									
TOP LEFT	A	0	$+\frac{1}{32}$	$+\frac{1}{32}$	0	0	0	0									
	B	0	$+\frac{3}{64}$	$+\frac{3}{64}$	0	$+\frac{1}{64}$	$+\frac{1}{32}$	$+\frac{1}{32}$									
BOTTOM RIGHT	A	0	0	$-\frac{1}{16}$	0	$-\frac{3}{64}$	$-\frac{1}{32}$	$-\frac{1}{32}$									
	B	0	$+\frac{1}{32}$	$+\frac{1}{16}$	0	$+\frac{3}{64}$	$+\frac{3}{64}$	$+\frac{3}{64}$									
BOTTOM LEFT	A	0	$-\frac{1}{32}$	$-\frac{1}{32}$	0	$-\frac{1}{32}$	$-\frac{1}{32}$	0									
	B	0	$+\frac{1}{32}$	$+\frac{1}{64}$	0	$+\frac{1}{32}$	$+\frac{3}{64}$	$+\frac{1}{32}$									

BOOM  
CONSTRUCTION



Weldment Type: 20' mid

Weldment Serial Number: C07101-4

Crane Serial Number: 23407.04

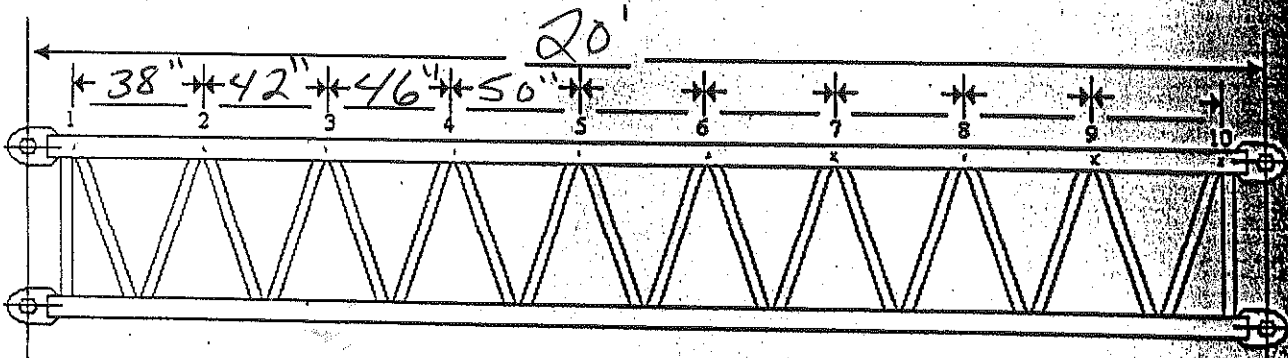
Crane Model Number: 340L

Inspected by: Brent

Date Inspected: 8/10/07



## MAIN CHORD STRAIGHTNESS CHECK



		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
TOP RIGHT	A	0	0	$-\frac{1}{32}$	$-\frac{3}{64}$	0	0	$-\frac{1}{32}$	$-\frac{3}{64}$	$-\frac{1}{32}$	0						
	B	0	0	$+\frac{1}{64}$	$+\frac{1}{64}$	$+\frac{1}{64}$	0	0	0	0	0						
TOP LEFT	A	0	0	0	0	0	$+\frac{1}{64}$	0	0	$+\frac{1}{64}$	0						
	B	0	0	$+\frac{1}{64}$	$+\frac{1}{32}$	$+\frac{1}{32}$	0	$+\frac{1}{64}$	$+\frac{1}{32}$	$+\frac{1}{32}$	0						
BOTTOM RIGHT	A	0	$+\frac{1}{32}$	$-\frac{1}{64}$	$-\frac{1}{64}$	$-\frac{1}{64}$	$-\frac{1}{64}$	$-\frac{1}{32}$	$-\frac{1}{32}$	$-\frac{3}{64}$	0						
	B	0	$+\frac{1}{32}$	$+\frac{1}{32}$	$+\frac{1}{32}$	$+\frac{1}{32}$	$+\frac{1}{64}$	$+\frac{1}{32}$	$+\frac{3}{64}$	$+\frac{3}{64}$	0						
BOTTOM LEFT	A	0	$-\frac{1}{64}$	$-\frac{1}{32}$	$-\frac{1}{32}$	$-\frac{1}{64}$	0	$-\frac{1}{32}$	$-\frac{1}{32}$	$-\frac{1}{64}$	0						
	B	0	$+\frac{1}{64}$	$+\frac{1}{64}$	$+\frac{1}{32}$	$+\frac{1}{32}$	0	0	0	0	0						

BOOM  
CONSTRUCTION

1 	2 
3 	4 OTHER:

