











**Bosnor S. A. DE  
C. V. / Pemex**

**PB-KU-H Platform**

**Vendor Data Book**

P.O. # 1550-0268/05-01

Serial # 24005C

Volume: 1

## **Nautilus Crane Model 340LA-100**

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**Vol. 1**

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### **Nautilus Crane Model 340LA-100**

## **FOREWARD**

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 of 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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## Nautilus Crane Model 340LA-100

### 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-100

## 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

*Oil States Industries Thailand*  
Donald Brown - International Service Supervisor  
Travis Dupre – SEA Sales / Service Director

Telephone: + 66 (0) 38 691643  
Fax: + 66 (0) 38 691644



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### **Nautilus Crane Model 340LA-100**

#### **Section 1.0 General Description**



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### Nautilus Crane Model 340LA-100

#### Section 1.1 API 2C Placard

<b>API SPEC 2C</b>			
SIXTH EDITION 2004		DATE MANUFACTURED	
		MAY 2006	
PRODUCED UNDER	2C-0007	QUALITY PROGRAM	
MANUFACTURER'S MODEL NO.	340LA-100		
DESIGN SERVICE TEMPERATURE	MIN.	32	DEG. F.
	MAX.	115	
MANUFACTURER SERIAL NUMBER	24005C		
MANUFACTURED BY	 OIL STATES INDUSTRIES, INC. NAUTILUS MARINE CRANES		
ADDRESS	HOUMA, LOUISIANA 70363		



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## **Nautilus Crane Model 340LA-100**

### **Section 1.2 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**

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**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

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## **Nautilus Crane Model 340LA-100**

### **Section 1.3 Crane General Arrangement Drawing N2005SK4-053**



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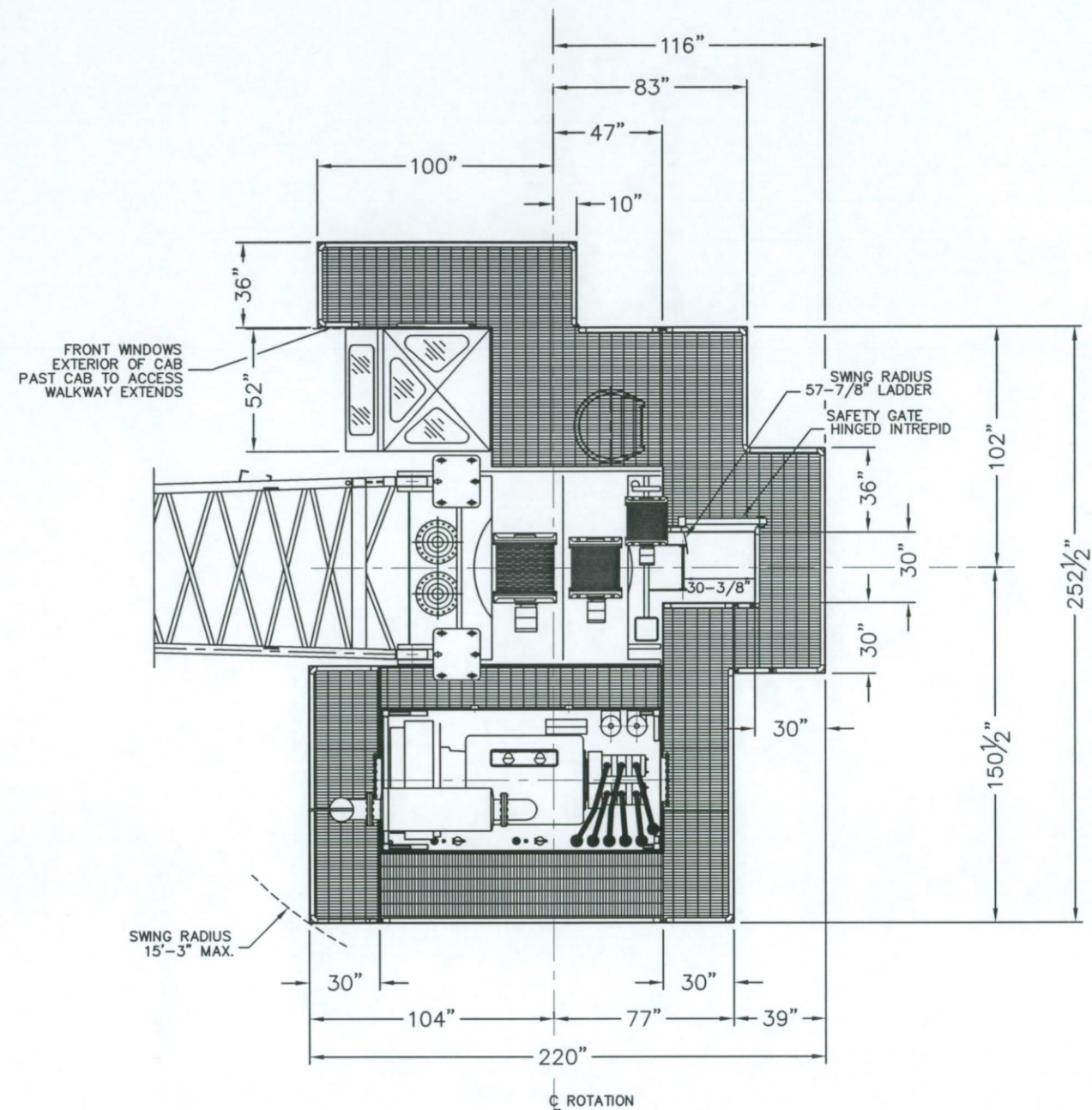
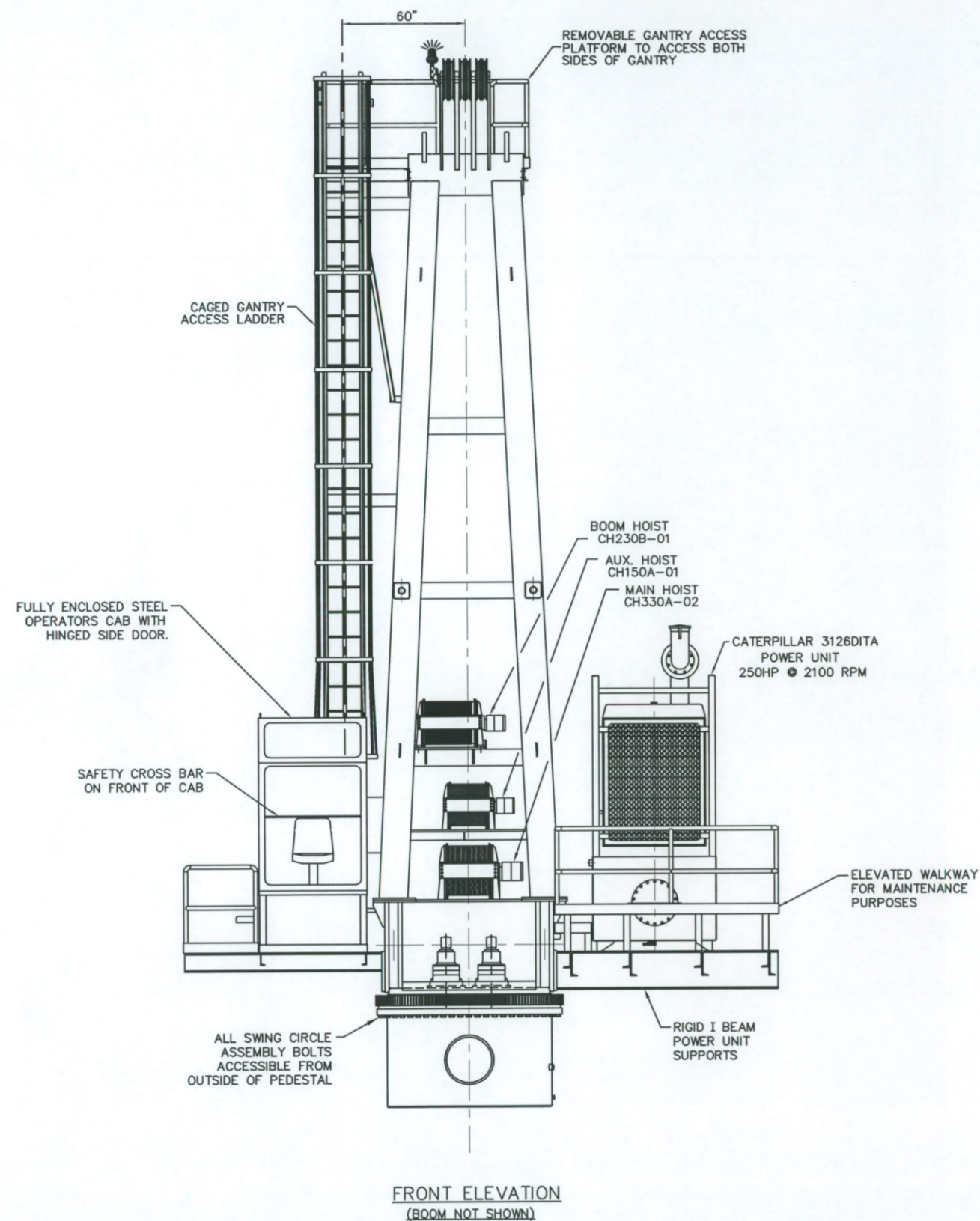












PLAN VIEW  
(GANTRY NOT SHOWN FOR CLARITY)

WORK ORDER NUMBER: 24005 & 24105  
P.O. NUMBER: 1550-0268/05-01  
TAG NUMBER: ZZZ-7550 & ZZZ-7555  
LOCATION: PB-KU-H PLATFORM

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## **Nautilus Crane Model 340LA-100**

### **Section 1.4 Lifting Load Capacity Chart N2006SK3-034**



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**NAUTILUS**MARINE CRANES  
HOUMA, LOUISIANA 70363  
(985) 868-0630MODEL 340LA-100  
SERIAL NUMBER 24005C  
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)
6.3	81	45,803	45,803	31,545	31,545	4,632	4,632	1,406	6.3
7	79	45,803	43,170	31,545	31,545				7
8	78	45,803	38,276	31,545	31,545				8
9	76	45,803	34,618	31,545	31,545				9
10	74	45,803	30,897	31,545	30,897				10
11	72	42,180	27,818	31,545	27,818				11
12	70	38,362	25,272	31,545	25,272				12
13	68	35,153	23,133	31,545	23,133				13
14	66	32,417	21,309	31,545	21,309				14
15	64	30,058	19,736	30,058	19,736				15
16	62	28,002	18,366	28,002	18,366				16
17	59	26,195	17,161	26,195	17,161				17
18	57	24,593	16,093	24,593	16,093				18
19	55	23,164	15,140	23,164	15,140				19
20	53	21,881	14,285	21,881	14,285				20
21	50	20,723	13,513	20,723	13,513				21
22	48	19,673	12,813	19,673	12,813				22
23	45	18,715	12,174	18,715	12,174				23
24	42	17,838	11,590	17,838	11,590				24
25	40	17,033	11,053	17,033	11,053				25
26	37	16,290	10,558	16,290	10,558				26
27	33	15,597	10,096	15,597	10,096				27
28	30	14,881	9,618	14,881	9,618				28
29	26	14,211	9,172	14,211	9,172				29
30	21	13,584	8,754	13,584	8,754				30
31	15	12,994	8,360	12,994	8,360				31
31.6	1	12,397	7,962	12,397	7,962				31.6
32	0	12,243	7,860	12,243	7,860				32

DESIGN CONDITIONS	
METHOD USED	DEFAULT DYNAMIC
HOOK DROP	76.2 M
MIN HOOK SPEED (MAIN LOW SPEED)	5.5 MPM
MIN HOOK SPEED (MAIN HIGH SPEED)	12 MPM
MIN HOOK SPEED (AUX.)	67 MPM

## NOTE:

- 1) OFFBOARD LIFTS BASED ON  $SWL \cdot C_v$
- 2)  $C_v$  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 ( $C_v=2.0$ )
- 3) SHEAVE EFFICIENCY CONSIDERED.
- 4) THE ABOVE RATINGS ARE NET RATINGS AS THE MAIN LOAD BLOCK WEIGHT OF 907Kg AND THE AUXILIARY OVERHAUL BALL WEIGHT OF 98Kg 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.: ZZZ-7550  
P.O. NO.: 1550-0268/05-01REV-A  
P/N: N2006SK3-034









**Bosnor S. A. DE  
C. V. / Pemex**

**PB-KU-H Platform**

**Vendor Data Book**



P.O. # 1550-0268/05-01

Serial # 24005C

Volume: 1

## Nautilus Crane Model 340LA-100

### Section 1.5 Information Chart

 <b>NAUTILUS</b> MARINE CRANES HOUMA, LOUISIANA 70363 (985) 868-0630		<b>INFORMATION CHART</b> (LATTICE BOOM)		 <b>Oil States</b> OIL STATES INDUSTRIES, INC.	
<b>SERIAL NUMBER :</b> 24005C <b>CRANE MODEL :</b> 340LA-100 <b>PURCHASE ORDER NUMBER :</b> 1550-0268/05-01 <b>TAG NUMBER :</b> ZZZ-7550					
<b>MAIN LIFTING CONFIGURATION:</b> <b>WIRE ROPE INFORMATION:</b> TYPE: DYFORM 18-HSLR SIZE: 7/8" [22.2mm] BREAKING STRENGTH: 87,600 lbs [39,734Kg] LENGTH: 1,913 FT [583M] <b>HOOK INFORMATION:</b> MAXIMUM TRAVEL: 250 FT [76.2M] *RADIUS MAX: 100 FT [30.5M] MIN: 20 FT [6M] **MAXIMUM HIGHSPEED SETTING: 51 FPM [15.5MPM] **MAXIMUM LOWSPEED SETTING: 22 FPM [6.7MPM]			<b>AUXILIARY LIFTING CONFIGURATION:</b> <b>WIRE ROPE INFORMATION:</b> TYPE: DYFORM 18-HSLR SIZE: 3/4" [19mm] BREAKING STRENGTH: 64,800 lbs [29,392Kg] LENGTH: 443 FT [135M] <b>HOOK INFORMATION:</b> MAXIMUM TRAVEL: 250 FT [76.2M] *RADIUS MAX: 100 FT [30.5M] MIN: 20 FT [6M] **MAXIMUM SPEED: 234 FPM [71MPM]		
<b>BOOM (LUFFING) LIFTING CONFIGURATION:</b> <b>WIRE ROPE INFORMATION:</b> TYPE: 6 X 25 EIPS IWRC SIZE: 3/4" [19mm] 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" [44.5mm] PARTS OF LINE: 2 BREAKING STRENGTH: 306,000 lbs [138,799Kg] LENGTH: 55 FT [16.8M]					
<b>NOTES :</b> * RECOMMENDED LIMITS. ** THE HOOK POSITIONED AT THE SUPPLY BOAT ELEVATION AND THE PLATFORM / VESSEL AT OPERATIONAL CONDITIONS					



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA











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PB-KU-H Platform**

## **Vendor Data Book**

P.O. # 1550-0268/05-01

Serial # 24005C

Volume: 1

### **Nautilus Crane Model 340LA-100**

#### **Section 1.6 Crane Acceptance Test Procedure and Report**



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USA









# CRANE ACCEPTANCE TEST PROCEDURE AND REPORT



**Nautilus Model 340LA-100 Marine Crane**

*for*

**Bosnor S.A. DE C.V.**

**PB-KU-H Platform**

**Serial Number: 24005**

**Tag Number: ZZZ-7550**

**Purchase Order: 1550-0268/05-1**

**Date: June 7, 2006**

  
(Oil States Industries, Inc. Representative)

  
(Bosnor, S.A DE C.V. Representative)

  
William Haynie (ABS Representative)

ABS will witness the FAT, and will issue "statement of fact" that the crane testing has been witnessed by ABS.



Crane Serial Number: 24005







**PRIOR TO START OF FAT:**

The crane will run an endurance test consisting of a normal duty cycle for a minimum of two hours.

Start time: 2:30 pm End time: 4:30 pm

**SECTION 1 – Gauges:**

Accept	Not Accept	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Pressure (Main Hoist)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Pressure (Aux. Hoist)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Pressure (Boom)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Pressure (Swing)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Pressure (Return)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engine Oil Pressure
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Accumulator Pressure
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engine Water Temp.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Oil Temp.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engine Tachometer
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Oil Level
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Diesel Fuel Level
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Load Indicator System (Main)
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Hydraulic Load Indicator System (Aux.)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Fire Extinguisher

**SECTION 2 – Function Test the Following:**

Accept	Not Accept	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engine Start
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engine Throttle
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engine Shutdown
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engine Air Intake / Over speed Shutdown (Chalmatic)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Low Oil Pressure/High Water Temperature Shutdown
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Main Line Anti-Two Block
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Auxiliary Line Anti-Two Block
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Swing Park Brake
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Dynamic Swing Brake
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Free Swing Capability
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Mechanical Swing Lock
<input checked="" type="checkbox"/>	<input type="checkbox"/>	360° Continuous Rotation
<input checked="" type="checkbox"/>	<input type="checkbox"/>	*High Angle Kick Out
<input checked="" type="checkbox"/>	<input type="checkbox"/>	*Low Angle Kick Out
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Low Boom Angle Kick Out Override
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Manual Recharge Pump
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Pneumatic Windshield Wiper (Pneumatic)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Attention Horn (Pneumatic)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	High Speed Manual Reset Valve

\* The boom high and low angle kickouts will be tested at a reduced speed

**SECTION 3 – Electrical:**

Accept	Not Accept		Accept	Not Accept	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Boom Floodlights (2)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Instrument Light (1)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Boom Tip Beacon Light (1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Air conditioner
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Gantry Beacon Light (1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Gaitronics System with Speaker
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Power On Light	<input checked="" type="checkbox"/>	<input type="checkbox"/>	115 VAC / 60 Hz Outlet (2)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Cab Light (2)			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Circuit Breaker			

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

FUNCTION	BOOM ANGLE (Degrees)	CRACKING PRESSURE NO LOAD (PSI)	FULL SPEED PRESSURE NO LOAD (PSI)
Boom Up:	60	500	1,100
Boom Down:	60	700	1,900
Main Hoist Up:	60	100	700
Main Hoist Down:	60	600	1,400
Aux. Hoist Up:	60	100	500
Aux. Hoist Down:	60	600	1,300
Swing CW:	60	100	500
Swing CCW:	60	100	500



Crane Serial Number: 24005







## SECTION 5: Load Test

Note: Load testing will be performed in increments close to 6m, however the low elevation of the test stand at the OSI facility restrict load testing to a maximum radius 23m due to insufficient hook height.

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

Lift No.	Static Rated Load (Kg)	Test Load (Kg)	Percent of Rated Load	Main Hoist Cracking Pressure (PSI) Up	Main Hoist Cracking Pressure (PSI) Down	Swing Cracking Pressure (PSI) CCW	Swing Cracking Pressure (PSI) CW	Boom Cracking Pressure (PSI) Up	Boom Cracking Pressure (PSI) Down	Load Cell (lbs)	3.05 m Speed Chain (sec)	Speed Chain Average (sec)	Hook Speed (mpm)
1	45,803	45,839	100%	200	600	200	200	2,000	700	45,000	1. 25.31	24.96	7.33
* 2	45,803	60,831	133%					2,500	600		2. 24.87		
											3. 24.71		

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

Lift No.	Static Rated Load (Kg)	Test Load (Kg)	Percent of Rated Load	Main Hoist Cracking Pressure (PSI) Up	Main Hoist Cracking Pressure (PSI) Down	Swing Cracking Pressure (PSI) CCW	Swing Cracking Pressure (PSI) CW	Boom Cracking Pressure (PSI) Up	Boom Cracking Pressure (PSI) Down	Load Cell (lbs)	3.05 m Speed Chain (sec)	Speed Chain Average (sec)	Hook Speed (mpm)
3	28,002	27,980	100%	1,300	700	200	500	1,700	700	28,000	1. 13.16	13.30	13.75
4	18,715	18,693	100%	1,000	600	200	700	1,700	700	18,000	2. 13.32		
											3. 13.43		

### Auxiliary Hoist: 1 - Part Reeving

Lift No.	Static Rated Load (Kg)	Test Load (Kg)	Percent of Rated Load	Aux. Hoist Cracking Pressure (PSI) Up	Aux. Hoist Cracking Pressure (PSI) Down	Full Speed Pressure (PSI) Up	Full Speed Pressure (PSI) Down	Swing Cracking Pressure (PSI) CCW	Swing Cracking Pressure (PSI) CW	Boom Cracking Pressure (PSI) Up	Boom Cracking Pressure (PSI) Down	Load Cell (lbs)	3.05 m Speed Chain (sec)	Speed Chain Average (sec)	Hook Speed (mpm)
5	4,632	4,680	101%	2,400	600	2,800	1,200	100	300	600	700	0	1. 2.18	2.17	84.15
													2. 2.20		
													3. 2.14		

### CERTIFIED TEST WEIGHTS (Kg)

1	45,839	=	544	+	1,043	+	8,287	+	17,123	+	6,586	+	12,256						
			Slings		A		D		E		H		I						
* 2	60,831	=	544	+	1,043	+	8,287	+	17,123	+	6,586	+	12,256	+	6,822	+	4,119	+	4,051
			Slings		A		D		E		H		I		G		B		C
3	27,980	=	544	+	12,256	+	6,822	+	4,119	+	4,051	+	188						
			Slings		I		G		B		C		1 rd wt						
4	18,693	=	544	+	6,822	+	4,119	+	4,051	+	1,361	+	1,043		4 rd wts				
			Slings		G		B		C		3" plate		A						
5	4,680	=	64	+	4,051	+	565												
			Slings		C		3 rd wts												

\* This is a 33% overload lift that will be conducted at a 10m radius. This will be done by lifting the load slightly off the ground, utilizing boom luffing only.