Weldment Type: 20' BASE

Weldment Serial Number: 23407-02

Crane Serial Number: C07101-02

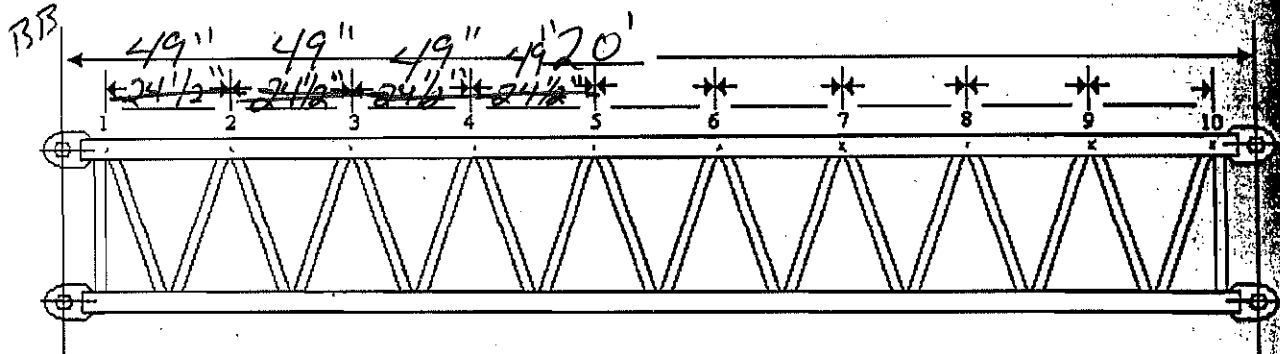
Crane Model Number: 340L

Inspected by: Brent Boen

Date Inspected: 8/10/07



## MAIN CHORD STRAIGHTNESS CHECK



		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
TOP RIGHT	A	0	0	-1/64	-1/32	0	+1/32	+1/64	0	0							
	B	0	0	-1/64	0	0	+1/64	0	0	0							
TOP LEFT	A	0	+1/32	+1/32	0	0	+1/64	+1/64	0	0							
	B	0	+1/64	0	+1/64	0	+1/64	0	0	0							
BOTTOM RIGHT	A	0	0	0	0	0	0	0	0	+1/64							
	B	0	0	-1/32	0	0	0	0	-1/32	+1/64							
BOTTOM LEFT	A	0	0	-1/32	0	0	+1/64	0	-1/64	0							
	B	0	-1/64	-1/32	0	0	0	-1/32	-1/64	0							

BOOM  
CONSTRUCTION

1 	2 
3 	4 OTHER:  

Weldment Type: 20' T.I.P

Weldment Serial Number: C07101-05

Crane Serial Number: 23407

Crane Model Number: 340L

Inspected by: Brent Reginald

Date Inspected: 8/25/07



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**Manchester Tank & Equipment Co.**

Shell

Job No: 30in200  
Number: 1Vessel Number: 1  
Mark Number: S1

Date Printed: 10/12/2006

**Cylindrical Shell Design Information**

Design Pressure:	200.00 PSI	Design Temperature:	650 °F
Static Head:	0.00 PSI	Joint Efficiency:	70 %
Shell Material:	SA-414 Gr G	Factor B Chart:	CS-3
Shell Length:	60.0000 in.	Material Stress (hot):	21400 PSI
Corrosion Allowance:	0.0000 in.	Material Stress (cold):	21400 PSI
External Corrosion Allowance:	0.0000 in.	Actual Circumferential Stress:	18766 PSI
Outside Diameter (new):	30.0000 in.	Actual Longitudinal Stress:	9951 PSI
Outside Diameter (corroded):	30.0000 in.	Specific Gravity:	0.00
Shell Surface Area:	39.27 Sq. Ft.	Weight of Fluid:	0.00 lb.
Shell Estimated Volume:	178.11 Gal.	Total Flooded Shell Weight:	360.53 lb.
		Shell Weight:	360.53 lb.

**Minimum Design Metal Temperature Data**

Minimum Design Metal Temperature: -20 °F  
Material is exempt from impact testing per UG-20(f), 1 through 5

**Design Thickness Calculations****Longitudinal Stress Calculations per Paragraph UG-27(c)(2)**

$$t = \frac{PR}{2SE + 0.4P} = \frac{200.00 * 14.7730}{2 * 21400 * 0.65 + 0.4 * 200.00} = 0.1059 + 0.0000 \text{ (corrosion)} + 0.0000 \text{ (ext. corrosion)} = \text{minimum of } 0.1059 \text{ in.}$$

**Circumferential Stress Calculations per Appendix 1-1(a)(1)**

$$t = \frac{PR_o}{SE + 0.4P} = \frac{200.00 * 15.0000}{21400 * 0.70 + 0.4 * 200.00} = 0.1992 + 0.0000 \text{ (corrosion)} + 0.0000 \text{ (ext. corrosion)} = \text{minimum of } 0.1992 \text{ in.}$$

External loads do not control design.

**Nominal Shell Thickness Selected = 0.2270 in.**

**Manchester Tank & Equipment Co.**

Head

Job No: 30in200  
Number: 1Vessel Number: 1  
Mark Number: H1

Date Printed: 10/12/2006

**Ellipsoidal Head Design Information**

Design Pressure:	200.00 PSI	Design Temperature:	650 °F
Static Head:	0.00 PSI	Joint Efficiency:	85 %
Head Material:	SA-414 Gr G	Factor B Chart:	CS-3
Corrosion Allowance:	0.0000 in.	Material Stress (hot):	21400 PSI
External Corrosion Allowance:	0.0000 in.	Material Stress (cold):	21400 PSI
Head Location:	Bottom	Actual Head Stress:	18764 PSI
Outside Diameter :	30.0000 in.	Straight Flange :	1.0000 in.
Thin Out :	0.0000 in.	Head Depth (ho) :	7.5930 in.
K = $\frac{1}{2} [2 + (D/2h)^2]$ :	1.00		
Head Surface Area:	7.38 Sq. Ft.	Specific Gravity:	0.00
Head Estimated Volume:	17.72 Gal.	Weight of Fluid:	0.00 lb.
Head Weight:	55.93 lb.	Total Flooded Head Weight:	55.93 lb.

**Minimum Design Metal Temperature Data**

Minimum Design Metal Temperature: -20 °F  
Material is exempt from impact testing per UG-20(f), 1 through 5

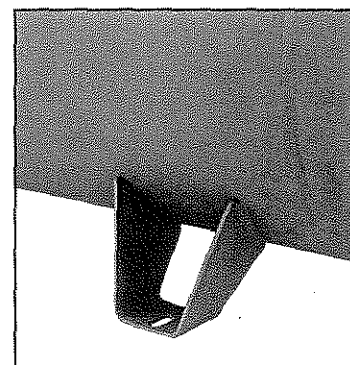
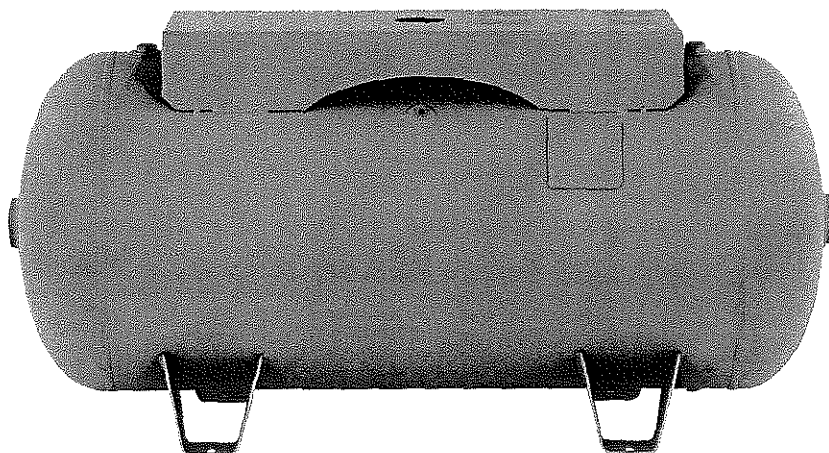
**Design Thickness Calculations****Design Thickness Calculations per Appendix 1-4(c)**

$$t = \frac{PD_oK}{2SE + 2P(K - 0.1)} = \frac{200.00 * 30.0000 * 1.00}{2 * 21400 * 0.85 + 2 * 200.00 * (1.00 - 0.1)}$$

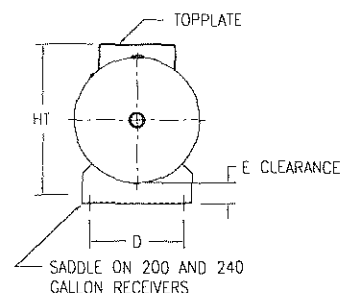
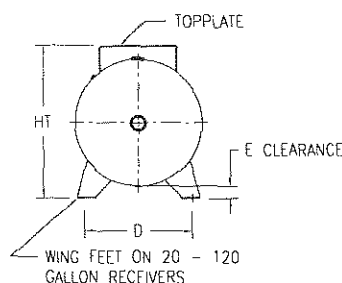
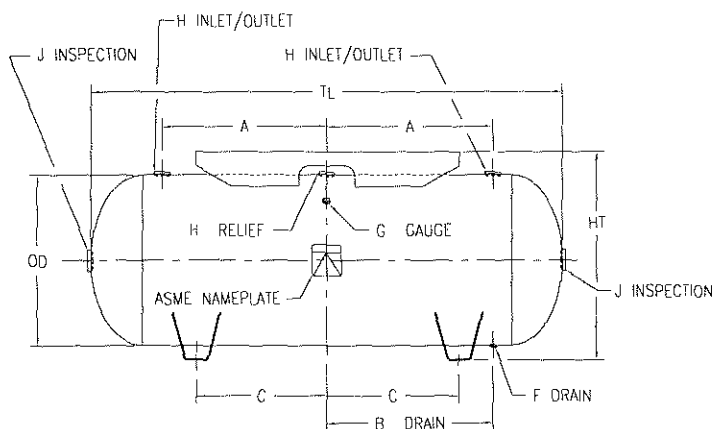
$$= 0.1633 + 0.0000 \text{ (corrosion)} + 0.0000 \text{ (ext. corrosion)} + 0.0000 \text{ (thin out)} = \text{minimum of } 0.1633 \text{ in.}$$