Crane Serial Number: 24005







**SPECIAL NOTES:**

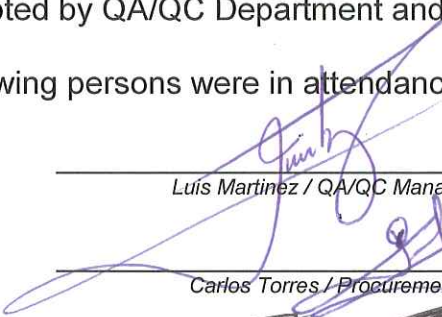
- All welding has been subjected to 100% NDT, which includes ultrasonic testing (all full penetration welds), wet magnetic particle examination (all fillet welds), and radiography (long seam on pedestal barrel), whichever is applicable to the type of weld connection, and comply with AWS D1.1.
- Oil States used the strain gage testing method for design verification; therefore heavy load lift testing of two times the static load is not required. Testing results are available at our facility for review.
- A two hour endurance test was conducted concurrent to the FAT. The joint testing of the crane was 5 hours, with a start time of 2:30pm and an ending time of 7:30pm.

**COMMENTS**

1. Complete general paint touch up
2. Replace aux load cell gauge and function test
3. Adjust swing mechanical and function test

This is to verify that Nautilus Model 340LA-100 Marine Crane, Serial Number 24005, for PB-KU-H Platform has met all API 2C specification 6<sup>th</sup> edition, Bosnor, S.A DE C.V. and Oil States Industries, Inc. requirements and inspections which were performed by Oil States Industries, Inc. prior to installation of the API Monogram and has been satisfactorily accepted by QA/QC Department and Bosnor, S.A DE C.V. representative.

The following persons were in attendance and witnessed FAT:

  
Luis Martinez / QA/QC Manager Bosnor

  
Carlos Torres / Procurement Bosnor

  
Tony G. Reyes / Penco Group, Logistics

  
Eric Bankston / Oil States, Project Manager

  
Young Nelson / Oil States, New Equipment Sales

  
Dwayne Bourgeois / Oil States, QA/QC

  
William Haynie / Senior Surveyor ABS American

Crane Serial Number: 24005









## Amendment to page two of the FAT

### PRIOR TO START OF FAT:

The crane will run an endurance test consisting of a normal duty cycle for a minimum of two hours.

Start time: 2:30 pm End time: 4:30 pm

### SECTION 1 – Gauges:

Accept	Not Accept	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Pressure (Main Hoist)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Pressure (Aux. Hoist)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Pressure (Boom)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Pressure (Swing)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Pressure (Return)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engine Oil Pressure
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Accumulator Pressure
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engine Water Temp.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Oil Temp.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engine Tachometer
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Oil Level
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Diesel Fuel Level
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Load Indicator System (Main)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Load Indicator System (Aux.)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Fire Extinguisher

### SECTION 2 – Function Test the Following:

Accept	Not Accept	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engine Start
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engine Throttle
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engine Shutdown
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engine Air Intake / Over speed Shutdown (Chalmatic)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Low Oil Pressure/High Water Temperature Shutdown
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Main Line Anti-Two Block
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Auxiliary Line Anti-Two Block
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Swing Park Brake
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Dynamic Swing Brake
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Free Swing Capability
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Mechanical Swing Lock
<input checked="" type="checkbox"/>	<input type="checkbox"/>	360° Continuous Rotation
<input checked="" type="checkbox"/>	<input type="checkbox"/>	*High Angle Kick Out
<input checked="" type="checkbox"/>	<input type="checkbox"/>	*Low Angle Kick Out
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Low Boom Angle Kick Out Override
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Manual Recharge Pump
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Pneumatic Windshield Wiper (Pneumatic)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Attention Horn (Pneumatic)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	High Speed Manual Reset Valve

\* The boom high and low angle kickouts will be tested at a reduced speed

### SECTION 3 – Electrical:

Accept	Not Accept	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Boom Floodlights (2)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Boom Tip Beacon Light (1)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Gantry Beacon Light (1)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Power On Light
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Cab Light (2)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Circuit Breaker

Accept	Not Accept	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Instrument Light (1)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Air conditioner
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Gaitronics System with Speaker
<input checked="" type="checkbox"/>	<input type="checkbox"/>	115 VAC / 60 Hz Outlet (2)

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

FUNCTION	BOOM ANGLE (Degrees)	CRACKING PRESSURE NO LOAD (PSI)	FULL SPEED PRESSURE NO LOAD (PSI)
Boom Up:	60	500	1,100
Boom Down:	60	700	1,900
Main Hoist Up:	60	100	700
Main Hoist Down:	60	600	1,400
Aux. Hoist Up:	60	100	500
Aux. Hoist Down:	60	600	1,300
Swing CW:	60	100	500
Swing CCW:	60	100	500

Crane Serial Number: 24005









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## Nautilus Crane Model 340LA-100

### Section 1.7 Crane Critical Component Log

Crane Model ..... 340LA-100  
Serial Number ..... 24005C

Manufacture Date ..... May 2006

Engine ..... N47787-008  
Serial Number ..... 9ZR03291  
Model Number ..... 3126 DITA  
Arrangement Number ..... 132-4383

Main Hoist ..... N46487-009  
Serial Number ..... 0600601  
Auxiliary Hoist ..... N45002-007  
Serial Number ..... 0600204  
Boom Hoist ..... N46430-009  
Serial Number ..... 0502379

Load Block ..... N46831-230  
Serial Number ..... 0632926

Overhaul Ball ..... N46832-014  
Serial Number ..... 631938

Ballring ..... N46397-002  
Serial Number ..... MD29110-A1

Swing Drive Assembly:  
Motor No.1 ..... N45375-003  
Brake No. 1 ..... N47199-002  
Gearbox No. 1 ..... N47103-004  
Pinion No. 1 ..... N61503-001  
Motor No. 2 ..... N45375-003  
Brake No. 2 ..... N47199-002  
Gearbox No. 2 ..... N47103-004  
Pinion No. 2 ..... N61503-001



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## **Nautilus Crane Model 340LA-100**

### **Section 2.0 Installation Manual**



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### Nautilus Crane Model 340LA-100

#### 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-100

### Section 2.2 Bolt Torquing Procedure



NOTE: USE 1-1/2" -6UNC GRADE 8 BOLTS

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



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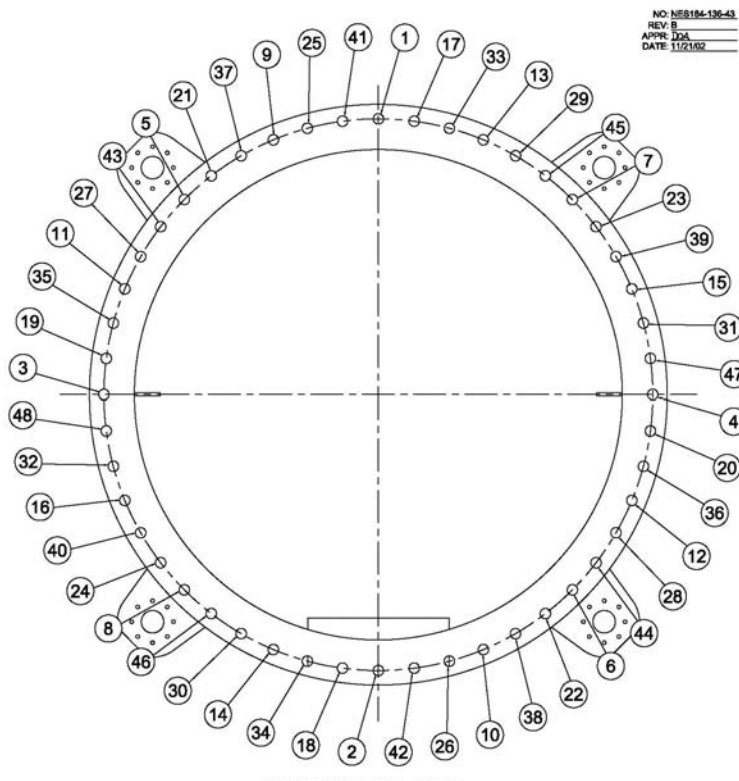
P.O. # 1550-0268/05-01

Serial # 24005C

Volume: 1

## Nautilus Crane Model 340LA-100

### 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 1900 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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Vendor Data Book

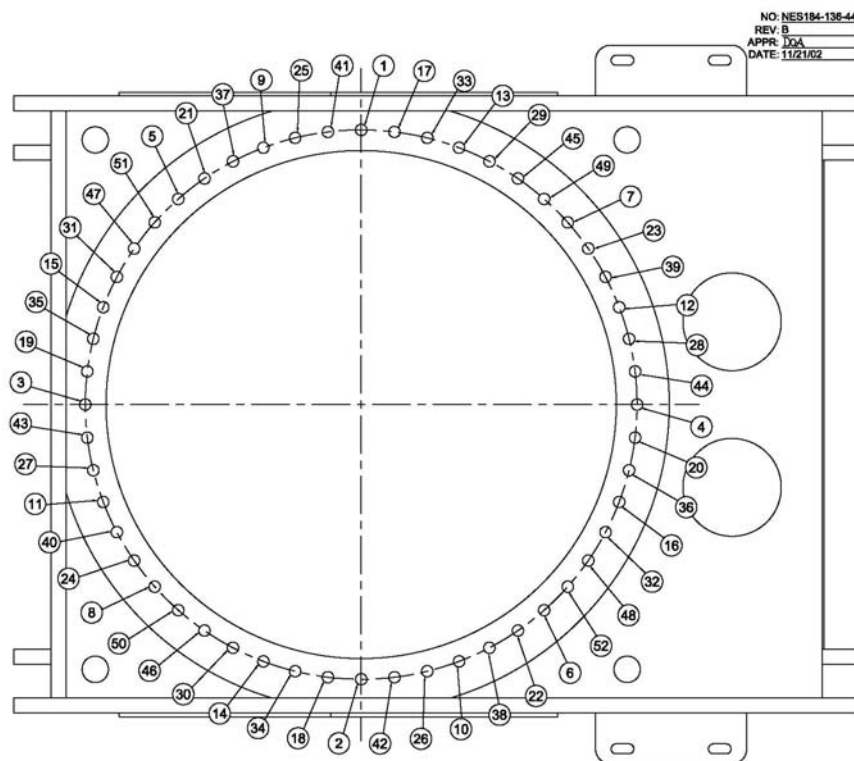
P.O. # 1550-0268/05-01

Serial # 24005C

Volume: 1

## Nautilus Crane Model 340LA-100

### 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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Serial # 24005C

Volume: 1

## Nautilus Crane Model 340LA-100

### Section 2.3 Torque for Plated Fasteners



**WARNING**

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 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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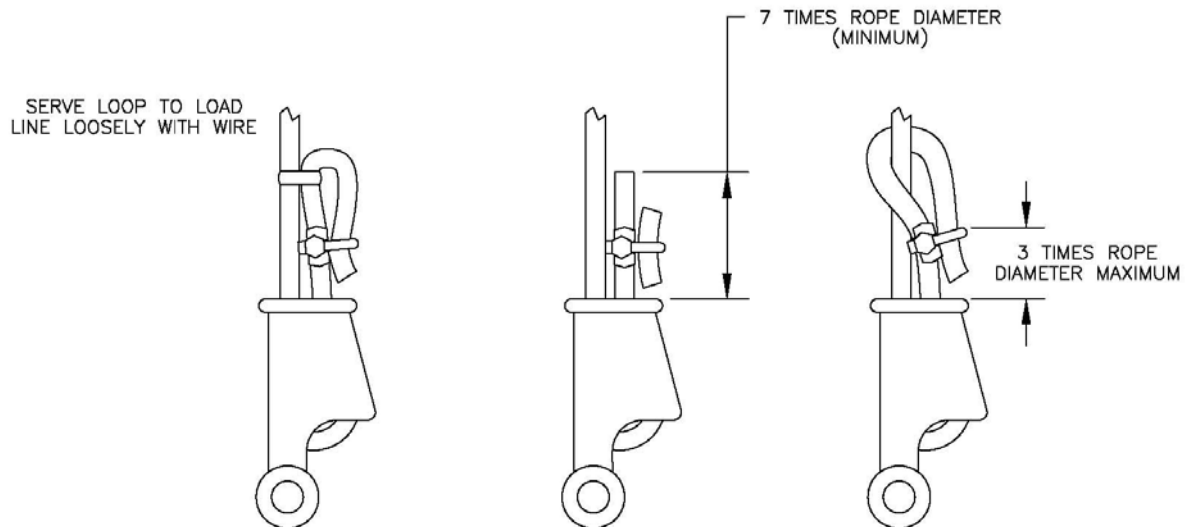
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## Nautilus Crane Model 340LA-100

### 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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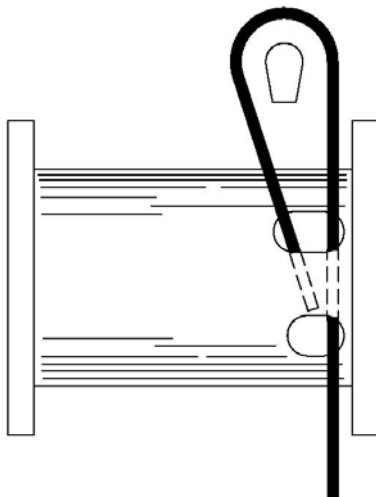
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## Nautilus Crane Model 340LA-100

### Section 2.5 Anchoring Wire Rope

<u>CH330A</u>	Main Hoist – 7/8" Wire Rope
<u>CH150A</u>	Aux Hoist – 3/4" Wire Rope
<u>CH230B</u>	Boom Hoist – 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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## **Nautilus Crane Model 340LA-100**

### **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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### **Nautilus Crane Model 340LA-100**

#### **Section 2.7 Reeving Diagrams**



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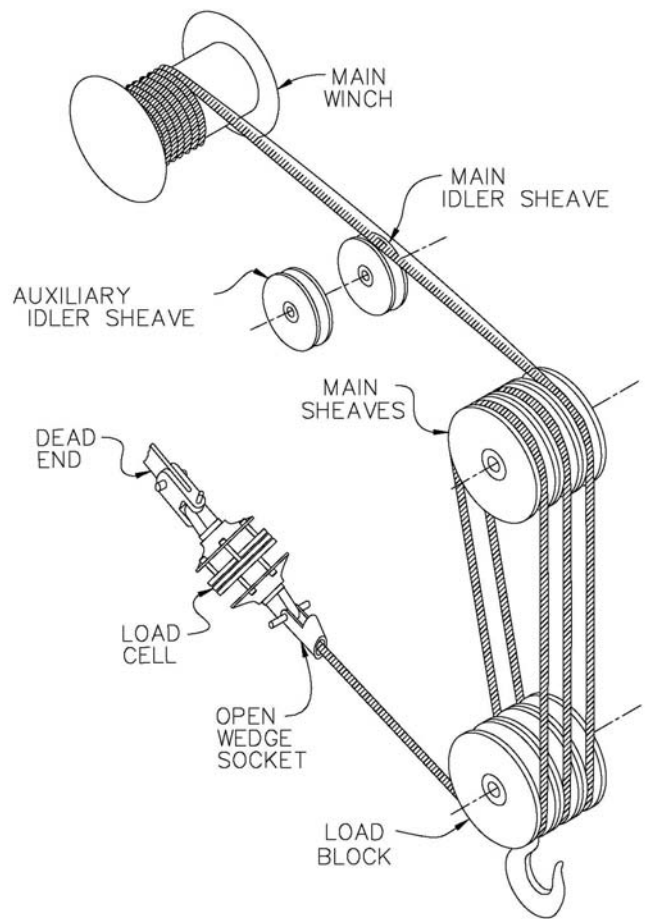
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## Nautilus Crane Model 340LA-100

### Section 2.7.1 6 Part Line Reeving Diagram



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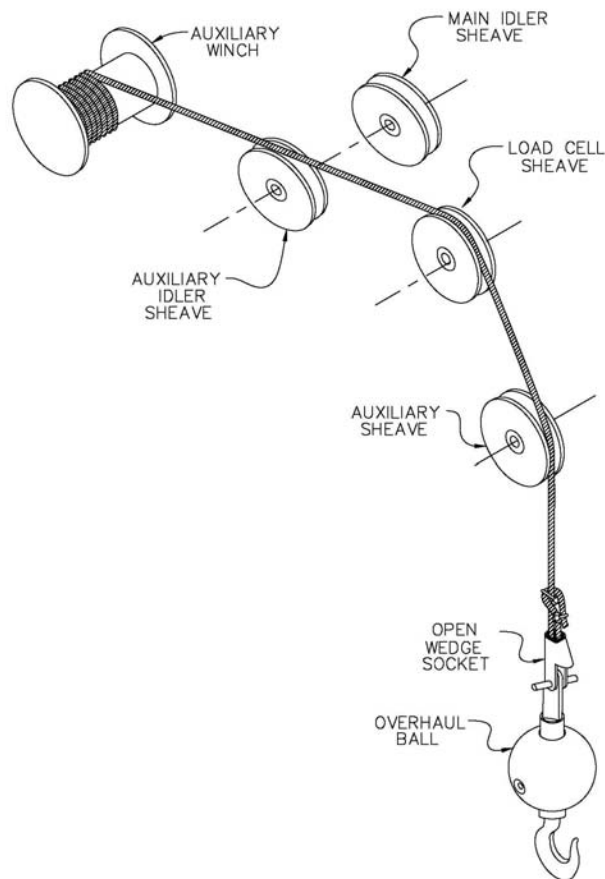
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## Nautilus Crane Model 340LA-100

### Section 2.7.2 1 Part Line Reeving Diagram



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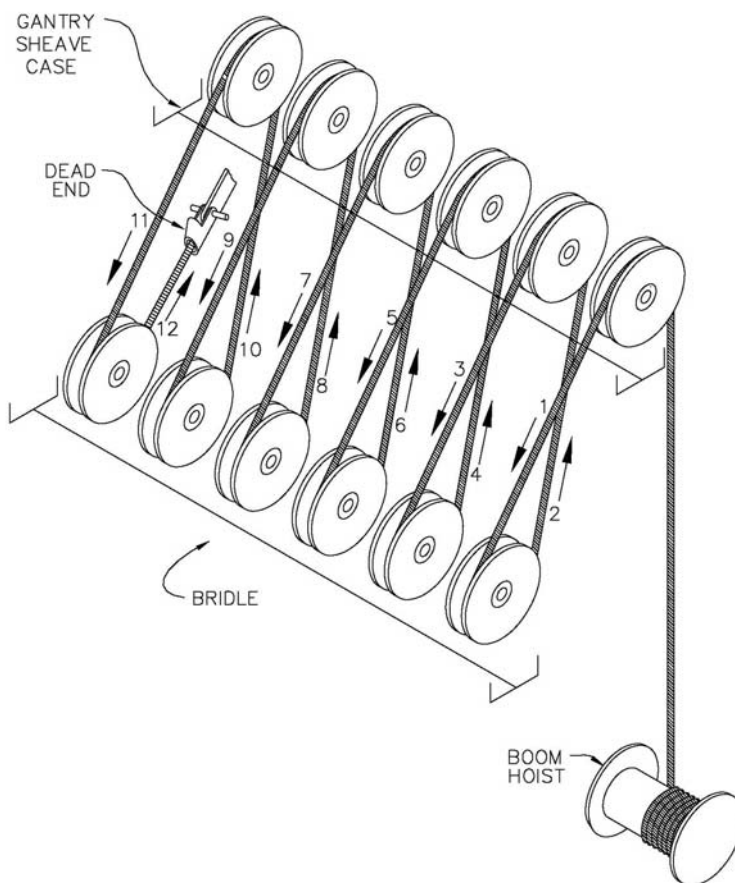
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## Nautilus Crane Model 340LA-100