**Minimum Head Thickness Selected = 0.1860 in.**

See NEMA frame sizes on p. 9



Wing Feet



# Horizontal Air Receivers 20-240 Gallons

GAL. CAPACITY	PART #	DESIGN PRESSURE	T.W.	TOP PLATE	CU. FT.	DIMENSIONS IN INCHES								N.P.T. OPENINGS			
						OD	TL	HT	A	B	C	D	E	F	G	H	J
20	35527	165	51	None	2.7	14	33	16	10 <sup>5</sup> / <sub>8</sub>	10 <sup>5</sup> / <sub>8</sub>	8	11 <sup>11</sup> / <sub>16</sub>	2	1/4	1/4	1/2	1 1/2
20	35527.1	165	68	.179x9x20	2.7	14	33	18	10 <sup>5</sup> / <sub>8</sub>	10 <sup>5</sup> / <sub>8</sub>	8	11 <sup>11</sup> / <sub>16</sub>	2	1/4	1/4	1/2	1 1/2
30	35529	165	76	None	4.0	16	38	18	13 <sup>1</sup> / <sub>4</sub>	13 <sup>1</sup> / <sub>4</sub>	10	12 <sup>13</sup> / <sub>16</sub>	2	1/4	1/4	3/4	1 1/2
30	33615.2	165	97	.179x10x24	4.0	16	38	20 <sup>5</sup> / <sub>8</sub>	13 <sup>1</sup> / <sub>4</sub>	13 <sup>1</sup> / <sub>4</sub>	10	12 <sup>13</sup> / <sub>16</sub>	2	1/4	1/4	3/4	1 1/2
30	36596	165	106	.179x9x39	4.0	16	38	19 <sup>3</sup> / <sub>4</sub>	13 <sup>1</sup> / <sub>4</sub>	13 <sup>1</sup> / <sub>4</sub>	10	12 <sup>13</sup> / <sub>16</sub>	2	1/4	1/4	3/4	1 1/2
60	35532	200	156	None	8.0	20	48	22	16 <sup>1</sup> / <sub>2</sub>	16 <sup>1</sup> / <sub>4</sub>	12	16 <sup>1</sup> / <sub>2</sub>	2	1/4	1/4	3/4	2
60	33252.3	200	191	.179x13.5x30	8.0	20	48	24 <sup>1</sup> / <sub>8</sub>	16 <sup>1</sup> / <sub>2</sub>	16 <sup>1</sup> / <sub>4</sub>	12	16 <sup>1</sup> / <sub>2</sub>	2	1/4	1/4	3/4	2
60	36597	200	211	.179x13x50	8.0	20	48	24	16 <sup>1</sup> / <sub>4</sub>	16 <sup>1</sup> / <sub>4</sub>	12	16 <sup>1</sup> / <sub>2</sub>	2	1/4	1/4	3/4	2
80	35534	200	190	None	10.7	20	63	22	16 <sup>1</sup> / <sub>2</sub>	22 <sup>1</sup> / <sub>2</sub>	16	16 <sup>1</sup> / <sub>2</sub>	2	1/4	1/4	1	2
80	33254.4	200	249	.224x15x40	10.7	20	63	23 <sup>5</sup> / <sub>8</sub>	16 <sup>1</sup> / <sub>2</sub>	22 <sup>1</sup> / <sub>2</sub>	16	16 <sup>1</sup> / <sub>2</sub>	2	1/4	1/4	1	2
80	36598	200	300	.224x15x66	10.7	20	63	23 <sup>7</sup> / <sub>8</sub>	22 <sup>1</sup> / <sub>2</sub>	22 <sup>1</sup> / <sub>2</sub>	16	16 <sup>1</sup> / <sub>2</sub>	2	1/4	1/4	1	2
120	35536	200	325	None	16.0	24	68	26	20 <sup>5</sup> / <sub>8</sub>	24	17	20 <sup>5</sup> / <sub>8</sub>	2	1/4	1/4	1 1/2	2
120	33256.2	200	355	.224x15x40	16.0	24	68	28 <sup>7</sup> / <sub>16</sub>	20 <sup>5</sup> / <sub>8</sub>	24	17	20 <sup>5</sup> / <sub>8</sub>	2	1/4	1/4	1 1/2	2
120	33256.3	200	393	.224x16x44	16.0	24	68	27 <sup>5</sup> / <sub>8</sub>	20 <sup>5</sup> / <sub>8</sub>	24	17	20 <sup>5</sup> / <sub>8</sub>	2	1/4	1/4	1 1/2	2
120	36599	200	480	.224x18x74	16.0	24	68	30	24	14	20	22	4	1/2	1/4	2	2
200	35538	200	518	None	26.7	30	72	33	23 <sup>1</sup> / <sub>2</sub>	24 <sup>3</sup> / <sub>8</sub>	19	23 <sup>1</sup> / <sub>2</sub>	3	1/2	1/4	2	2
200	33617.2	200	630	.224x19x48	26.7	30	72	35 <sup>5</sup> / <sub>8</sub>	23 <sup>1</sup> / <sub>2</sub>	24 <sup>3</sup> / <sub>8</sub>	19	23 <sup>1</sup> / <sub>2</sub>	3	1/2	1/4	2	2
200	36601	200	740	.224x19x86	26.7	30	72	35	24 <sup>3</sup> / <sub>8</sub>	24 <sup>3</sup> / <sub>8</sub>	19	23 <sup>1</sup> / <sub>2</sub>	3	1/2	1/4	2	2
240	35541	200	605	None	32.1	30	84	33	23 <sup>1</sup> / <sub>2</sub>	30 <sup>3</sup> / <sub>8</sub>	22	23 <sup>1</sup> / <sub>2</sub>	3	1/2	1/4	2	2
240	33619.1	200	700	.224x19x48	32.1	30	84	35 <sup>5</sup> / <sub>8</sub>	23 <sup>1</sup> / <sub>2</sub>	30 <sup>3</sup> / <sub>8</sub>	22	23 <sup>1</sup> / <sub>2</sub>	3	1/2	1/4	2	2

Phoenix Forging Company, Inc.

P.O. Box 70  
Catasauqua, PA 18032



215-264-2861

PA 800-982-6267

Outside PA 800-523-9487

August 5, 1987

TO: ALL TANK FLANGE CUSTOMERS  
SUBJECT: PRESSURE TEMPERATURE RATINGS

The following list of Phoenix Tank Flanges and the accompanying Pressure Temperature Ratings is now updated to include our two new series identified as 390 and 950.

<u>Series</u>	<u>Minimum Pressure Rating (PSI)</u> <u>at -20 degree to 650 degree F</u>
100	1620
125	1620
150	1610
175	2350
250	1500
300	2330
380	1520
390 *	3927
450	3080
500	2380
700	2620
950 *	3271

CONTROLLING  
VALUE

The above P/T Ratings were calculated in accordance with the 1986 Edition of ASME Section VIII Division 1 and apply to both SA-105 and SA181-70.

The P/T Ratings apply to the fitting as required by UG-11. Attention is called to UW-16(f)(5) and other code paragraphs which may apply such as UW-16 and UG-36 to UG-42 inclusive.

P/T Ratings are available for each size within a series as well as for temperatures exceeding 650° F on request. The above listed P/T ratings are minimums for all sizes within a series.

\* Added series

Sincerely,

PHOENIX FORGING COMPANY, INC.

*W. E. Kiesshauer*

W. E. Kiesshauer,  
Sales Manager



**FORM U-1A MANUFACTURER'S DATA REPORT FOR PRESSURE VESSELS**

Part #

(Alternative Form for Single Chamber, Completely Shop or Field Fabricated Vessels Only)

PO #

As Required by the Provisions of the ASME Code Rules, Section VIII, Division 1

1. Manufactured and certified by **Manchester Tank IN, 905 X Street, Bedford, Indiana, 47421, USA**

(Name and address of manufacturer)

2. Manufactured for **OIL STATES SKAGIT SMATCO**

(Name and address of purchaser)

3. Location of Installation **UNKNOWN**

(Name and address)

4. Type **Horizontal**  
(Horiz. or Vert. tank)

**190833**  
(Mfr's serial No.)

**F0628.1C**  
(CRN)

**303629-REV.A**  
(Drawing No.)

**190833**  
(Nat'l. Bd. No.)

**2007**  
(Year built)

5. The chemical and physical properties of all parts meet the requirements of material specifications of the ASME BOILER AND PRESSURE VESSEL CODE. The design, construction, and workmanship conform to ASME Rules, Section VIII, Division 1

**2046-2**  
Code Case Nos.

**N/A**  
Special Service per UG-120(d)

**2004** to **A06**  
(year) Addenda (Date)

6. Shell:

**SA-414-G**  
Mat'l. (Spec. No., Grade)

**.227**  
Nom. Thk.

**N/A**  
Corr. Allow.

**2' 6" (OD)**  
Diam. I.D.

**4' 7"**  
Length (overall)

7. Seams:

**TYPE 1**

**NONE**

**70%**

**N/A**

**N/A**

**TYPE 2**

**NONE**

**65%**

**1**

Long. (Welded, Dbl., Sngl., Lap, Butt)

R.T. (Spot or Full)

Eff. (%)

H.T. Temp

Time (hr)

Girth. (Welded, Dbl., Sngl., Lap, Butt)

R.T. (Spot or Full)

Eff. (%)

No. of Courses

8. Heads: (a) Mat'l:

**SA-414-G**  
(Spec. No., Grade)

(b) Mat'l

**SA-414-G**  
(Spec. No., Grade)

	Location (Top, Bottom, Ends)	Minimum Thickness	Corrosion Allowance	Crown Radius	Knuckle Radius	Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure (Convex or Concave)
(a)	ENDS	.186	N/A	N/A	N/A	2:1	N/A	N/A	N/A	Concave
(b)	ENDS	.186	N/A	N/A	N/A	2:1	N/A	N/A	N/A	Concave

If removable, bolts used (describe other fastenings)

**N/A**  
(Mat'l., Spec. No., Gr., Size, No.)

9. MAWP

**200 psi**  
(internal)

**N/A**  
(external)

at max. temp.

**400 °F**  
(internal)

**N/A**  
(external)

Min. design metal temp.

**-20 °F**

at

**200 psi**

Hydro, pneu., or comb. test pressure

**PNEU at 260 psi**

10. Nozzles, inspection and safety valve openings:

Purpose (Inlet, Outlet, Drain)	No.	Diam. or Size	Type	Mat'l.	Nom. Thk.	Reinforcement Mat'l.	How Attached	Location
INSP.OPEN.	2	2"	NPT.FLG.	SA-181-70	1500#		WELDED	HEAD
UNKNOWN	3	2"	NPT.FLG.	SA-181-70	1500#		WELDED	
UNKNOWN	1	.25"	NPT.FLG.	SA-181-70	1500#		WELDED	
DRAIN	1	.5"	NPT.FLG.	SA-181-70	1500#		WELDED	

11. Supports:

Skirt **N/A**  
(Yes or no)

Lugs **N/A**  
(No.)

Legs **N/A**  
(No.)

Other

**2 SADDLES**  
(Describe)

Attached

**WELDED/BOTTOM**  
(Where and how)

12. Remarks: Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors, have been furnished for the following items of the report:

**Constructed Under the Provisions of Para.UG-90(c)(2); Exempt from Impact Testing by UG-20(f)**

(Name of part, item number, Mfr's name and identifying stamp)

**CERTIFICATE OF SHOP/FIELD COMPLIANCE**

We certify that the statements made in this report are correct and that all details of design, material, construction, and workmanship of this vessel conform to the ASME Code for Pressure Vessels, Section VIII, Division 1. "U" Certificate of Authorization No. **6046** expires **12/24/2007**

Date **10/24/2007**

Co. name

**Manchester Tank IN**  
(Manufacturer)

Signed

*[Signature]*  
(Representative)