### Section 2.7.3 12 Part Line Reeving Diagram



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### **Nautilus Crane Model 340LA-100**

#### **Section 2.8 Spacer Kits**



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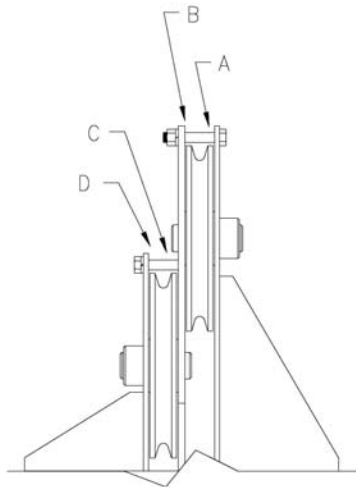
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## Nautilus Crane Model 340LA-100

### Section 2.8.1 Main / Auxiliary Fleet Idler Sheaves



#### 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	1/8"	4-1/2"	2-1/2"	Nyl
B	1/8"	4-1/2"	2-1/2"	Nyl
C	1/8"	4-1/2"	2-1/2"	Nyl
D	1/8"	4-1/2"	2-1/2"	Nyl
E	-	-	-	-
F	-	-	-	-
G	-	-	-	-
H	-	-	-	-



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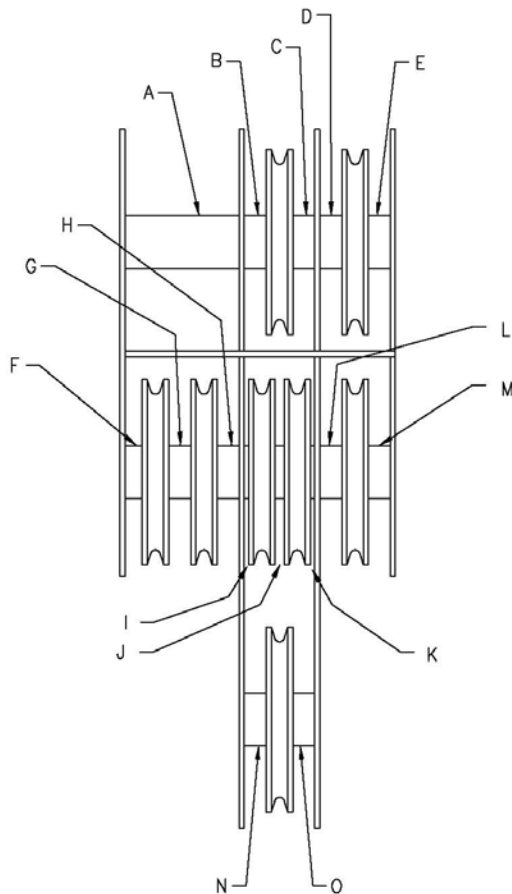
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## Nautilus Crane Model 340LA-100

### Section 2.8.2 Auxiliary Load Cell Sheave



#### Bearing Retainers

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

Spacer	Thickness	O.D.	I.D.	Material
A	-	-	-	-
B	-	-	-	-
C	-	-	-	-
D	-	-	-	-
E	-	-	-	-
F	-	-	-	-
G	-	-	-	-
H	-	-	-	-
I	-	-	-	-
J	-	-	-	-
K	-	-	-	-
L	-	-	-	-
M	-	-	-	-
N	11/16"	5"	3"	NYL
O	3-5/8"	5"	3"	NYL



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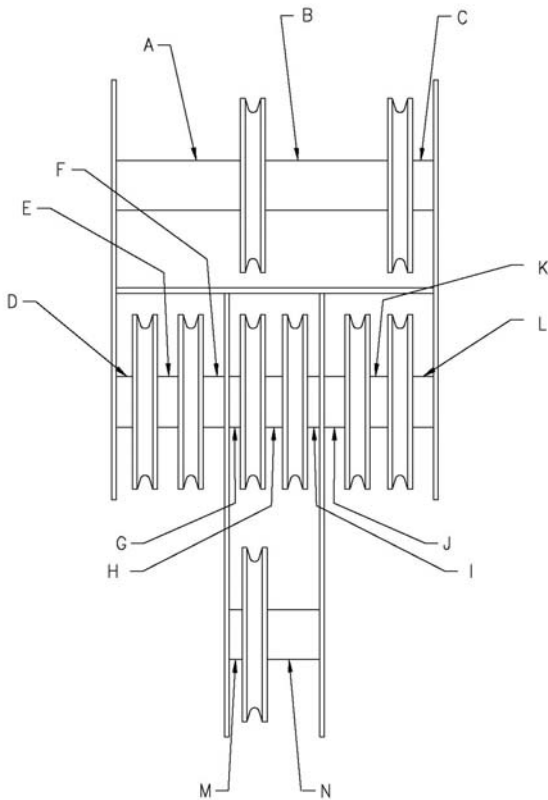
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## Nautilus Crane Model 340LA-100

### Section 2.8.3 Main / Auxiliary Sheaves



#### Bearing Retainers

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

Spacer	Thickness	O.D.	I.D.	Material
A	12-5/8"	5"	3"	NYL
B	5-5/8"	5"	3"	NYL
C	7-9/16"	5"	3"	NYL
D	-	-	-	-
E	3"	5"	3"	NYL
F	1/4"	5"	3"	NYL
G	3-5/16"	5"	3"	NYL
H	1/8"	5"	3"	NYL
I	-	-	-	-
J	1/4"	5"	3"	NYL
K	3-1/8"	5"	3"	NYL
L	-	-	-	-
M	5/8"	5"	3"	NYL
N	3-5/8"	5"	3"	NYL



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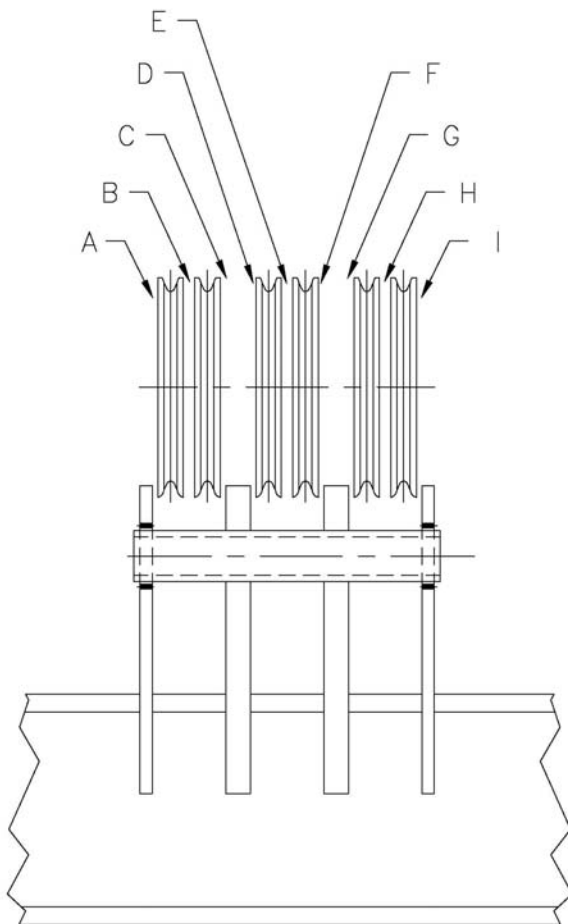
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### Nautilus Crane Model 340LA-100

#### Section 2.8.4 Bridle Sheaves



#### Bearing Retainers

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

Spacer	Thickness	O.D.	I.D.	Material
A	1/4"	5"	3"	NYL
B	1/2"	5"	3"	NYL
C	3/16"	5"	3"	NYL
D	3/16"	5"	3"	NYL
E	1/2"	5"	3"	NYL
F	1/8"	5"	3"	NYL
G	3/8"	5"	3"	NYL
H	3/8"	5"	3"	NYL
I	1/8"	5"	3"	NYL



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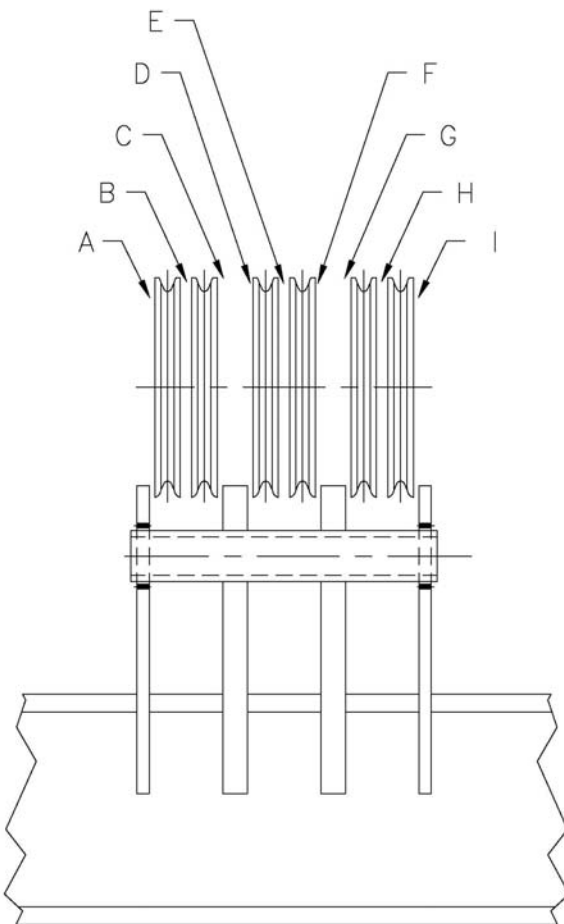
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### Nautilus Crane Model 340LA-100

#### Section 2.8.5 Gantry Sheaves



#### Bearing Retainers

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

Spacer	Thickness	O.D.	I.D.	Material
A	1/8"	5"	3"	NYL
B	1/2"	5"	3"	NYL
C	1/8"	5"	3"	NYL
D	1/4"	5"	3"	NYL
E	1/2"	5"	3"	NYL
F	1/8"	5"	3"	NYL
G	1/4"	5"	3"	NYL
H	1/2"	5"	3"	NYL
I	1/8"	5"	3"	NYL



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## **Nautilus Crane Model 340LA-100**

### **Section 2.9 Miscellaneous**



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## **Nautilus Crane Model 340LA-100**

### **Section 2.9.1 Installation Procedure**



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## LIFTING PROCEDURE FOR LATTICE BOOM CRANES COMPLETELY ASSEMBLED

1. Lifting a lattice boom crane with two cranes, using the proper rigging rig the first crane to the lifting eyes at the top of the gantry.
2. Rig the second crane using the proper rigging to the lifting eyes on the boom. The lifting eyes will be located about  $\frac{3}{4}$  of the length of the boom away from upperstructure. They will be pin up with the upper set of boom connection pins.
3. Once the cranes are rigged to these two places a test lift can be performed. If the upper structure or the ballring is not level side to side during the test lift shackles can be added to the lifting eyes at the top of the gantry. The shackle would be added to the side that is higher this will level the ballring side to side. If the ballring is unlevel front to back the crane holding the boom can be lowered or raised this will level the ballring front to back. It may take more than one test lift to get the crane lifting properly.
4. Once the crane is level it can then be lifted and installed to the pedestal.











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## **Nautilus Crane Model 340LA-100**

### **Section 2.9.2 SAT Commissioning Procedure**



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# COMMISSIONING PROCEDURES

## NAUTILUS MARINE CRANES

Jan 18, 2006

Serial No.'s 24005 & 24105

### **Preload testing inspection:**

A basic guideline for Pre-Commissioning Inspection should consider, but not be limited to, the following:

1. Check all fluid levels of prime mover.
2. Check control mechanisms including brakes and clutches for proper operation.
3. Visually check for hoist lubricant oil leakage. In hoists where a sight glass is provided, also check the fluid level.
4. Visually check for leakage or damage in the air and non mechanical systems.
5. Check the following devices where applicable:
  - a. Boom Hoist Pawl.
  - b. Helicopter Warning Light.
  - c. Crane Hook Latch.
6. Perform a walk-around visual examination of the crane boom and support structure to ensure that no damage exists.
7. Ensure the correct load rating chart for the configuration in use is visible to the crane operator at the primary control station.
8. Visually check wire rope for evident deterioration and damage, or improper reeving.
9. Visually check for loose, missing, or corroded bolts, pins, keepers or cotter pins.
10. Visually check loose gear to be used, such as slings, sling hooks and shackles.
11. Further check all control mechanisms for proper adjustment, excessive wear of components, and contamination by foreign matter.
12. Check electrical apparatus for proper function.
13. Check boom hoist limit and anti-two block devices for proper operation. Care should be exercised to prevent damage to crane components.
14. Boom should be inspected for bent chord members, missing or broken lacing and cracked welds on critical members. Boom section end connections should be inspected for cracked welds, deformation and corrosion.
15. Check boom angle/radius indicators over full range for accuracy.
16. Sheaves should be inspected for wear, cracks, rope path alignment and bearing condition.
17. Check power plants for proper performance compliance with safety requirements.
18. Check belts and chains for proper adjustment.
19. Visually check crane hooks for deformation, and discard if deformations exceed those manufacturers' recommendations.
20. Inspect wire rope as per indicates in API –2D, Section 5.1.2.
21. Check lubricant level in all hoists and slew drives, including those not fitted with sight glasses.

Lubricate components and correct deficiencies as required based on the results of these inspections. Oil sample analysis, as suggested by the hoist manufacturer, is intended primarily to



evaluate its mechanical integrity. Oil sample analysis need not necessarily mean a laboratory analysis. It can be effectively achieved by qualitative tests performed in the field by a Qualified Inspector or Operator (such as cheese cloth, smell and texture tests).

**Inspection of critical crane components:**

The Pre- Commissioning Inspection of critical components appropriate for an individual machine will differ, depending on the crane type and design of the individual components. A basic guideline for inspection of critical crane components should consider but not be limited to the following:

22. Hoist Assemblies- Inspection and maintenance of the hoist should be determined by the Owner as a function of the hoist type, past and anticipated duty cycle, and condition. The quality of the hoist lubricant is considered a primary indicator of the mechanical integrity of the hoist. Brakes should be tested by stalling the drive.
23. Foundation-Weldments in the crane's pedestal and supporting deck structure should be visually examined for fracture, deformation and corrosion. Special attention should be paid to areas of rust and spilled paint.
24. Swing Circle Assembly-The swing circle assembly is the connecting component between the crane revolving upper structure and the pedestal. Consequently, regular inspections are paramount to insure a long and safe operational life.

- Ball/Roller Bearings

The inspection procedure for each varies significantly and must be tailored, not only to fit the type of swing circle assembly, but also for the physical and operational environment of each particular crane and platform.

Regardless of the type of swing circle assembly, the objective of any inspection is to determine and monitor wear, fatigue, corrosion, and the overall operational condition. Inspect balling for grease regularly.



**Load Test:**

1. Crane shall be operated during test in accordance with API RP 2D, latest edition.
2. Crane shall be thoroughly inspected per API RP 2D paragraph 3.1.2 “Annual Inspection” before and after the test. Attention should be given to rigging used to attach loads. Tag lines should be used on test loads.
3. Test weights or dynamometer should be verified for accuracy by Qualified Inspector.
4. All lifts should be planned in advance taking into account the crane’s physical location, the available space for staging and assembling the test loads and the hazardous areas to be avoided.
5. Crane load indicators shall not be used to test cranes, but the readings should be recorded on each lift where load indicators are installed on the crane.
6. Relief valves on hydraulic cranes should not be adjusted above manufacturer’s recommended pressures and current limiting devices on electric cranes should not be bypassed or adjusted to increase available hoist line pull. The test can be conducted with the highest load the hoist can lift as long as it is in excess of the static rated load.
7. The test load for all lifts shall be based on crane rating chart, wire rope strength, available hoist line pull and number of parts of line. The static test load and the test radius should be calculated to load the crane as follows:

<b>Static Rated Load in Pounds at a Specific Radius</b>	<b><u>Test Loads in Excess of Static Rated Load at a Specific Radius</u></b>
Up to 40,000	25%
40,000 to 100,000	10,000 pounds
over 100,000	10%

8. All cranes should be tested as they are normally rigged. Cranes should not be rigged with extra parts of line or have their hydraulic pressures, electric currents, or engine output increased unless the test radius is restricted by physical location. The correct test load should not necessarily be based on the highest load shown on the rating chart.
9. In the case of cranes that do not conform to API spec. 2C, Third or later Edition, the crane manufacturer should be consulted, as required, to determine test loads based on the crane’s normal rigging arrangement.
10. Select appropriate load for component(s) being tested.
11. The test load should be applied by one of the following methods:
  - A. **Suspended Weight Method** – Select a suitable test load per note 7 of this section. Assemble the load, lift the load and boom out to the desired radius. With the load suspended, set the load hoist and boom hoist brakes and check for drum rotation. (The load test does not require that the test load be boomed or swung).
  - B. **Dynamometer Method** – Determine the available dynamometer tie-down locations. Measure and record the radius value. Align the boom point with the tie-down and attach the dynamometer. Verify that the load hoist line is vertical, then, pull with the load hoist until the desired test load is indicated on the dynamometer. Set the load hoist brake and check for drum rotation.







**Postload testing inspection:**

A basic guideline for Pre-Commissioning Inspection should consider, but not be limited to, the following:

1. Check all fluid levels of prime mover.
2. Check control mechanisms including brakes and clutches for proper operation.
3. Visually check for hoist lubricant oil leakage. In hoists where a sight glass is provided, also check the fluid level.
4. Visually check for leakage or damage in the air and non mechanical systems.
5. Check the following devices where applicable:
  - d. Boom Hoist Pawl.
  - e. Helicopter Warning Light.
  - f. Crane Hook Latch.
6. Perform a walk-around visual examination of the crane boom and support structure to ensure that no damage exists.
7. Ensure the correct load rating chart for the configuration in use is visible to the crane operator at the primary control station.
8. Visually check wire rope for evident deterioration and damage, or improper reeving.
9. Visually check for loose, missing, or corroded bolts, pins, keepers or cotter pins.
10. Visually check loose gear to be used, such as slings, sling hooks and shackles.
11. Further check all control mechanisms for proper adjustment, excessive wear of components, and contamination by foreign matter.
12. Check electrical apparatus for proper function.
13. Check boom hoist limit and anti-two block devices for proper operation. Care should be exercised to prevent damage to crane components.
14. Boom should be inspected for bent chord members, missing or broken lacing and cracked welds on critical members. Boom section end connections should be inspected for cracked welds, deformation and corrosion.
15. Check boom angle/radius indicators over full range for accuracy.
16. Sheaves should be inspected for wear, cracks, rope path alignment and bearing condition.
17. Check power plants for proper performance compliance with safety requirements.
18. Check belts and chains for proper adjustment.
19. Visually check crane hooks for deformation, and discard if deformations exceed those manufacturers' recommendations.
20. Inspect wire rope as per indicates in API –2D, Section 5.1.2.
21. Check lubricant level in all hoists and slew drives, including those not fitted with sight glasses.

Lubricate components and correct deficiencies as required based on the results of these inspections. Oil sample analysis, as suggested by the hoist manufacturer, is intended primarily to evaluate its mechanical integrity. Oil sample analysis need not necessarily mean a laboratory analysis. It can be effectively achieved by qualitative tests performed in the field by a Qualified Inspector or Operator (such as cheese cloth, smell and texture tests).

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The Pre- Commissioning Inspection of critical components appropriate for an individual machine will differ, depending on the crane type and design of the individual components. A



basic guideline for inspection of critical crane components should consider but not be limited to the following:

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23. Foundation-Weldments in the crane's pedestal and supporting deck structure should be visually examined for fracture, deformation and corrosion. Special attention should be paid to areas of rust and spilled paint.
24. Swing Circle Assembly-The swing circle assembly is the connecting component between the crane revolving upper structure and the pedestal. Consequently, regular inspections are paramount to insure a long and safe operational life.

- Ball/Roller Bearings

The inspection procedure for each varies significantly and must be tailored, not only to fit the type of swing circle assembly, but also for the physical and operational environment of each particular crane and platform.

Regardless of the type of swing circle assembly, the objective of any inspection is to determine and monitor wear, fatigue, corrosion, and the overall operational condition. Inspect balling for grease regularly.



# PROCEDURE TO CHECK BALLRING WEAR ON NON-COUNTER WEIGHTED CRANES

1. Check ballring mounting bolt torque. Replace any bolts if loose.
2. Visually check ballring and pedestal for cracks. If cracks are observed, crane is to be repaired prior to further use.
3. Grease ballring every 15 degrees. Pull upper and lower seal for samples of grease every 15 degrees. Place samples in clean containers.
4. Position dial caliper with magnetic base on inside wall of pedestal approximately 1-2" below flange on northern side of barrel.
5. Position boom between 45 to 60 degrees from horizontal with the boom centered over the first measuring point.

**NOTE:** *The boom angle selected shall provide adequate weight to insure an over center tilt of the crane upper works. This angle should be logged down for future readings to be taken.*

**Boom Angle:** \_\_\_\_\_

6. Zero dial caliper at five revolutions of caliper dial against the bottom of the inside race of the ballring. *(This area shall be a machined surface, clean of paint and rust. This area should be re-coated to prevent future corrosion upon completion of readings.)*
7. Rotate the crane clockwise 45 degrees and stop the boom in north-east direction. Record caliper reading to the thousands of an inch.
8. Proceed to rotate the boom in 45 degree increments and record values on chart shown below. For second column, crane should be rotated 90 degrees and repeat steps 4 through 8.

DIAL CALIPER READING				
DEGREES	BOOM POSITION	Boom Rest	Water Side	Reason for no deflection reading
0	North	_____	_____	_____
45	Northeast	_____	_____	_____
90	East	_____	_____	_____
135	Southeast	_____	_____	_____
180	South	_____	_____	_____
225	Southwest	_____	_____	_____
270	West	_____	_____	_____
315	Northwest	_____	_____	_____
360	North	_____	_____	_____

9. If dial caliper does not return +/- .002 inches of zero on final reading, repeat the procedure for one additional set of readings.
10. Bearing Manufacturer: \_\_\_\_\_ S/N: \_\_\_\_\_
11. Crane Model: \_\_\_\_\_ S/N: \_\_\_\_\_
12. Customer: \_\_\_\_\_ Location: \_\_\_\_\_







## CRANE LOAD TEST CERTIFICATE

**Company** \_\_\_\_\_ **Crane Location** \_\_\_\_\_

Crane Manufacturer \_\_\_\_\_ Crane Model \_\_\_\_\_

Crane Serial Number \_\_\_\_\_ Crane Boom Length \_\_\_\_\_

Load Winch Model \_\_\_\_\_ Aux. Winch Model \_\_\_\_\_

**Boom Winch Model** \_\_\_\_\_

Wire Rope Size, Construction and Length:

**Load Winch Wire Rope** \_\_\_\_\_

**Aux. Winch Wire Rope** \_\_\_\_\_

**Boom Winch Wire Rope** \_\_\_\_\_

Dynamometer:

Serial Number: \_\_\_\_\_ Calibration Due Date: \_\_\_\_\_

Load Winch:

Load-tested to \_\_\_\_\_ lbs. At \_\_\_\_\_ boom angle

At \_\_\_\_\_ ft. radius, at \_\_\_\_\_ PSI.

Aux. Winch:

Load-tested to \_\_\_\_\_ lbs. At \_\_\_\_\_ boom angle

At \_\_\_\_\_ ft. radius, at \_\_\_\_\_ PSI.

The above referenced pedestal-mounted offshore crane has been load-tested in accordance with API 2C and API RP 2D, current edition.

\_\_\_\_\_  
Company Representative \_\_\_\_\_ Date \_\_\_\_\_ AHSI WO No. \_\_\_\_\_

\_\_\_\_\_  
Applied Hydraulic Systems, Inc. Representative \_\_\_\_\_ Date \_\_\_\_\_







# CRANE INSPECTION FORM

W/O NO.: \_\_\_\_\_

CUSTOMER: \_\_\_\_\_

CRANE LOCATION: \_\_\_\_\_

CRANE MAKE/MODEL: \_\_\_\_\_

CRANE SERIAL NUMBER: \_\_\_\_\_

GENERAL CONDITION: \_\_\_\_\_ (1=Out of Service 2=Poor 3=Moderate 4=Good 5=Excellent)

TYPE OF INSPECTION: \_\_\_\_\_

1.            **PREVIOUS CRANE INSPECTION RECORDS**  
☐ OK    ☐ Records Not Available

2.            **PEDESTAL SPROCKET**  
☐ OK    ☐ Teeth Worn

3.            **SWING PINION or DRIVE SPROCKET**  
☐ OK    ☐ Little or No Grease    ☐ Teeth Worn

4.            **SWING CHAIN**  
☐ OK    ☐ Little or No Lube    ☐ Corroded

5.            **PEDESTAL CONDITION**    ☐ OK    ☐ Corroded

6.            **FRONT ROLLER ASSEMBLY-WEAR BAND**  
☐ OK    ☐ Little or No Grease

7.            **RADIAL/THRUST-BEARING/BUSHING**  
☐ OK    ☐ Little or No Grease  
☐ Worn

8.            **PEDESTAL TO BALLRING MOUNTING BOLTS**  
☐ OK    ☐ Need Replacement  
Torque Value                                   
Size & Length                                 

9.            **TURRET TO BALLRING MOUNTING BOLTS**  
☐ OK    ☐ Need Replacement  
Torque Value                                   
Size & Length                                 

10.            **BALLRING GREASE SAMPLE**  
☐ OK    ☐ Little or No Grease    ☐ Contaminated  
(No. 2 Extreme Pressure Grease)

11.            **BALLRING CLEARANCE**  
☐ OK    ☐ Exces. Wear    ☐ See Ballring Report

12.            **GANTRY**  
☐ OK    ☐ Corroded    ☐ Bearing/Bushing Worn  
☐ Worn Sheave Grooves  
Sheave Pin    ☐ OK    ☐ Worn    ☐ No Grease

13.            **BOOM STOPS**  
☐ OK    ☐ Needs Repair

14.            **BRIDAL ASSEMBLY**  
☐ OK    ☐ Bearings/Bushings Worn  
☐ Corroded    ☐ Worn Sheave Grooves  
Sheave Pin    ☐ OK    ☐ Worn    ☐ No Grease

15.            **LADDER AND LADDER CAKE**  
☐ OK    ☐ Damaged

16.            **BOOM FOOT PINS**  
☐ OK    ☐ Little or No Grease  
☐ Pin Worn    ☐ Loose in Turntable

17.            **BOOM**  
☐ Lattice    ☐ Box    ☐ Scoper  
☐ Pin Type    ☐ Bolt Type    Total Length                                 

18.            **BOOM BUTT SECTION**  
☐ OK    Length                                 ,  
☐ Bent Main Chords    ☐ Bent Lacings  
☐ Bushings Worn    ☐ Corroded

19.            **BOOM CENTER SECTIONS**  
Section No. 1: Length                                   
☐ OK    ☐ Bent Lacings  
☐ Bent Main Chords    ☐ Corroded  
Section No. 2: Length                                   
☐ OK    ☐ Bent Lacings  
☐ Bent Main Chords    ☐ Corroded  
Section No. 3: Length                                   
☐ OK    ☐ Bent Lacings  
☐ Bent Main Chords    ☐ Corroded

20.            **BOOM TIP SECTION**  
☐ OK    ☐ Corroded  
☐ Bent Main Chords    ☐ Bent Lacings  
☐ Bearing/Bushing Worn    ☐ Sheave Groove Worn  
☐ Cable Guide Roller Missing or Frozen  
Sheave Pin    ☐ OK    ☐ Worn    ☐ No Grease

21.            **BOOM TIP EXTENSION**  
☐ OK    ☐ Main Structure Bent  
☐ Bushing/Bearing Worn    ☐ Sheave Groove Worn  
Sheave pin    ☐ OK    ☐ Worn    ☐ No Grease

22.            **PENDANT CABLES**  
☐ OK    ☐ Needs Lube    ☐ Replacement Needed  
Size    Length    Position  
                                        
                                        
                                      

23.            **BOOM HOIST WIRE ROPE**  
Size-Length                                 /                                  
Construction                                   
☐ OK    ☐ Needs Lube  
☐ Replacement Needed

24.            **AUXILIARY HOIST WIRE ROPE**  
Size-Length                                 /                                  
Construction                                   
☐ OK    ☐ Needs Lube  
☐ Replacement Needed

25.            **MAIN HOIST WIRE ROPE**  
Size-Length                                 /                                  
Construction                                   
☐ OK    ☐ Needs Lube  
☐ Replacement Needed

26. **WEDGE SOCKETS**  
 1) Auxiliary ☐ OK ☐ Wrong Wedge  
 2) Main ☐ OK ☐ Wrong Wedge  
 3) Boom ☐ OK ☐ Wrong Wedge  
☐ Other Comments See Discrepancy Report

27. **HOOK BLOCK**  
 Tons: \_\_\_\_\_ Weight: \_\_\_\_\_  
 Hook Throat Opening: \_\_\_\_\_  
☐ OK ☐ Bushings/Bearings Worn  
☐ Trunion Worn ☐ Corroded  
 Safety Latch: ☐ OK ☐ Needs Repair  
 Dye Test Hook (Annual Only) \_\_\_\_\_

28. **OVERHAUL BALL**  
 Tons: \_\_\_\_\_ Weight: \_\_\_\_\_  
 Hook Throat Opening: \_\_\_\_\_  
☐ OK ☐ Thrust Bearing Worn  
 Safety Latch: ☐ OK ☐ Needs Repair  
 Personnel Type ☐ Yes ☐ No  
 Dye Test Hook (Annual Only) \_\_\_\_\_

29. **HYDRAULIC OIL COOLER**  
☐ OK ☐ Leaking ☐ Mounting Loose

30. **HYDRAULIC RESERVOIR**  
☐ OK ☐ Oil Level Low  
☐ Oil Contaminated \_\_\_\_\_

31. **DEISEL RESERVOIR**  
☐ OK ☐ Low ☐ Contaminated

32. **HYDRAULIC RETURN FILTER**  
☐ OK ☐ Needs Replacing Type \_\_\_\_\_

33. **HYDRAULIC HOSES**  
☐ OK ☐ See Discrepancy Report

34. **SWING CIRCUIT**  
 Control Valve ☐ OK ☐ Leaking ☐ Spool Corroded  
 Relief Valve Setting \_\_\_\_\_  
 RPM @ Max. Power Source RPM \_\_\_\_\_

35. **MAIN HOIST CIRCUIT**  
 Control Valve ☐ OK ☐ Leaking ☐ Spool Corroded  
 Relief Valve Setting \_\_\_\_\_  
 Speed @ Max. Power Source RPM \_\_\_\_\_

36. **BOOM HOIST CIRCUIT**  
 Control Valve ☐ OK ☐ Leaking ☐ Spool Corroded  
 Relief Valve Setting \_\_\_\_\_  
 Speed @ Max. Power Source RPM \_\_\_\_\_

37. **AUXILIARY HOIST CIRCUIT**  
 Control Valve ☐ OK ☐ Leaking ☐ Spool Corroded  
 Relief Valve Setting \_\_\_\_\_  
 Speed @ Max. Power Source RPM \_\_\_\_\_

38. **SWING GEARBOX**  
☐ OK ☐ Oil Low ☐ Mounting Bolts Loose  
☐ Seal Leaking ☐ Lower Bearing Worn  
 Gear Oil Sample: ☐ OK ☐ Contaminated

39. **SWING MOTOR**  
☐ OK ☐ Leaking ☐ Poor Performance

40. **SWING PARK BRAKE**  
☐ OK ☐ Leaking ☐ Slipping

41. **AUXILIARY HOIST** ☐ OK  
 Model: \_\_\_\_\_  
 S/N: \_\_\_\_\_  
 Brake Test: ☐ OK ☐ Slipping ☐ Other  
☐ Leaking Gear Oil ☐ Oil Level Low  
 Winch Motor: ☐ OK ☐ Leaking Oil  
 Gear Oil Sample: ☐ OK ☐ Contaminated

42. **MAIN HOIST** ☐ OK  
 Model: \_\_\_\_\_  
 S/N: \_\_\_\_\_  
 Brake Test: ☐ OK ☐ Slipping ☐ Other  
☐ Leaking Gear Oil ☐ Oil Level Low  
 Winch Motor: ☐ OK ☐ Leaking Oil  
 Gear Oil Sample: ☐ OK ☐ Contaminated

43. **BOOM HOIST** ☐ OK  
 Model: \_\_\_\_\_  
 S/N: \_\_\_\_\_  
 Brake Test: ☐ OK ☐ Slipping ☐ Other  
☐ Leaking Gear Oil ☐ Oil Level Low  
 Winch Motor: ☐ OK ☐ Leaking Oil  
 Gear Oil Sample: ☐ OK ☐ Contaminated

44. **BOOM HOIST RATCHET AND PAWL**  
☐ OK ☐ Leaking ☐ Worn

45. **OPERATOR STATION OR CAB**  
☐ OK ☐ Glass Missing ☐ Badly Corroded

46. **OPERATORS SEAT**  
☐ OK ☐ Worn ☐ Seat Pedestal Corroded

47. **HAND & GUARD RAILS**  
☐ OK ☐ Badly Corroded ☐ Badly Bent  
☐ Parts Missing \_\_\_\_\_

48. **CONTROL LEVERS**  
☐ OK ☐ Too Tight ☐ Too Loose ☐ Frozen

49. **CONTROL CABLES**  
☐ OK ☐ Too Tight ☐ Too Loose ☐ Frozen

50. **CONTROL LINKAGE**  
☐ OK ☐ Too Tight ☐ Too Loose ☐ Frozen

51. **SAFETY SYSTEMS**  
 Anti-Two Blocking System  
☐ Main      ☐ Auxiliary  
☐ OK      ☐ Needs Repairs      ☐ Adjusted  
           Type:      ☐ Override      ☐ Non-Override  
                       ☐ Hanging Weight  
                       ☐ Hanging Valve  
                       ☐ Over Relief  
 Boom Hoist Kick-Out:  
                       ☐ High Angle      ☐ Low Angle  
                       ☐ Override      ☐ Non-Override  
                       ☐ OK      ☐ Needs Repair      ☐ Adjusted  
 Engine Emergency Shut Down  
                       ☐ OK      ☐ Needs Repairs

52. **BOOM CYLINDER(S)**  
 No. 1:      ☐ OK      ☐ Leaking  
           Load Holding Valve \_\_\_\_\_  
           Bushing/Bearing Condition \_\_\_\_\_  
           Upper Pin \_\_\_\_\_  
           Lower Pin \_\_\_\_\_  
           Rod Condition \_\_\_\_\_  
 No. 2:      ☐ OK      ☐ Leaking  
           Load Holding Valve \_\_\_\_\_  
           Bushing/Bearing Condition \_\_\_\_\_  
           Upper Pin \_\_\_\_\_  
           Lower Pin \_\_\_\_\_  
           Rod Condition \_\_\_\_\_

53. **POWER SOURCE**  
☐ Diesel      ☐ Electric      ☐ Air  
☐ On Board      ☐ Remote

54. **DEISEL ENGINE** \_\_\_\_\_  
 Model \_\_\_\_\_  
 Serial No. \_\_\_\_\_  
 Engine Starter Type  
☐ Air      ☐ Electric      ☐ Hydraulic      ☐ Other \_\_\_\_\_

55. **AIR CLEANER**  
☐ OK      ☐ Dirty Element or Oil      ☐ Corroded

56. **ENGINE EXHAUST**  
 Insulated ..... ☐ Yes      ☐ No  
 Protective Guard ..... ☐ Yes      ☐ No  
 Exposed to Incidental Contact ..... ☐ Yes      ☐ No  
 Condition: ☐ OK      ☐ Corroded

57. **ENGINE COOLANT**  
☐ OK      ☐ Low  
 Fan Belts      ☐ OK      ☐ Worn

58. **ENGINE LUBE**  
☐ OK      ☐ Low      ☐ Low Oil Pressure

59. **ENGINE SHUT DOWN**  
☐ OK      ☐ Frozen      ☐ Not Connected

60. **ENGINE MOUNTS**  
☐ OK      ☐ Loose

61. **ENGINE RPM**  
☐ OK      ☐ Pulls Down      ☐ Too High

62. **ENGINE FILTERS**  
 Oil filter \_\_\_\_\_  
 Primary fuel filter \_\_\_\_\_  
 Second fuel filter \_\_\_\_\_

63. **HYDRAULIC PUMP MULTI-DRIVE**  
☐ OK      ☐ Oil Low      ☐ Seal Leaking  
 Gear Oil Sample: ☐ OK      ☐ Contaminated

64. **ELECTRIC MOTOR** \_\_\_\_\_  
 Model # \_\_\_\_\_ S/N \_\_\_\_\_  
 HP Rating \_\_\_\_\_ RPM \_\_\_\_\_

65. **GAUGES**  
☐ OK      \_\_\_\_\_ Oil Pressure      \_\_\_\_\_ Water Temp.  
           \_\_\_\_\_ Amp.      \_\_\_\_\_ Tachometer      \_\_\_\_\_ Hydraulic

66. **STATIC / DYNAMIC LOAD CHART**  
☐ Yes      ☐ No      ☐ Legible      ☐ Not Legible

67. **BOOM ANGLE OR RADIUS INDICATOR**  
☐ OK      ☐ Needs Repair  
☐ Right Hand      ☐ Left Hand

68. **WEIGHT INDICATOR**  
 Make: \_\_\_\_\_ Model: \_\_\_\_\_  
☐ OK      ☐ Needs Repair  
 Dial Reading: 0 - \_\_\_\_\_

69. **BOOM RACK**  
☐ OK      ☐ Poorly Positioned      ☐ Weak or Bent

70. **RIGGING EQUIPMENT**  
☐ OK      ☐ Damaged

**ADDITIONAL ITEMS:**  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**ADDITIONAL REPORTS ATTACHED:**  
☐ (BR) BALLRIGGING REPORT  
☐ (DR ) DISCREPANCY REPORT  
☐ (LT) LOAD TEST CERTIFICATE  
☐ (RI) RIGGING INSPECTION REPORT  
☐ (NA) NOT APPLICABLE

\*CORRODED: 25% Metal Loss in Concentrated Area.









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**Vendor Data Book**  
P.O. # 1550-0268/05-01  
Serial # 24005C  
Volume: 1

## **Nautilus Crane Model 340LA-100**

### **Section 3.0 Operation Manual**



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USA











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## **Nautilus Crane Model 340LA-100**

### **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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### **Nautilus Crane Model 340LA-100**

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. 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).

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.



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### **Nautilus Crane Model 340LA-100**

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.

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, or 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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### **Nautilus Crane Model 340LA-100**

#### **Section 3.1.1 About Load Charts**

##### ONBOARD CONDITIONS

To be considered a 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:



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- 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).

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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### Nautilus Crane Model 340LA-100

#### Section 3.1.2 Maintenance & Inspection Guidelines

The crane must 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 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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## **Nautilus Crane Model 340LA-100**

### **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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## Nautilus Crane Model 340LA-100

### Section 3.3 Operation Caution



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

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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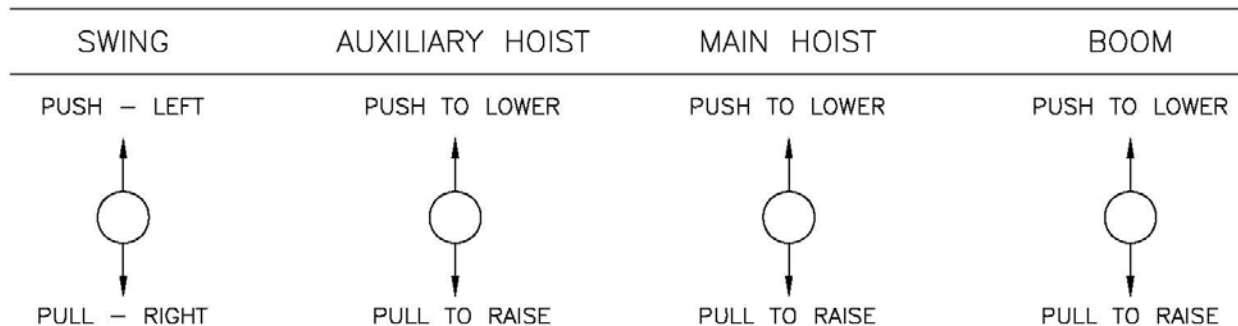
P.O. # 1550-0268/05-01

Serial # 24005C

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## Nautilus Crane Model 340LA-100

### Section 3.4 Crane Operation Lever Controls: Basic Four Lever Crane Control Diagram (Viewed from Operator's Station)



1. Swing Control

Push lever to swing crane to the left. The center (neutral) is to stop. Pull lever to swing crane to the right.