**CERTIFICATE OF SHOP/FIELD INSPECTION**

Vessel constructed by **Manchester Tank IN** at **905 X Street, Bedford, Indiana, 47421, USA** I, the undersigned, holding a valid commission issued by The National Board of Boiler and Pressure Vessel Inspectors and/or the State or Province **KY, IN** and employed by **HSB CT of Hartford, CT** have inspected the component described in this Manufacturer's Data Report on **October 24, 2007** and state that, to the best of my knowledge and belief, the Manufacturer has constructed this pressure vessel in accordance with ASME Code, Section VIII, Division 1. By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date **10/24/2007**

Signed

*[Signature]*  
(Authorized Inspector)

Commissions

**13406A, KY1010, IN1826**  
(Nat'l Board (incl. endorsements), State, Prov. and No.)

**Manchester Tank & Equipment Co.**

Shell

Job No: 30in200  
Number: 1Vessel Number: 1  
Mark Number: S1

Date Printed: 10/12/2006

**Cylindrical Shell Design Information**

Design Pressure:	200.00 PSI	Design Temperature:	650 °F
Static Head:	0.00 PSI	Joint Efficiency:	70 %
Shell Material:	SA-414 Gr G	Factor B Chart:	CS-3
Shell Length:	60.0000 in.	Material Stress (hot):	21400 PSI
Corrosion Allowance:	0.0000 in.	Material Stress (cold):	21400 PSI
External Corrosion Allowance:	0.0000 in.	Actual Circumferential Stress:	18766 PSI
Outside Diameter (new):	30.0000 in.	Actual Longitudinal Stress:	9951 PSI
Outside Diameter (corroded):	30.0000 in.	Specific Gravity:	0.00
Shell Surface Area:	39.27 Sq. Ft.	Weight of Fluid:	0.00 lb.
Shell Estimated Volume:	178.11 Gal.	Total Flooded Shell Weight:	360.53 lb.
		Shell Weight:	360.53 lb.

**Minimum Design Metal Temperature Data**

Minimum Design Metal Temperature: -20 °F  
Material is exempt from impact testing per UG-20(f), 1 through 5

**Design Thickness Calculations****Longitudinal Stress Calculations per Paragraph UG-27(c)(2)**

$$t = \frac{PR}{2SE + 0.4P} = \frac{200.00 * 14.7730}{2 * 21400 * 0.65 + 0.4 * 200.00} = 0.1059 + 0.0000 \text{ (corrosion)} + 0.0000 \text{ (ext. corrosion)} = \text{minimum of } 0.1059 \text{ in.}$$

**Circumferential Stress Calculations per Appendix 1-1(a)(1)**

$$t = \frac{PR_o}{SE + 0.4P} = \frac{200.00 * 15.0000}{21400 * 0.70 + 0.4 * 200.00} = 0.1992 + 0.0000 \text{ (corrosion)} + 0.0000 \text{ (ext. corrosion)} = \text{minimum of } 0.1992 \text{ in.}$$

External loads do not control design.

**Nominal Shell Thickness Selected = 0.2270 in.**

**Manchester Tank & Equipment Co.**

Head

Job No: 30in200  
Number: 1Vessel Number: 1  
Mark Number: H1

Date Printed: 10/12/2006

**Ellipsoidal Head Design Information**

Design Pressure:	200.00 PSI	Design Temperature:	650 °F
Static Head:	0.00 PSI	Joint Efficiency:	85 %
Head Material:	SA-414 Gr G	Factor B Chart:	CS-3
Corrosion Allowance:	0.0000 in.	Material Stress (hot):	21400 PSI
External Corrosion Allowance:	0.0000 in.	Material Stress (cold):	21400 PSI
Head Location:	Bottom	Actual Head Stress:	18764 PSI
Outside Diameter :	30.0000 in.	Straight Flange :	1.0000 in.
Thin Out :	0.0000 in.	Head Depth (ho) :	7.5930 in.
K = $\frac{1}{6}[2 + (D/2h)^2]$ :	1.00		
Head Surface Area:	7.38 Sq. Ft.	Specific Gravity:	0.00
Head Estimated Volume:	17.72 Gal.	Weight of Fluid:	0.00 lb.
Head Weight:	55.93 lb.	Total Flooded Head Weight:	55.93 lb.

**Minimum Design Metal Temperature Data**

Minimum Design Metal Temperature: -20 °F  
Material is exempt from impact testing per UG-20(f), 1 through 5

**Design Thickness Calculations****Design Thickness Calculations per Appendix 1-4(c)**

$$t = \frac{PD_0K}{2SE + 2P(K - 0.1)} = \frac{200.00 * 30.0000 * 1.00}{2 * 21400 * 0.85 + 2 * 200.00 * (1.00 - 0.1)}$$