2. Auxiliary Hoist Control

Push lever to lower load. The center (neutral) is to stop. Pull lever to hoist load.

3. Main Hoist Control

Push lever to lower load. The center (neutral) is to stop. Pull lever to hoist load.

4. Boom Hoist Control

Push lever to lower boom. The center (neutral) is to stop. Pull lever to raise boom.



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## **Nautilus Crane Model 340LA-100**

### **Section 3.5 Crane Signals**



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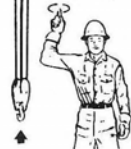



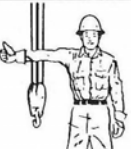
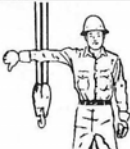
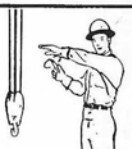
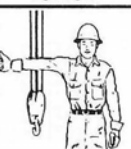
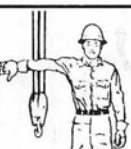

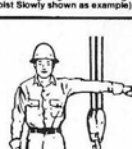

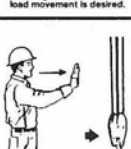
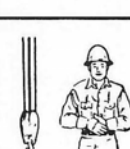
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## Nautilus Crane Model 340LA-100


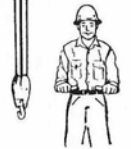


**CRANE SIGNALS**

**Oil States**  
OIL STATES INDUSTRIES, INC.

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

 <b>HOIST</b> With forearm vertical, forefinger pointing up, move hand in small horizontal circle	 <b>LOWER</b> With arm extended downward, forefinger pointing down, move hand in small horizontal circles
 <b>USE MAIN HOIST</b> Tap fist on head; then use regular signals	 <b>USE WHIP LINE</b> (Auxiliary Hoist) Tap elbow with one hand; then use regular signals
 <b>RAISE BOOM</b> Arm extended, fingers closed, thumb pointing upward	 <b>LOWER BOOM</b> Arm extended, fingers closed, thumb pointing downward
 <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)	 <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.
 <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.	 <b>SWING</b> Arm extended, point with finger in direction of swing of boom
 <b>STOP</b> Arm extended, palm down, hold position rigidly.	 <b>EMERGENCY STOP</b> Arm extended, palm down, move hand rapidly right and left.
 <b>TRAVEL</b> Arm extended, hand open and slightly raised, make pushing motion in direction of travel.	 <b>DOG EVERYTHING</b> Clasp hands in front of body.

**CRANE SIGNALS FOR TELESCOPING BOOM**

 <b>EXTEND BOOM</b> Both fists in front of body with thumbs pointing outward.	 <b>RETRACT BOOM</b> Both fists in front of body with thumbs pointing toward each other.
 <b>EXTEND BOOM</b> One Hand Signal. One fist in front of chest with thumb tapping chest.	 <b>RETRACT BOOM</b> One Hand Signal. One fist in front of chest, thumb pointing outward and heel of fist tapping chest.

P.N. 45376 In Accordance with API SPECIFICATION RP2D



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## Nautilus Crane Model 340LA-100

### Section 3.6 Emergency Load Lowering Kit Instructions

DWG. NO. **N95SK5-040** SH. 1 OF 2

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

VIEW "A"-"A"

BRAKE RELEASE HOSE

BRAKE TEST NEEDLE VALVE

BRAKE VALVE

SIDE VIEW

FRONT VIEW

ITEM	QTY.	PART NUMBER	MATERIAL SPEC.	DESCRIPTION	APPROVED BY
1	1	N45215		HAND PUMP	
2	1	N45844-029		3000 PSI DIRECT MOUNT PRESSURE GAUGE WITH 2-1/2" FACE	
3	1	N40044-040		1/4" TEE, MNPT x MNPT x FNPT (2093-4-4S)	
4	1	N40083-040		ADAPTOR, 1/4" MJIC x 1/4" FNPT (2022-4-4S)	
5	1	N76404-120		HOSE ASSEMBLY, 1/4" DIA. X 5 FT. LONG WITH 1/4" FJIC SWIVEL ENDS (2500 PSI)	
6	—	—		—	
7	2	N46650-024		1-1/2" ANCHOR FLANGE, CODE 61	
8	1	N40039-240		90° ELBOW 1-1/2" FNPT x 1-1/2" MNPT (2089-24-24S)	
9	1	N46984-024		STAND PIPE, 1-1/2" DIA. SCH 40 X 12" LONG (THREAD ONE END ONLY)	
10	1	N40169-240		PLUG, 1-1/2" NPT (2082-24S)	
11	1	—		1/4" JIC CAP	
12	1	N40038-240		90° ELBOW, 1-1/2" FNPT x 1-1/2" FNPT (2087-24-24)	
13	1	N40030-240		NIPPLE, 1-1/2" MNPT x 1-1/2" MNPT (2083-24-24S)	
14	1	2027-4-4		UNION, 1/4" JIC FITTING	
15	1	N46649-002		TOOL BOX	

VIEW "B"-"B"

\* IF THE PORT IS FACING DOWN USE ITEM 8, ITEM 13, AND ITEM 12 WITH ITEM 9 AND ITEM 7 -- SEE VIEW "B"-"B"

BY:	APPRO.	DATE:	BY:	APPRO.	DATE:	BY:	APPRO.	DATE:	BY:	APPRO.	DATE:	BY:	APPRO.	DATE:	BY:	APPRO.	DATE:	BY:	APPRO.	DATE:

REVISIONS

DESCRIPTION

OIL STATES INDUSTRIES, INC.  
APPLIED HYDRAULIC SYSTEMS DIVISION

**NAUTILUS**  
Marine Cranes

Sales & Service  
(985) 868-0630  
Fax No. (985) 851-0754

Manufacturing Plant  
1180 Mulberry Rd.  
Houma, LA 70363

**EMERGENCY LOAD  
LOWERING KIT INSTRUCTIONS  
CH SERIES**

DWG. NO. **N95SK5-040**

SCALE: NA CHK'D BY: DWN BY: **ANTHONY**

DATE: 11/24/95 APP'D BY: **ANTHONY** SH. 1 OF 2



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## Nautilus Crane Model 340LA-100

### 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		NAUTILUS Marine Cranes 1180 Mulberry Road Houma, LA 70363 (504) 888-0030 Fax No. (504) 881-0754	
DESCRIPTION		EMERGENCY LOWERING CH HOIST ONLY	
DATE	BY	DATE	BY
APPROVED	APPROVED	DATE	BY
REVISIONS		DWG. NO. N95SK5-040	
This drawing, including all novel and patented features, is the property of Oil States Industries, Inc. and is loaned with the understanding that it will not be reproduced nor be used for any purpose other than that for which it was prepared. Any unauthorized reproduction or use of this drawing by Oil States Industries, Inc. and it will be returned on demand.		SCALE: NA DATE: 11/28/95 APPROVED BY: M DWG. BY: PZZZ SHEET 2 OF 2	

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Verify Current Revision in Master Control  
Before Proceeding With Work

SHEET 2 OF 2

N95SK5-040



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## **Nautilus Crane Model 340LA-100**

### **Section 4.0 Maintenance Manual**



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## **Nautilus Crane Model 340LA-100**

### **Section 4.1 Maintenance Introduction**

Maximum crane performance is maintained by proper upkeep and maintenance

The 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 & Scheduled Maintenance of your engine, generator\*, winch, hydraulic pump, load, and moment indicator system\* are specified in the manufacturer's maintenance operation manuals. See Table of Contents 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-100

### 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-100**

### **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 Bolt	
Sheave Pins (Main / Auxiliary / Boom / Bridle / Gantry)	
Boom Foot Pins	
Ballring / Ballring Bolts	
Wedge Socket Connectors	
Hoist And Wire Ropes (Main / Auxiliary / Boom)	
Boom Pendant Lines	
Hydraulic Hoses	
Pin Keepers And Bolts	
Hydraulic Oil Level	
Electrical Swivel	
Boom Section (Connection Pins)	
Load Block And Safety Latch	
Overhaul Ball And Safety Latch	

#### **Daily Functional Test**

Perform functional tests each day crane is operated

Test Anti-Two Block Function By Raising Load Block	
Test Anti-Two Block Function By Raising Overhaul Ball	
Test Parking Brake Valve	
Test Boom High / Low Angle And Override Valve	
Test Electrical Components	



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## **Nautilus Crane Model 340LA-100**

### **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 environment 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-100

#### 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(MAIN/ AUX/ BOOM)	-----	CHANGE	-----	-----	-----	-----	CHANGE
GEARBOX OIL	-----	CHANGE	-----	-----	-----	CHANGE	-----
*BALLING & REDESTAL BOLTS	-----	-----	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	-----	-----	-----	CHANGE	-----	-----
FUEL FILTERS	CHANGE	-----	-----	-----	CHANGE	-----	-----
EXHAUST SYSTEM	-----	-----	-----	-----	DRAIN	-----	-----
OIL FILTER	-----	-----	-----	CHANGE	-----	-----	-----
FUEL TANK	-----	-----	-----	-----	DRAIN	-----	-----
EMERGENCY ENGINE KILL CABLE	TEST/INSPEC T	-----	-----	-----	-----	-----	-----
ENG. FOOT THROTTLE ACTUATOR	INSPECT	-----	-----	-----	-----	-----	-----
DYNAMIC SWING BRAKE ACTUATOR	INSPECT	-----	-----	-----	-----	-----	-----
AIR FILTER	-----	-----	-----	-----	CHANGE	-----	-----
RADIATOR COOLANT NORMAL USE	-----	-----	-----	-----	-----	-----	CHANGE
HEAVY USE	-----	-----	-----	-----	-----	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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### Nautilus Crane Model 340LA-100

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 & OVERHAULL BALL	LUBRICATE	-----	-----
PARKING BRAKE SPOOLS	LUBRICATE	-----	-----
GEARBOXES	LUBRICATE	-----	-----
HOISTS (MAIN / AUX. / BOOM / SECONDARY)	LUBRICATE	-----	-----
CONTROL VALVE SPOOLS	LUBRICATE	-----	-----
CONTROL LEVER LINKAGE PIN	LUBRICATE	-----	-----
ENG. FOOT THROTTLE ACTUATOR	LUBRICATE	-----	-----
DYNAMIC SWING BRAKE ACTUATOR	LUBRICATE	-----	-----
BOOM STOPS	LUBRICATE	-----	-----
SWING LOCK BEARCLAW	LUBRICATE	-----	LUBRICATE
*BALLRING	-----	LUBRICATE	-----
WIRE ROPES (MAIN / AUX. / BOOM / SECONDARY)	-----	-----	LUBRICATE
PENDANT LINES (BOOM)	-----	-----	LUBRICATE
PINION GEARS	-----	LUBRICATE	-----
<div>  <p><b>*Ballring and Pedestal bolts must be retorqued at the intervals shown to prevent premature bearing wear and / or failure.</b></p> </div>			



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## **Nautilus Crane Model 340LA-100**

### **Section 4.6 Lubrication Diagrams**



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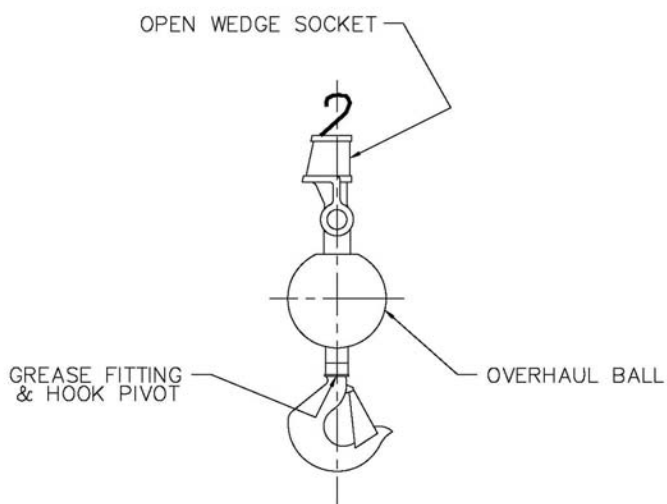
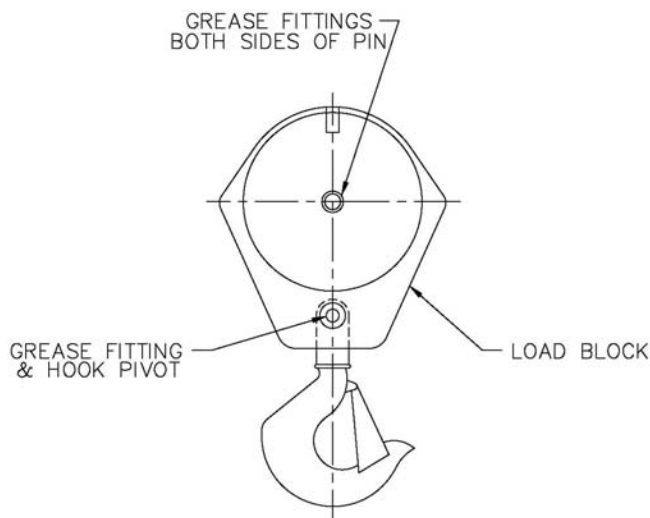
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### Nautilus Crane Model 340LA-100

#### Section 4.6.1 Load Block & Overhaul Ball Lubrication











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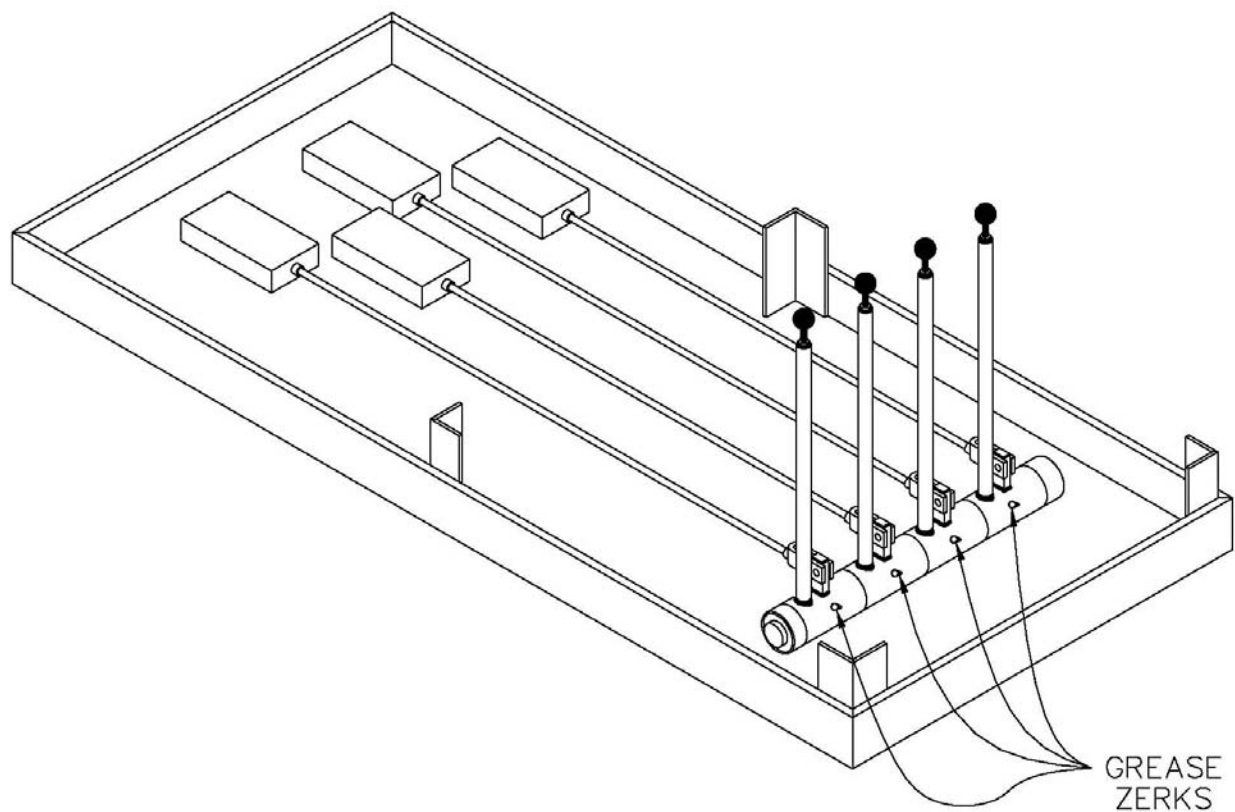
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## Nautilus Crane Model 340LA-100

### Section 4.6.2 Linkage Assembly Lubrication



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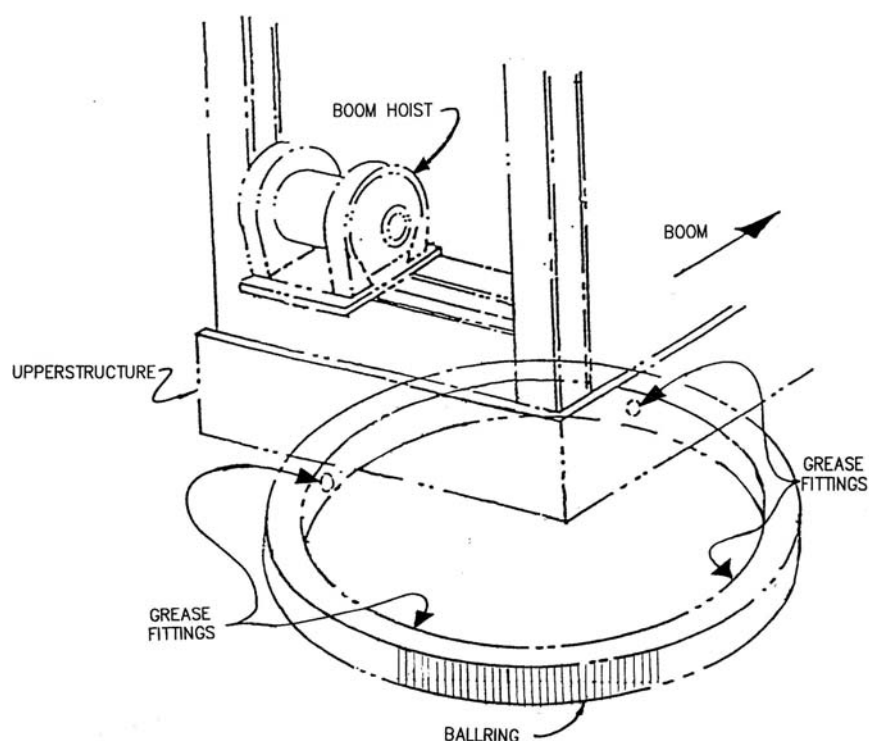
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## Nautilus Crane Model 340LA-100

### Section 4.6.3 Ballring Lubrication



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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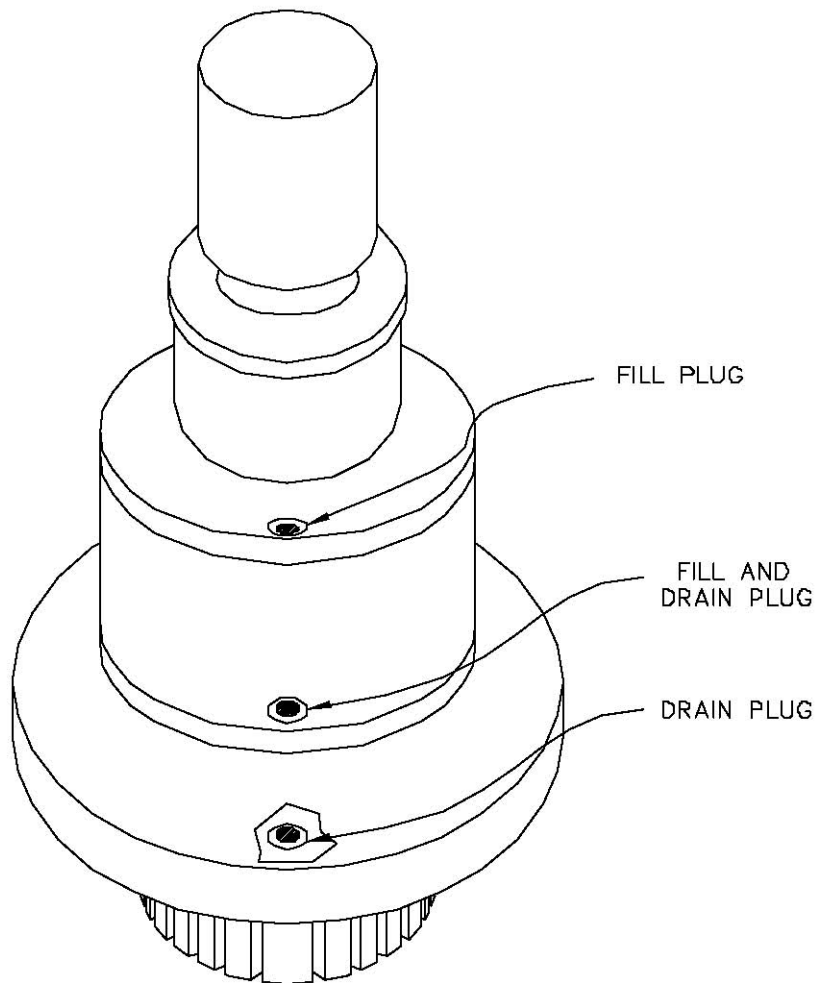
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### Nautilus Crane Model 340LA-100