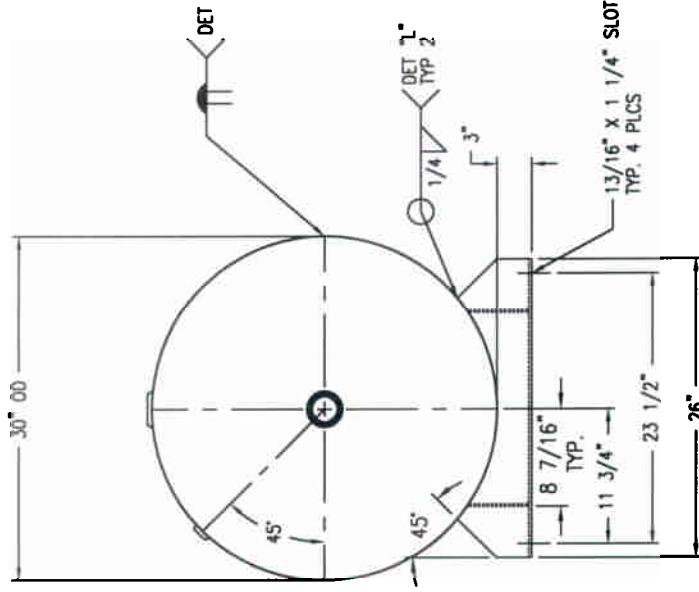
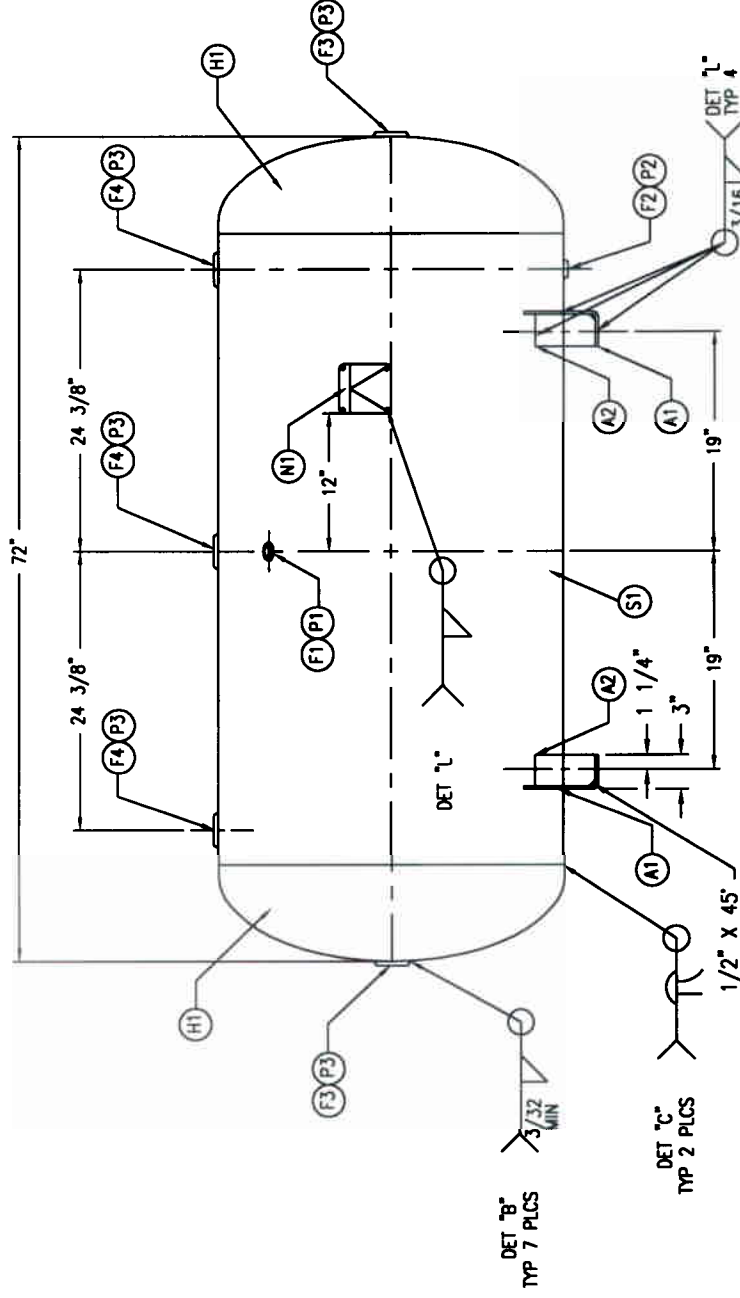
= 0.1633 + 0.0000 (corrosion) + 0.0000 (ext. corrosion) + 0.0000 (thin out) = minimum of 0.1633 in.

Minimum Head Thickness Selected = 0.1860 in.

CODE/ADDENDA 07/A- APPROVED JR  
RELEASED FOR PRODUCTION  
O.C. DATE

NO.	QTY	PART NO.	DESCRIPTION
H1	2		HEAD: .186 MIN. X 30" OD
S1	1		SHELL: .227 MIN. X 30" OD
F1	1		FLANGE: 1/4" NPT
F2	1		FLANGE: 1/2" NPT
F3	2		FLANGE: 2" NPT FLAT
F4	3		FLANGE: 2" NPT RAD

NO.	QTY	PART NO.	DESCRIPTION
A1	2	A92148	SADDLE: 1/4" X 9 1/16" X 26"
A2	4		GUSSET: 3/16" X 2 3/4" X 5 3/16"
N1	1		NAMEPLATE: ASME / NB
P1	1		PLUG: 1/4" PLASTIC
P2	1		PLUG: 1/2" PLASTIC
P3	5		PLUG: 2" PLASTIC
			GRAY PRIMER



SYN	DATE	BY	REVISION	APP
1	4/04	SN	ADDED BOM TO DRAWING	AS
A	02/06	UP	UPDATED TO BEDFORD FORMAT	
			1 CHECKED U-SHED SAMPLE TO L-SHED SAMPLE	

NOTES
1. SEAL WELD NAMEPLATE & SADDLES.