#### Section 4.6.4 Gearbox Lubrication











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### **Nautilus Crane Model 340LA-100**

#### **Section 4.6.5 Sheave Case Lubrication**



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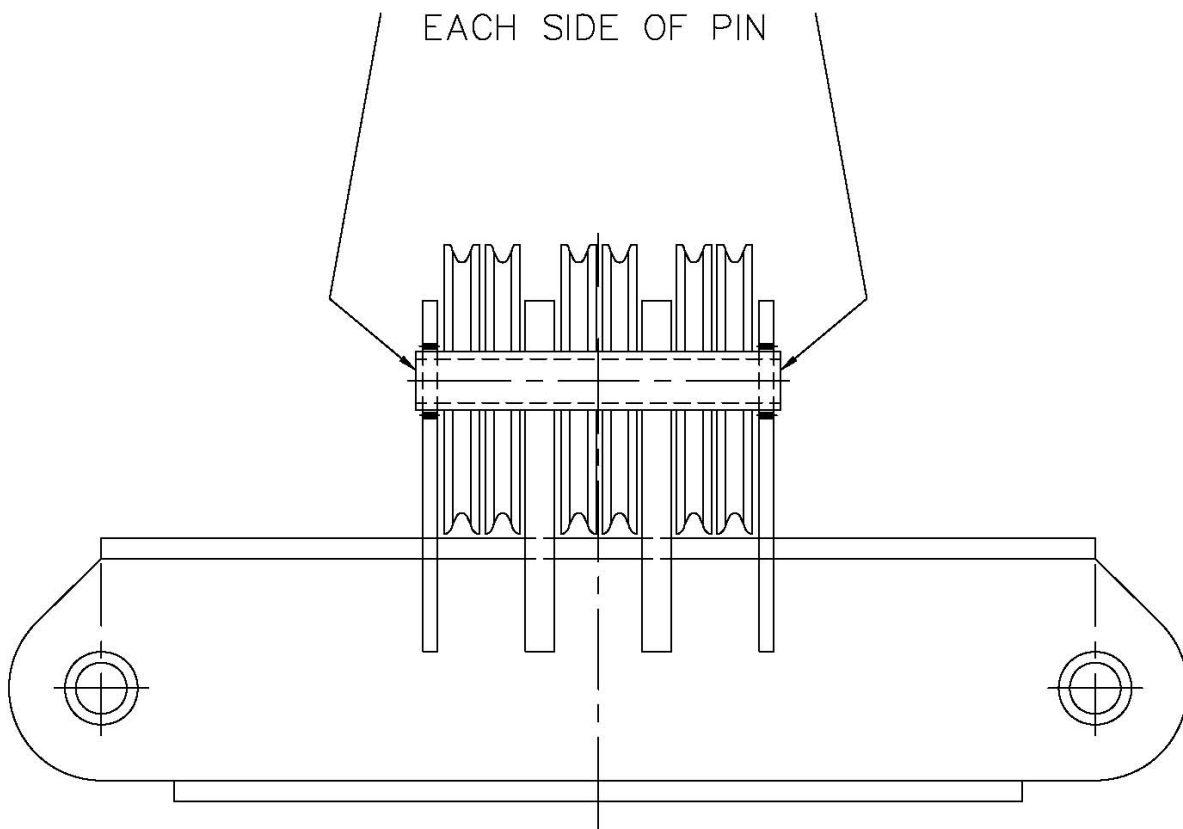
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## Nautilus Crane Model 340LA-100

### Section 4.6.5 (a) Sheave Case Lubrication (Bridle)



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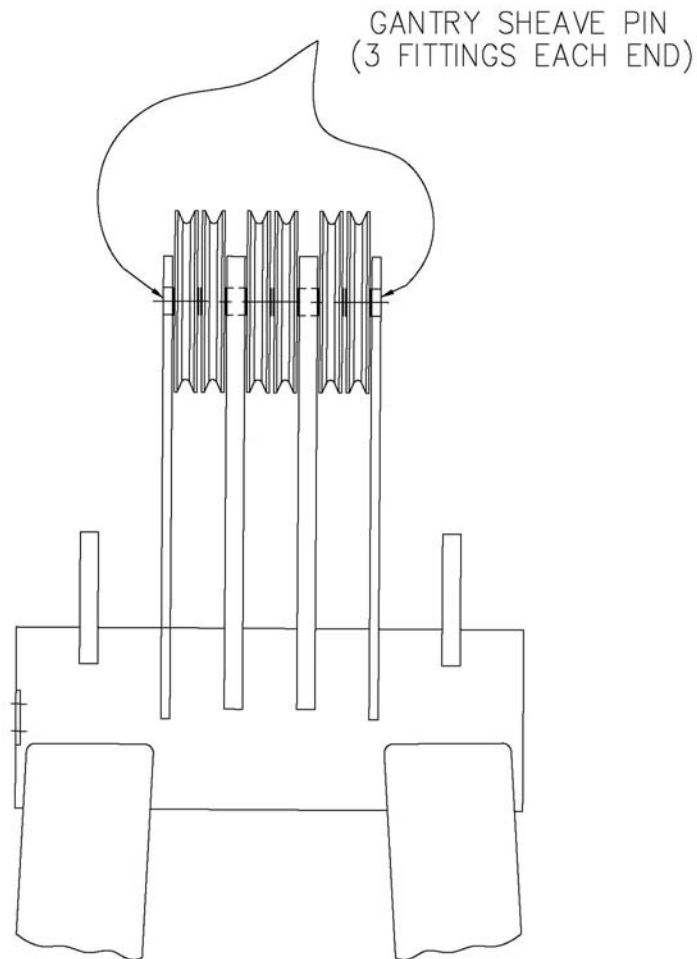
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## Nautilus Crane Model 340LA-100

### Section 4.6.5 (b) Sheave Case Lubrication (Gantry)











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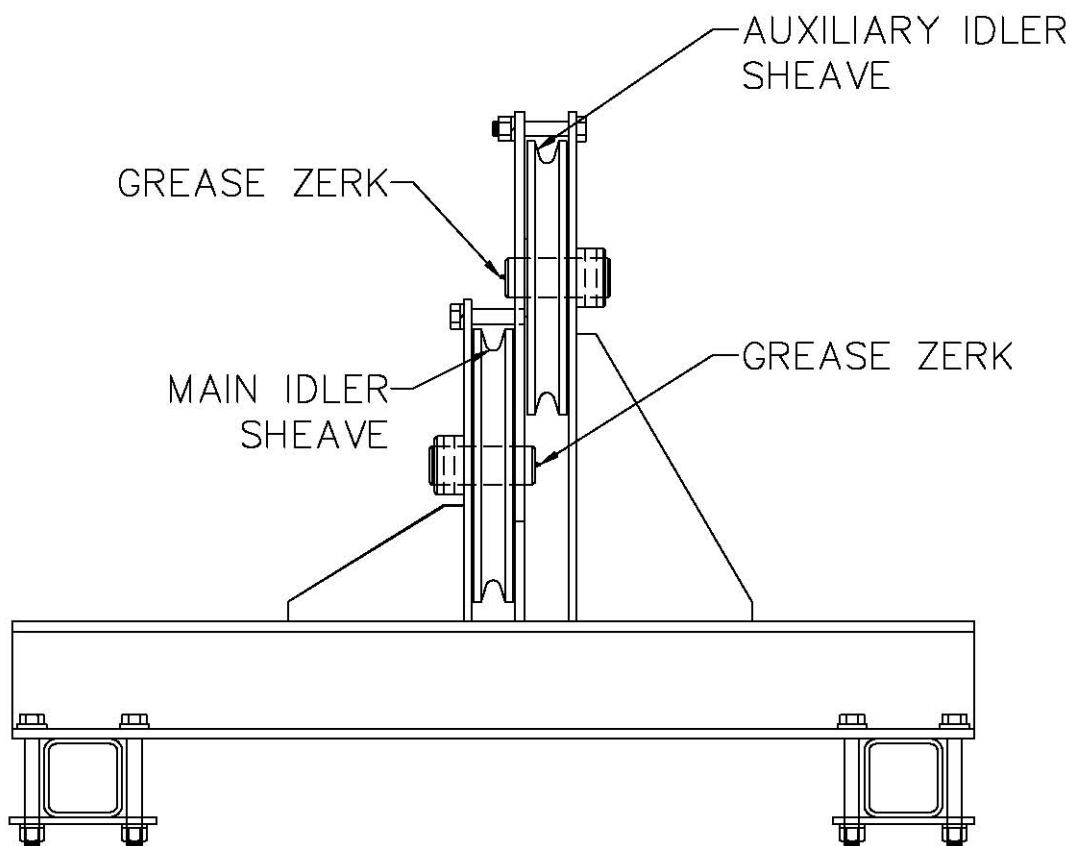
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### Nautilus Crane Model 340LA-100

#### Section 4.6.5 (c) Sheave Case Lubrication (Idler)



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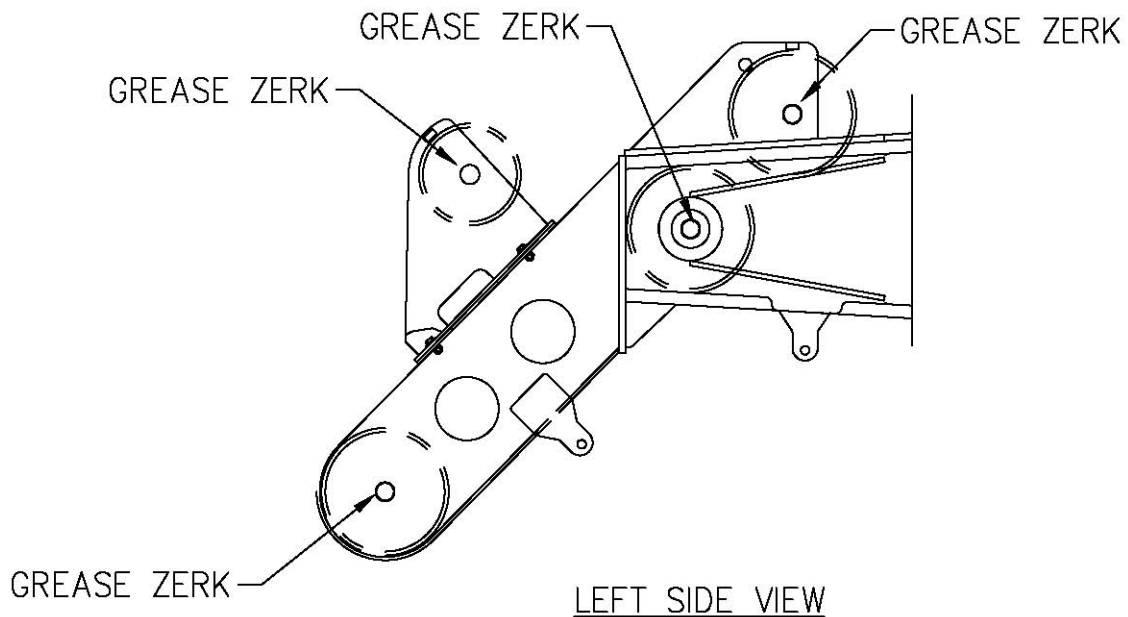
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## Nautilus Crane Model 340LA-100

### Section 4.6.5 (d) Sheave Case Lubrication (Boom Point)



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## **Nautilus Crane Model 340LA-100**

### **Section 4.7 Recommended Fluids and Lubricants**



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## Nautilus Crane Model 340LA-100

### 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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## Nautilus Crane Model 340LA-100

### 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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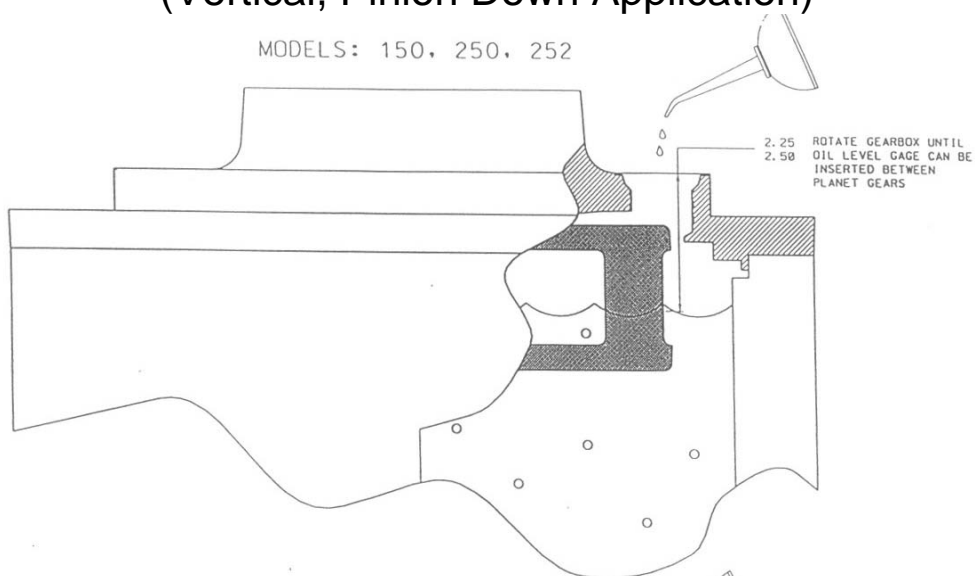
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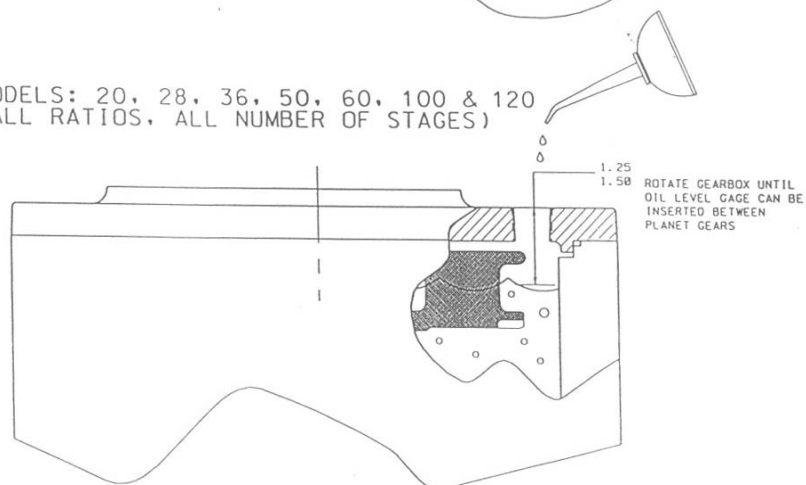
### Nautilus Crane Model 340LA-100

#### 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-100**

#### **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:**

Esguard



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## **Nautilus Crane Model 340LA-100**

### **Section 4.9 Maintenance Malfunction Diagnosis**



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### Nautilus Crane Model 340LA-100

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-100

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
<i>Cylinders drift loosely</i>	Tank breather plugged	Clean breather
	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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## Nautilus Crane Model 340LA-100

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-100**

### **Section 4.10 Hoist Descriptive Literature, Catalogues**



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## **Nautilus Crane Model 340LA-100**

### **Section 4.10.1**

#### **Braden Gearmatic**

**Inspection, Testing, Preventive Maintenance and Special Operating Instructions**



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HOUMA, LA 70363  
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# 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. 2, Bulletin PA125A and Braden Part No. 25672. ←

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

These instructions apply to the following planetary hoists:

PD5/GH5/BG6 (any design series)	CH150A, CH175A, CH185A, CH210A
PD7/BG8 (any design series, Equal Speed only)	CH230A, CH240A, CH330A, CH400A
PD12 (any design series)	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 record of ALL inspections, load tests, maintenance, repairs or modifications must be kept readily available in an appropriate location for a minimum of two years.

### Usage and Inspection:

Inspection procedures for hoists are divided into five general categories based upon their usage or duty cycle, which in turn determines different, 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.

<b>INSPECTION USAGE CATEGORY</b>	<b>PRE-USE DAILY INSPECTION</b>	<b>QUARTERLY INSPECTION</b>	<b>SEMI-ANNUAL INSPECTION</b>	<b>ANNUAL INSPECTION</b>	<b>TEAR-DOWN INSPECTION</b>
<b>IDLED</b> Not used for 3 months	REQUIRED BEFORE PLACED IN SERVICE	REQUIRED BEFORE PLACED IN SERVICE	REQUIRED BEFORE PLACED IN SERVICE	----	REQUIRED IF MAINTENANCE & REPAIR HISTORY UNKNOWN
<b>INFREQUENT USAGE</b> less than ten hours per month	REQUIRED	REQUIRED	REQUIRED	REQUIRED	5 YEARS 3 YEARS IF NOT SUBJECT TO FULL INSPECTION PROGRAM
<b>MODERATE USAGE</b> 10-50 hours per month	REQUIRED	REQUIRED	REQUIRED	REQUIRED	4 YEARS 2 YEARS IF NOT SUBJECT TO FULL INSPECTION PROGRAM
<b>HEAVY USAGE</b> 50-200 hours per month	REQUIRED	REQUIRED	REQUIRED	REQUIRED SEMI-ANNUALLY (6 months)	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	REQUIRED MONTHLY	REQUIRED QUARTERLY (3 months)	REQUIRED SEMI-ANNUALLY (6 months)	1 YEAR

### **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 inspector.

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 inspector.

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:**

Must include but not limited to the following inspections that must be performed by a qualified crane inspector.

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:

If a hoist has reached the recommended service interval or has an unknown history of usage, maintenance or repair, it is recommended that the hoist undergo a tear-down inspection prior to being placed into service. A tear-down inspection should include complete disassembly of the hoist, thorough cleaning and inspection of all parts. All worn, cracked, pitted, corroded or distorted parts must be replaced. Refer to the applicable Braden or Gearmatic service manual for more details. All seals and o-rings should be replaced during a tear-down inspection.

All ring gears and reduction gears must be inspected using Magnetic Particle Inspection (MPI). Fluorescent Wet Magnetic Particle is the preferred method, using black (ultraviolet) light consistent with ASTM E 709, Standard Guide for Magnetic Particle Examination.

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

All component deficiencies must be corrected before the hoist is returned to service.

All of the following operations must be performed **BEFORE** the hoist is placed in service.

1. The rebuilt hoist must be pull tested to the specific rated load capacity. The hoist rated load capacity will vary based upon gear ratio, motor, and drum options. The test load should be the maximum rating for the specific application at normal relief valve setting, not the reduced rating for personnel handling (where applicable).
2. The hoist must be dynamically tested by rotating the drum several times in both hoisting and lowering directions, while under load of at least 30% of the rated lifting capacity. Check for smooth operation and positive brake application. A test tower is preferred over a cylinder test stand as the motor-brake valve-static brake interaction can be better evaluated.
3. The static brake should be tested as described in the Brake Test Procedure on page 6 on this bulletin.

After successful repair and testing, a new certificate of personnel handling (where applicable) and load testing should be issued by the service technician effective on the date the hoist was tested. A sample certificate and identification tag is shown below.

Name of Service Company \_\_\_\_\_

Approved by Braden for handling personnel if operated and maintained in accordance with Braden Recommendation for Personnel Handling Hoists

Hoist Model: \_\_\_\_\_

Hoist Serial Number: \_\_\_\_\_

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

Work Order/Job Number: \_\_\_\_\_

Technician Name: \_\_\_\_\_

Date Placed in Service: \_\_\_\_\_

For product information contact PACCAR Winch Division,  
PO Box 547, Broken Arrow, OK, 74013 USA, [www.paccarwinch.com](http://www.paccarwinch.com),  
Telephone: 1-918-251-8511, Fax: 1-918-259-1575



## 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".

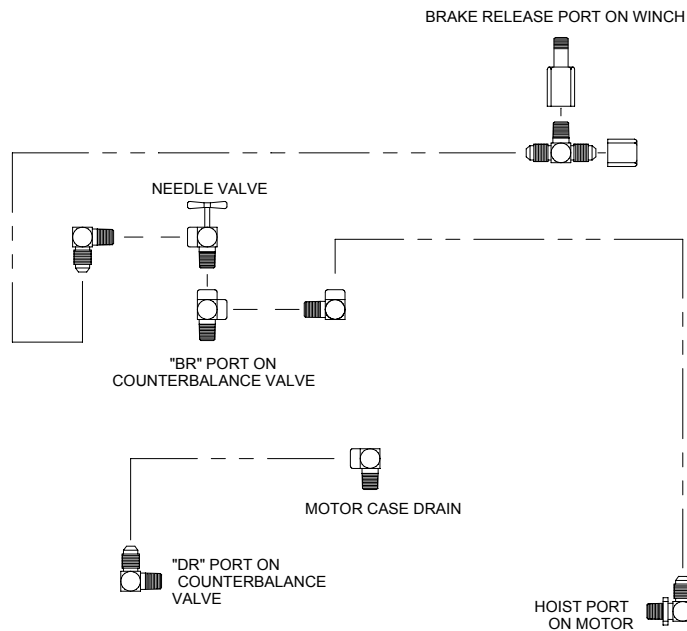
**NOTE: Oil analysis cannot detect nor warn against a fatigue failure.**



## 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.



Relative location of needle valve to other components and fittings on the winch, motor and counterbalance 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.

## 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 and attach a standpipe to the lowering motor port (opposite side of the motor from 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 (10,350 kPa) 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 lifting and supporting shall be made under controlled conditions and under the direction of an appointed qualified signal person.
- The operator and signal person shall conduct a test lift, without personnel in the personnel platform, to verify adequacy of the crane footing or 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 all brakes set before personnel enters or exits.

\* If there are any questions, concerns, or conflicts 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, 32751 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. 42<sup>nd</sup> Street, New York, New York 10036 USA (212) 642-4900
- API Specification 2C and RP 2D, American Petroleum Institute (API) 1220 L Street, N.W., Washington, DC 20005 USA (202) 682-8375





**Bosnor S. A. DE  
C. V. / Pemex  
PB-KU-H Platform**

**Vendor Data Book**  
P.O. # 1550-0268/05-01  
Serial # 24005C  
Volume: 1

## **Nautilus Crane Model 340LA-100**

### **Section 4.10.2 CH Series Hoist Installation, Maintenance, and Service Manual**



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA











**Bosnor S. A. DE  
C. V. / Pemex**

**PB-KU-H Platform**

**Vendor Data Book**

P.O. # 1550-0268/05-01

Serial # 24005C

Volume: 1

## **Nautilus Crane Model 340LA-100**

### **Section 4.10.2 (a) Main Hoist CH330A**



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA







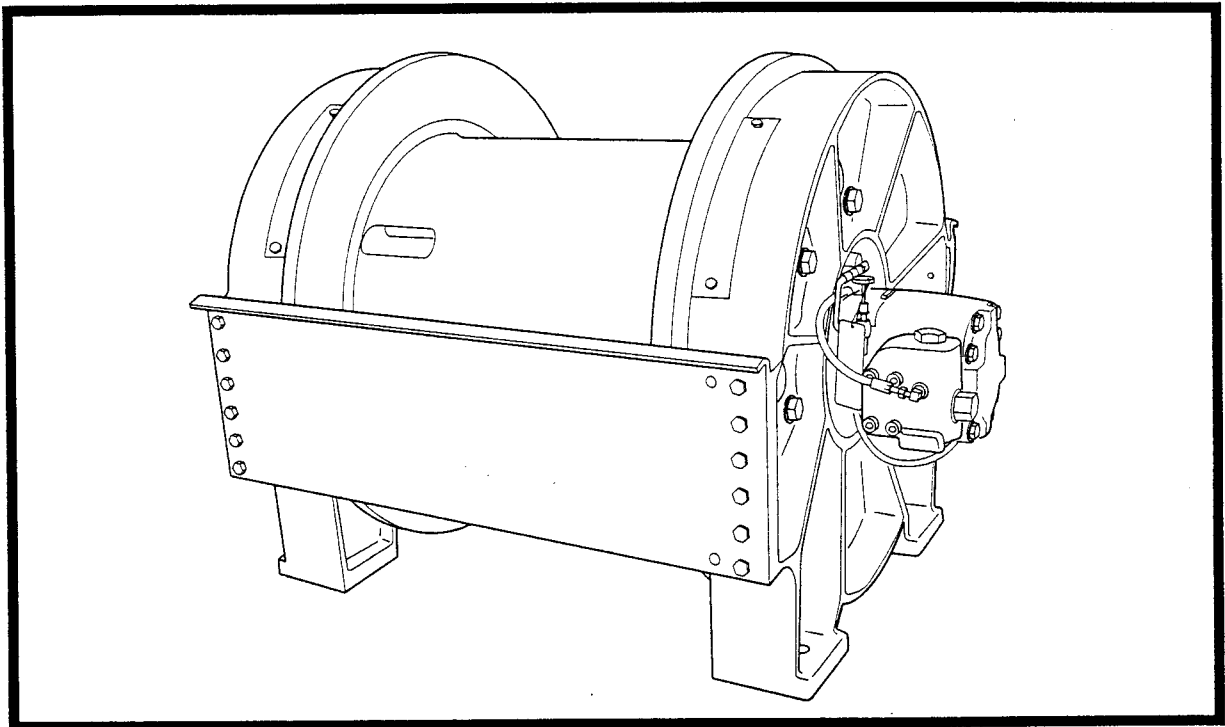


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# BRADEN

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## CH330/CH400 HYDRAULIC WINCH



## INSTALLATION, MAINTENANCE AND SERVICE MANUAL

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**PACCAR WINCH DIVISIONS**



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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, 08:00-16:30 hours, CT, Monday through Friday.

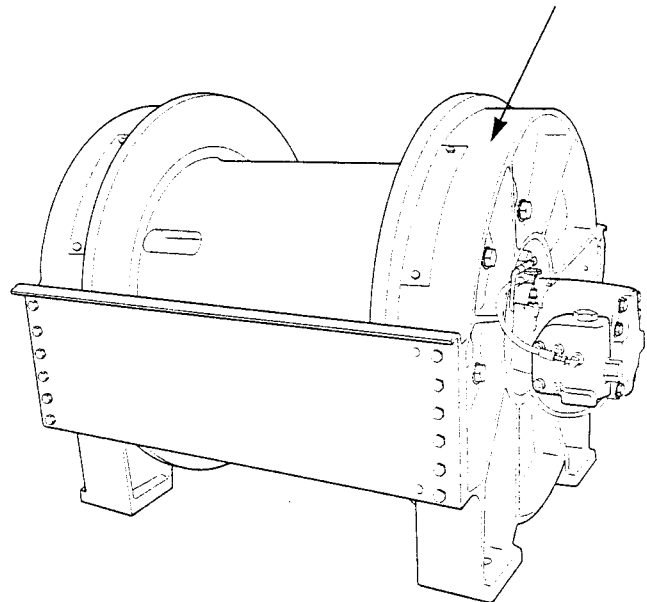
The minimum service intervals specified are for operating hours of the prime mover.

The following service instructions have been prepared to provide assembly, disassembly and maintenance information for the BRADEN Model CH330/400 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 Number and Model Number stamped into the motor end bracket as shown at right. Always refer to the Serial Number and Model Number when requesting information or service parts.



## EXPLANATION OF MODEL NUMBER

<b>CH</b>	<b>330</b>	<b>A</b>	<b>69</b>	<b>120</b>	<b>- 01</b>	<b>- G</b>	<b>- 1</b>
CONSTRUCTION HOIST	MAX RATING	DESIGN MODEL	GEAR RATIO	MOTOR SIZE	DRUM SIZE	DRUM OPTION	OPTION

**CH** DESIGNATES CONSTRUCTION HOIST (C2H DESIGNATES TWO SPEED)

**330** DESIGNATES 33,000 LB FIRST LAYER LINE PULL

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

**69** DESIGNATES TOTAL GEAR REDUCTION

**120** DESIGNATES HYDRAULIC MOTOR DISPLACEMENT IN CU IN/REV  
(DECIMAL POINT ELIMINATED. EXAMPLE: 090 = 9.0 CU IN/REV)

**01** DESIGNATES THE DRUM SIZE OPTION

**G** DESIGNATES OTHER DRUM OPTIONS (G = GROOVED; M = MACHINED; P = RACHET AND PAWL;  
U = UNDERWOUND)

**1** PERMITS TESTING AND INSPECTION PER API2C FOR OFFSHORE CRANES



# 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 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.

## WARNING

FAILURE TO OBEY THE FOLLOWING SAFETY RECOMMENDATION MAY RESULT IN PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

1. Read all warning tag information and become familiar with all controls before operating winch.
2. Never attempt to clean, oil or perform any maintenance on a machine with the engine running, unless instructed to do so in the service manual.
3. Never operate winch controls unless you are properly seated at the operators station on the prime mover and you are sure personnel are clear of the work area.
4. Assure that personnel who are responsible for hand signals are clearly visible and that the signals to be used are thoroughly understood by everyone.
5. Ground personnel should stay in view of the prime mover operator and clear of winch drum. Do not allow ground personnel near winch line under tension. A safe distance of at least 1½ times the length of the cable should be maintained.
6. On machines having hydraulically, mechanically and/or cable controlled equipment, be certain the equipment is either lowered to the ground or blocked securely before servicing, adjusting and/or repairing the winch. Always apply the prime mover parking brakes and lower equipment before dismounting the prime mover.
7. Inspect rigging, winch and hydraulic hoses at the beginning of each work shift. Defects should be corrected immediately.
8. Keep equipment in good operating condition. Perform scheduled servicing and adjustments listed in the "Preventive Maintenance" section of this manual.
9. An equipment warm-up procedure is recommended for all start-ups and is essential at ambient temperatures below +40° F (4° C). Refer to "Warm-up Procedure" listed in the "Preventive Maintenance" section of this manual.

10. Be sure of equipment stability before operating winch.
11. The winches described herein are neither designed nor intended for use or application to equipment used in the lifting or moving of persons.
12. Do not exceed the maximum pressure (PSI or kPa) or flow (GPM or LPM) stated in the winch specifications.
13. Operate winch line speeds to match job conditions.
14. Leather gloves should be used when handling winch cable.
15. Never attempt to handle winch cable when the hook end is not free.
16. When winding winch cable on the winch drum, never attempt to maintain tension by allowing winch cable to slip through hands. Always use "hand-over-hand" technique.
17. Never use winch cable with broken strands. Replace winch cable.
18. Do not weld on any part of the winch.
19. Do not use knots to secure or attach winch cable.
20. Use recommended hydraulic oil and gear lubricant.
21. Keep hydraulic system clean and free from contamination at all times.
22. Use correct size cable anchor for cable and pocket in winch drum.
23. The BRADEN 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 informational callouts used in this manual include:**

## WARNING

WARNING – This emblem is used to warn against hazards and unsafe practices 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 or product or property damage if proper procedures are not followed.



# THEORY OF OPERATION

## DESCRIPTION OF WINCH

The winch is made up of the following sub-assemblies and parts:

1. Hydraulic motor, brake valve and motor adapter
2. Drum and drum support assembly
3. Motor end support
4. Tie plates
5. Brake clutch assembly
6. Drive assembly with multiple disc parking brake and internal gearing

## 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 haul-in 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 pay-out 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 1, 2 and 3.

Figure 1

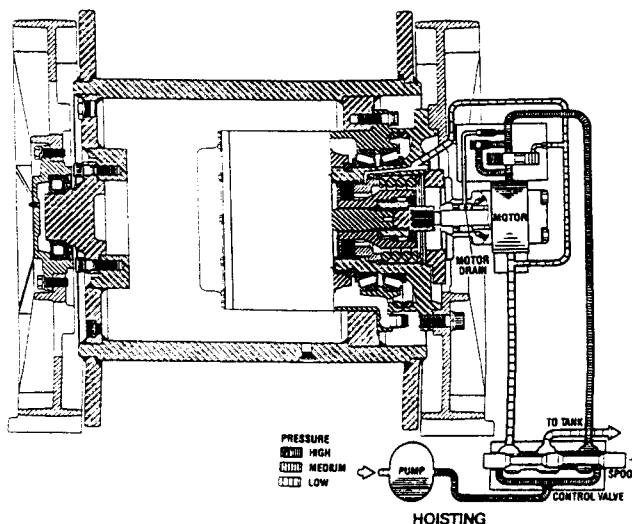


Figure 2

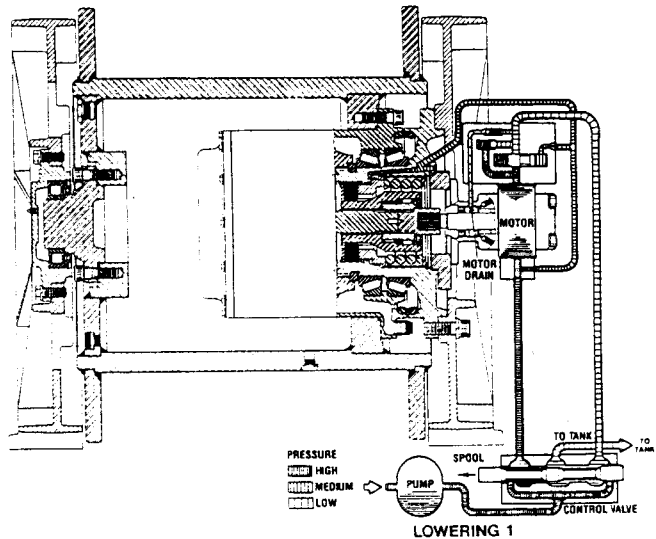
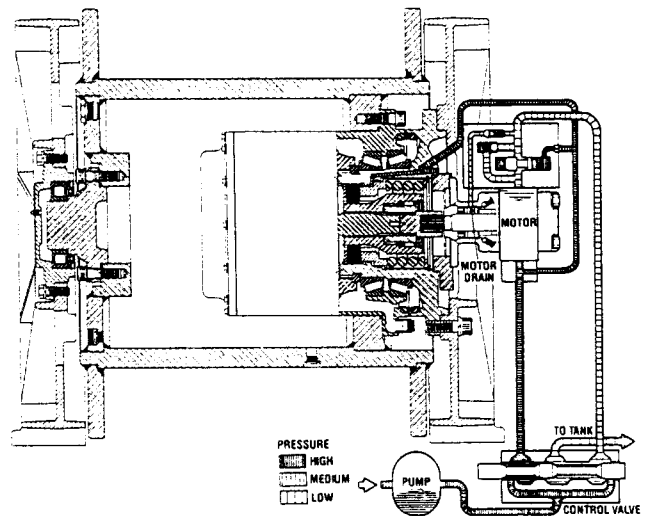


Figure 3



The static brake system has three operating components:

1. Spring applied, hydraulically released multiple friction disc brake pack
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 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 inner race of the brake clutch is a splined coupling between the motor and the primary sun gear. The outer race is splined to the friction discs in the brake pack, while steel separator plates are splined to the stationary housing. The brake clutch allows this shaft to turn freely in the haul-in direction, and locks up to force the brake discs to turn with the shaft in the pay-out direction. See figures 4 and 5.

Spring pressure prevents the brake discs from turning



Figure 4

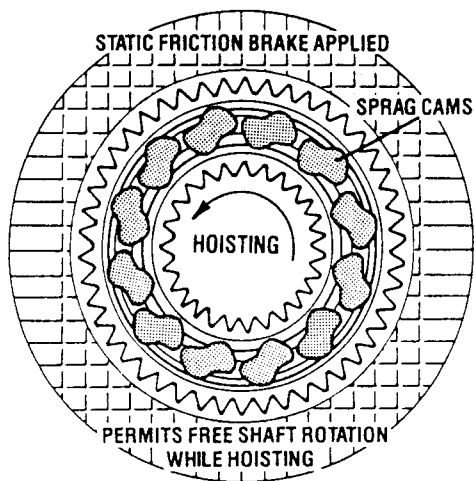
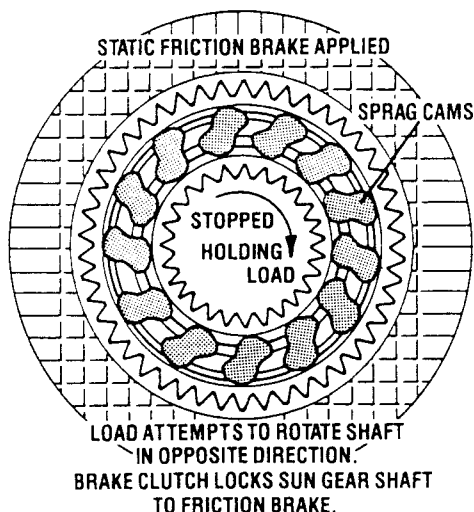


Figure 5



until the hydraulic cylinder and piston are pressurized, releasing the brake.

## OPERATION

When hauling-in cable, or hoisting a load, the motor shaft and winch gear train turn freely as the sprag cams lay over between the inner and outer races of the brake clutch. See figure 4.

The multiple disc friction brake remains fully engaged and the winch is not affected by any braking action. See figure 1.

When the operation is stopped, the load tries to turn the winch drum, gear train and primary sun gear in the reverse direction. This reversed input to the inner race of the brake clutch causes the sprag cams to instantly roll upward and lock the shaft to the fully engaged friction brake. See figure 5.

When the winch is powered in the pay-out or lowering

direction, the motor cannot rotate until sufficient pilot pressure is present to release the brake and open the brake valve. See figures 2 and 3. The friction brake will completely release at a pressure lower than that required to open the brake valve. The extent to which the brake valve opens determines the amount of oil that can flow through the motor, which is directly related to the drum speed of the winch. Increasing the flow of oil to the winch motor causes the pilot pressure to rise which increases the opening in the brake valve, allowing more oil to flow through the motor and increasing the drum speed. Decreasing this oil flow causes the pilot pressure to drop, reducing the opening in the brake valve which slows the motor and winch speed.

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

When the control valve is shifted to neutral, pilot pressure drops closing the brake valve spool, stopping the motor and the load. The friction brake then engages and holds the load after the brake valve has closed.

When lowering a load very slowly for precise positioning, no oil flow actually occurs through the pilot operated spool in the brake valve. Pressure builds up to a point where the friction 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.

## WINCH OPERATION

The input section of the drive assembly is bolted to the motor end support and cannot rotate. The drive housing is the output member of the gear set and is bolted to the winch drum. The motor shaft is directly coupled to the primary sun gear through the inner race of the brake clutch. The motor turns the primary sun gear which drives three successive planetary gear sets, turning the drive housing and the winch drum.

In the haul-in direction, hydraulic oil flows through a large check valve in the brake valve and turns the motor in the free rotating direction of the brake clutch, driving the gear train and winch drum. The friction brake remains fully engaged.

In the pay-out direction, oil flow through the motor is initially blocked by a spool in the brake valve. Oil pressure supplied to the motor through the control valve is piloted to the friction brake and the brake valve spool. The friction brake is released at a lower pressure than that required to shift the brake valve spool. When pressure is sufficient to shift the brake valve spool, oil is allowed to flow through the motor, rotating the winch gear train and drum.



# WINCH AND WIRE ROPE INSTALLATION

1. The winch should be mounted with the centerline of the cable drum in a horizontal position. The mounting plane of the winch may be rotated in any position around this centerline providing the vent in the motor adapter is above the centerline of the cable drum. The vent should be as close to top dead center as possible.
2. When mounting the winch, use all four (4) mounting holes and grade eight (8) bolts and nuts. Evenly tighten the nuts to the torque in the "Recommended Fastener Torque" chart. Make certain the winch drum is centered behind the first sheave and the fleet angle does not exceed  $1\frac{1}{2}$  degrees. The winch should also be mounted perpendicular to an imaginary line from the center of the drum to the first sheave to ensure even spooling.

Refer to "Dimensional Drawing" for bolt hole size and pattern.

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, the mounting surface should be flat within  $\pm 0.020$  inches. If necessary, install shims under the winch mounting pads to achieve even mounting.

3. The hydraulic lines and components that operate the winch should be of sufficient size to assure minimum back pressure at the winch. The back pressure at the motor must not exceed 100 psi (690 kPa) to maintain full brake system design factor and optimum motor seal life.

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).

4. 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 5,000 SUS with a pour point at least 20° F (11° C) lower than the minimum ambient temperature.