SPECIFICATIONS
O.D. 30 LGTH. 72 MAWP: 200 PSI @ 400 °F RTD: 200 PSI ECONOMY - 20 PSI WGT. 516 # CU. FT. 27 X-RAY: NONE CRN# P0628-1C
SH. .227 MAT'LSA-414-G HD. .186 MAT'LSA-414-G CAL. 200 SA. 51 ft. WGT. 516 # CU. FT. 27 CODE: ASME / NB PER DATE OF DWG/LAST REV
WELD DETAILS M-1932 STD. TOLERANCES (UNLESS OTHERWISE NOTED) M-2461

		SCALE: NONE DRAWING NO. <b>303629</b>
HORIZONTAL AIR RECEIVER		DATE: 9/5/01 DRAWN BY: DM DATE: 9/6/01 APP. BY: AS



Part #

(Alternative Form for Single Chamber, Completely Shop or Field Fabricated Vessels Only)

PO #

As Required by the Provisions of the ASME Code Rules, Section VIII, Division 1

1. Manufactured and certified by **Manchester Tank IN, 905 X Street, Bedford, Indiana, 47421, USA**  
(Name and address of manufacturer)

2. Manufactured for **OIL STATES SKAGIT SMATCO**  
(Name and address of purchaser)

3. Location of Installation **UNKNOWN**  
(Name and address)

4. Type **Horizontal** (Horiz. or Vert. tank)  
**190833** (Mfr's serial No.)  
**F0628.1C** (CRN)  
**303629-REV.A** (Drawing No.)  
**190833** (Nat'l. Bd. No.)  
**2007** (Year built)

5. The chemical and physical properties of all parts meet the requirements of material specifications of the **ASME BOILER AND PRESSURE VESSEL**  
**CODE**. The design, construction, and workmanship conform to ASME Rules, Section VIII, Division 1  
**2004** (year) to **A06** Addenda (Date)

**2046-2** Code Case Nos.  
**N/A** Special Service per UG-120(d)

6. Shell: **SA-414-G** Mat'l. (Spec. No., Grade) **.227** Nom. Thk. **N/A** Corr. Allow. **2' 6" (OD)** Diam. I.D. **4' 7"** Length (overall)  
 7. Seams: **TYPE 1** Long. (Welded, Dbl., Sngl., Lap, Butt) **NONE** R.T. (Spot or Full) **70%** Eff. (%) **N/A** H.T. Temp. **N/A** Time (hr) **TYPE 2** Girth. (Welded, Dbl., Sngl., Lap, Butt) **NONE** R.T. (Spot or Full) **65%** Eff. (%) **1** No. of Courses

8. Heads: (a) Mat'l:		SA-414-G (Spec. No., Grade)				(b) Mat'l SA-414-G (Spec. No., Grade)				
	Location (Top, Bottom, Ends)	Minimum Thickness	Corrosion Allowance	Crown Radius	Knuckle Radius	Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure (Convex or Concave)
(a)	ENDS	.186	N/A	N/A	N/A	2:1	N/A	N/A	N/A	Concave
(b)	ENDS	.186	N/A	N/A	N/A	2:1	N/A	N/A	N/A	Concave

If removable, bolts used (describe other fastenings)

**N/A**  
(Mat'l., Spec. No., Gr., Size, No.)

9. MAWP **200 psi** (internal) **N/A** (external) at max. temp. **400 °F** (internal) **N/A** (external)

Min. design metal temp. **-20 °F** at **200 psi** Hydro, pneu., or comb. test pressure **PNEU at 260 psi**

10. Nozzles, inspection and safety valve openings:

Purpose (Inlet, Outlet, Drain)	No.	Diam. or Size	Type	Mat'l.	Nom. Thk.	Reinforcement Mat'l.	How Attached	Location
INSP.OPEN.	2	2"	NPT.FLG.	SA-181-70	1500#		WELDED	HEAD
UNKNOWN	3	2"	NPT.FLG.	SA-181-70	1500#		WELDED	
UNKNOWN	1	.25"	NPT.FLG.	SA-181-70	1500#		WELDED	
DRAIN	1	.5"	NPT.FLG.	SA-181-70	1500#		WELDED	

11. Supports: Skirt **N/A** (Yes or no) Lugs **N/A** (No.) Legs **N/A** (No.) Other **2 SADDLES** (Describe) Attached **WELDED/BOTTOM** (Where and how)

12. Remarks: Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors, have been furnished for the following items of the report:

**Constructed Under the Provisions of Para.UG-90(c)(2); Exempt from Impact Testing by UG-20(f)**

(Name of part, item number, Mfr's name and identifying stamp)

### CERTIFICATE OF SHOP/FIELD COMPLIANCE

We certify that the statements made in this report are correct and that all details of design, material, construction, and workmanship of this vessel conform to the ASME Code for Pressure Vessels, Section VIII, Division 1. "U" Certificate of Authorization No. **6046** expires **12/24/2007**

Date **10/24/2007**

Co. name

**Manchester Tank IN**  
(Manufacturer)

Signed

*[Signature]*  
(Representative)

### CERTIFICATE OF SHOP/FIELD INSPECTION

Vessel constructed by **Manchester Tank IN** at **905 X Street, Bedford, Indiana, 47421, USA**, the undersigned, holding a valid commission issued by The National Board of Boiler and Pressure Vessel Inspectors and/or the State or Province **KY, IN** and employed by **HSB CT of Hartford, CT** have inspected the component described in this Manufacturer's Data Report on **October 24, 2007** and state that, to the best of my knowledge and belief, the Manufacturer has constructed this pressure vessel in accordance with ASME Code, Section VIII, Division 1. By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date **10/24/2007**

Signed

*[Signature]*  
(Authorized Inspector)

Commissions

**13406A, KY1010, IN1826**  
(Nat'l Board (incl. endorsements), State, Prov. and No.)