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

*In general terms:*

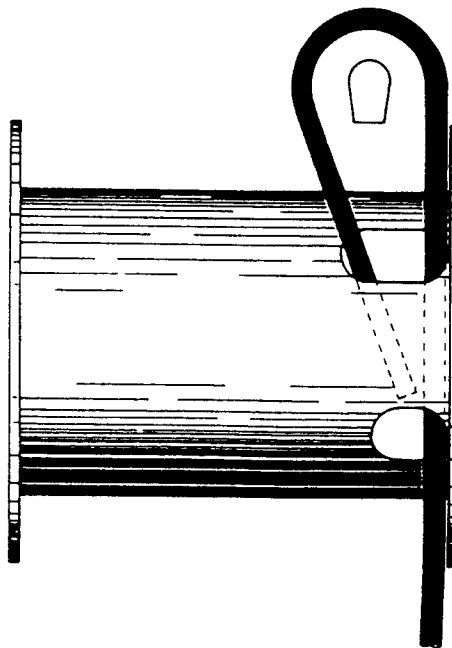
for continuous operation at ambient temperatures between 50° F (10° C) and 110° F (43° C), use SAE 20W; for continuous operation between 10° F (-12° C) and 90° F (32° C), use 10W; for applications colder than 10° F (-12° C), contact the BRADEN/GEAR-MATIC Service Department. The use of multi-viscosity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

For winch gear oil, refer to "Lubricant Specifications" in the "Preventive Maintenance and Specifications" section.

5. The hydraulic oil filter should have a 10 micron nominal rating and be full flow type.
6. The vent plug in the motor adapter must be located as close to top dead center as possible. If the winch is mounted on a pivoting surface, the vent plug must remain above the centerline of the cable drum to prevent gear oil leakage.
7. Refer to "Dimensional Drawing" for relationship between drum rotation and which port is pressurized.

## WIRE ROPE INSTALLATION 03 AND 04 DRUM

Take the free end of the wire rope and insert it through the small opening of the anchor pocket you are going to use. Loop the wire rope and push the free end about three-fourths of the way back through the pocket. Install the cable anchor with the small end toward the drum, then pull the slack out of the wire rope. The cable anchor will slip into the pocket and secure the wire rope to the drum. A minimum of five (5) wraps of wire rope should remain on the cable drum at all times. Refer to "General Safety Recommendations" for additional information.





## 01 AND 02 DRUM – ANCHOR

Remove both sheet metal covers from the end bracket of the winch. Pull the end of the cable through the opening in the drum flange and out through the end bracket as shown in figure 1. Form the cable around part 1 of the wedge as shown in figure 2, and pull the assembly into the anchor pocket (part 2 and the nut are not attached to part 1 at this time). Access the threaded rod attached to part 1 through the other opening in the end bracket and install part 2 and the nut. On large diameter cable, it may be necessary to hammer on the cable looped around part 1 in order to force it far enough into the anchor pocket to attach part 2. It is important for the 'dead' end of the cable to extend beyond the end of part 2, as shown in figure 2, but not far enough to come in contact with the end bracket when the winch is operating. A load should be applied to the 'live' end of the cable to properly seat the anchor. After the initial load is applied, check the tightness of the nut holding part 2 in place and tighten it if required. A minimum of five (5) wraps of wire rope should remain on the cable drum at all times. Refer to "General Safety Recommendations" for additional information.

Figure 1

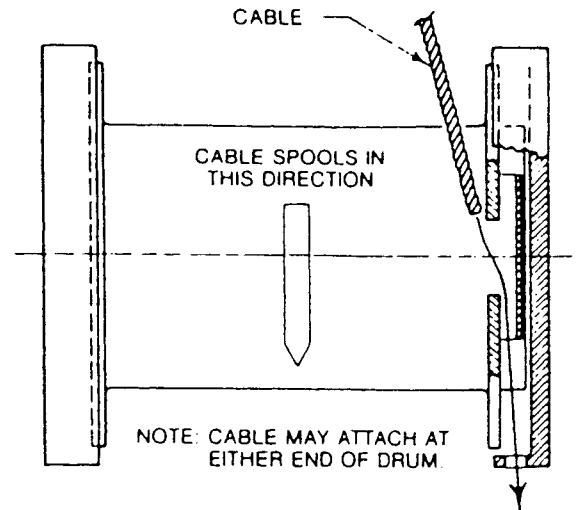
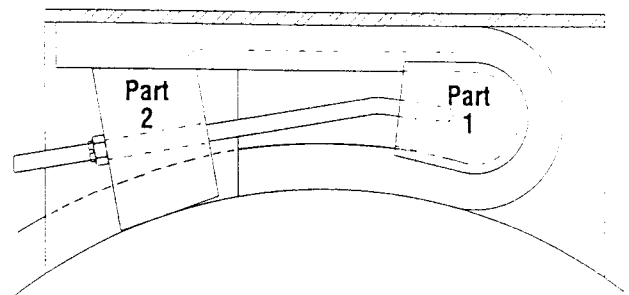
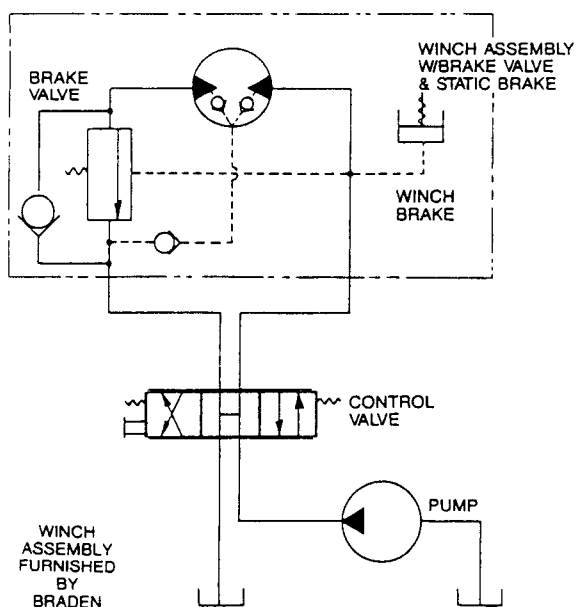


Figure 2

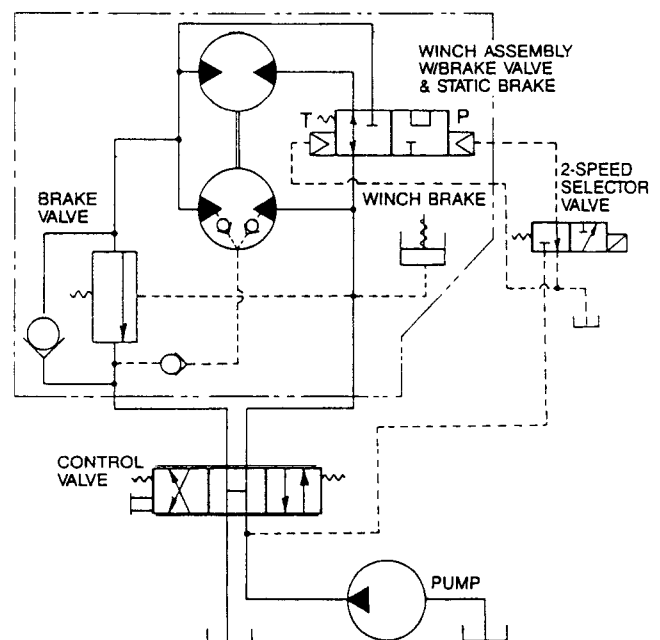


## HYDRAULIC CIRCUITS

### SINGLE SPEED CIRCUIT

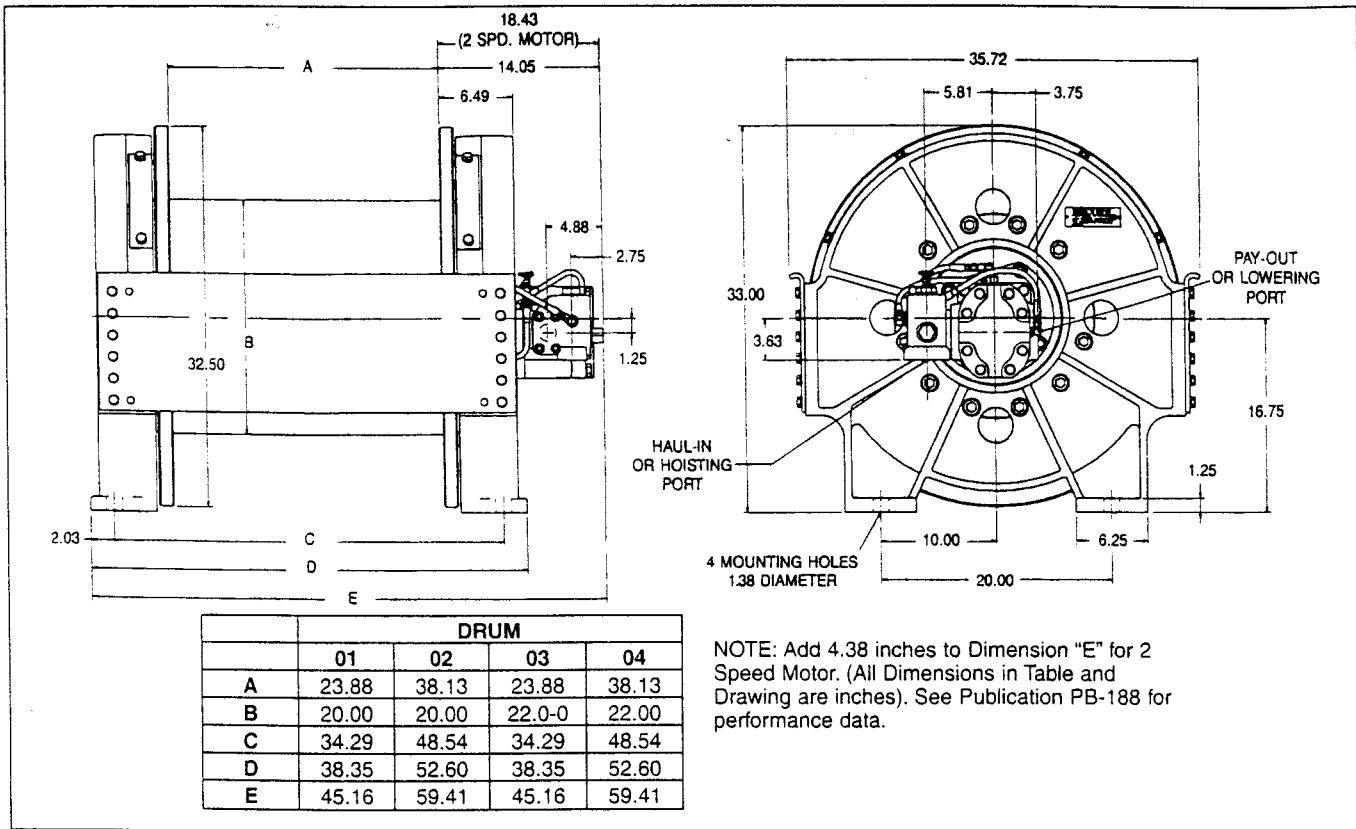


### 2 SPEED CIRCUIT





# DIMENSIONAL



## 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, indicates 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. Oil level should be even with the centerline of the winch drum. Rotate the winch drum until the level plug can be seen in one of the two access holes on either side of the drum support and remove the plug. 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.

Rotate the drum until the -8 drain plug is aligned with the lowest opening in the drum end support plate. Install a short piece of 1 inch pipe through the end plate. Reach through the pipe with a 5/16 hex allen wrench and remove the -8 plug to drain the oil. Install the -8 plug and remove the 1 inch pipe when all the oil has been drained from the drum. Although gear oil circulates between the drive and the drum through holes in the primary ring gear, it is advisable to also remove the plug in the rotating part of the winch drive to drain any trapped oil in the drive. This is done by aligning the plug with the opening in the support bracket directly below the winch motor.

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 operation. 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 plan-



etary gear oil may contribute to brake 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 directly above the winch motor near the brake release port. 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 manufacturer's 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 procedure

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.

### 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 and obtaining long gear train life.

## ! 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.

For simplicity, we have 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. BG4A Planetary winches are factory filled with Texaco Meropa 150 or equivalent.

### 9. Inspection

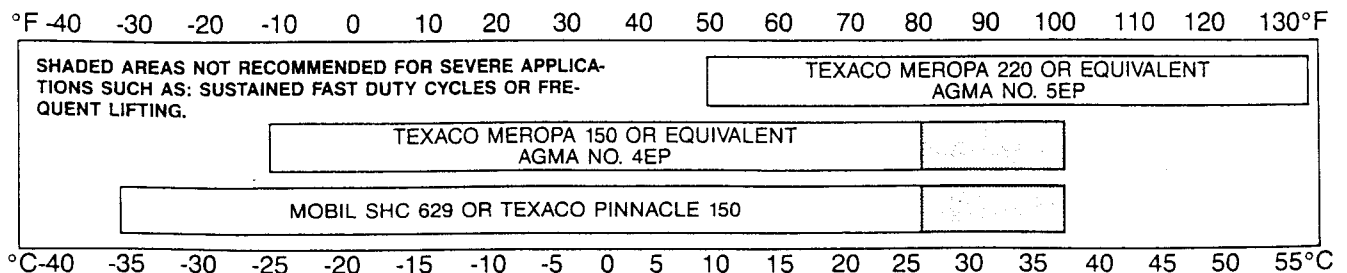
In compliance with ANSI specification number B30.5c1987 and API Recommended Practice RP 2D section 3, we recommend that the winch be disassembled for a thorough inspection of all wear items every 2,000 hours of operation or twelve (12) months, whichever occurs first.

## ! WARNING !

Failure to use the proper type and viscosity of planetary gear oil may contribute to intermittent brake 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 temperatures 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 winch is correct for your prevailing ambient temperature.

## RECOMMENDED GEAR OIL

### PREVAILING AMBIENT TEMPERATURE



CH330/CH400 winches are factory filled with Texaco Meropa 150 or equivalent gear oil.



# WEIGHTS, OIL CAPACITIES AND SPECIAL TOOLS

DRUM	APPROXIMATE WEIGHT (LBS)	APPROXIMATE OIL CAPACITY (QUARTS)
01	2,600	33
02	2,975	60
03	2,800	40
04	3,100	75

## SPECIAL TOOLS

- 2 each  $\frac{5}{16}$ -18NC eye bolt
- 2 each  $\frac{1}{2}$ -13NC eye bolt
- 2 each  $\frac{3}{4}$ -10NC eye bolt:

**NOTE:** The first two items below are required only if the motor support is separated from the ring gear. The other tools are required to service the brake assembly.

1 inch diameter bar approximately 36 inches long and various sized small steel blocks (key stock).

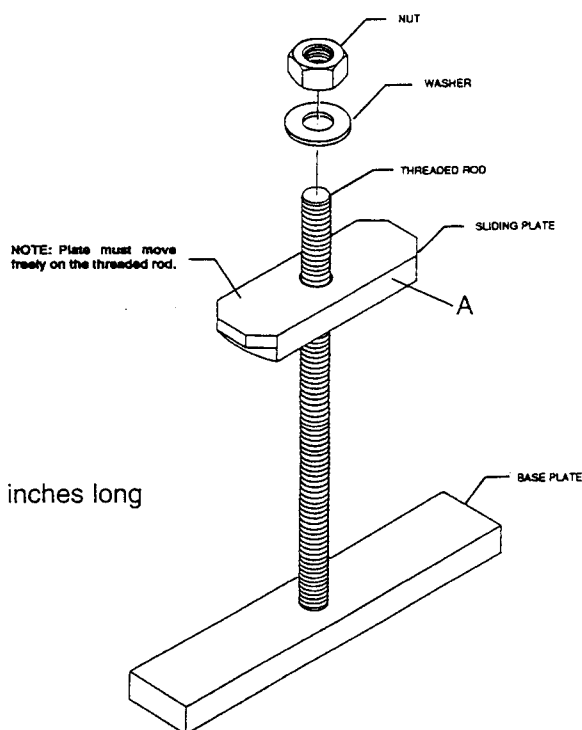
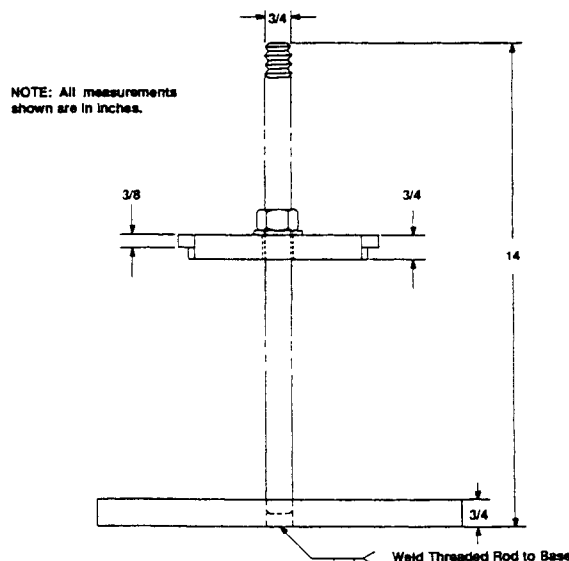
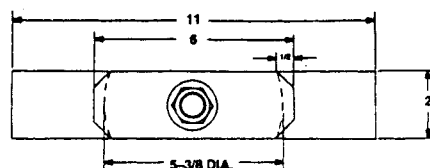
3 each  $\frac{7}{8}$ -9NC x 6 inch long capscrews.

A ratcheting internal snap ring pliers capable of handling an N5000 700 snap ring.

All units use a single coil spring to apply the internal brake. The following spring compressor must be fabricated and is strongly recommended.

**NOTE:** If a press is available (with at least 5 inches of travel), only part (A) shown below is required (center hole not required). If a press is not available, all parts shown and listed below are required.

- 1 each  $\frac{3}{4}$ -16NF threaded rod, 4 inches long
- 1 each  $\frac{3}{4}$ -16NF nuts
- 1 each  $\frac{3}{4}$  inch plain washer





# TROUBLE SHOOTING

## WARNING

If a winch ever exhibits any sign of erratic operation, or load control difficulties (i.e. load creeping or chattering) appropriate trouble shooting 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
<b>A</b>		
The winch will not lower the load or not lower the load smoothly.	1. The friction brake may not be releasing as a result of a defective brake cylinder seal.	Check brake cylinder seal as follows:
	NOTE: If the brake cylinder seal is defective you will usually find oil leaking from the winch vent plug.	A. Disconnect the swivel tee from the brake release port. Connect a hand pump with accurate 0-2000 psi (0-13,800 kPa) gauge and shut-off valve to the -4 J.I.C. fitting in the brake release port. B. Apply 1000 psi (6,900 kPa) to the brake. Close shut-off valve and let stand for five (5) minutes. 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."
	2. Friction brake will not release as a result of damaged brake discs.	Disassemble brake to inspect brake discs.
<b>B</b>		
Oil leaks from vent plug.	1. Same as A1.	Same as A1.
	2. Motor seal may be defective as a result of high system back pressure or contaminated oil.	System back pressure must not exceed 150 psi (1,030 kPa). 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. 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.



TROUBLE	PROBABLE CAUSE	REMEDY
<b>C</b>		
The brake will not hold a load with the control lever in neutral.	<ol style="list-style-type: none"> <li>1. Excess 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>Same as remedy for Trouble B2.</p> <p>Same as remedy for Trouble A2.</p> <p>Improper planetary gear oil may cause the brake clutch to slip. Drain oil 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>
<b>D</b>		
The winch will not hoist the rated load	<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> <li>3. Be certain hydraulic system temperature is not more than 180° F (82° C). Excess hydraulic oil temperatures increase motor internal leakage and reduce motor performance. ▶</li> <li>4. Winch line pull rating is based on 1st layer of wire rope. ▶</li> <li>5. Rigging and sheaves not operating efficiently. ▶</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> <ol style="list-style-type: none"> <li>A. Install an accurate 0-4000 psi (28,000 kPa) gauge into the inlet port of the brake valve.</li> <li>B. Apply a stall pull load on the winch while monitoring pressure.</li> <li>C. Compare gauge reading to winch specifications. Adjust relief valve as required.</li> </ol> <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 and 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>



TROUBLE	PROBABLE CAUSE	REMEDY	
E			
The winch runs hot.	1. Same as D1.	Same as remedies for Trouble D1.	
	2. Be certain that the hydraulic system temperature is not more than 180° F (82° C). Excessive hydraulic oil temperatures may be caused by:		
	A. Plugged heat exchanger.		Thoroughly clean exterior and flush interior.
	B. Too low or too high oil level in hydraulic reservoir.		Fill/drain to proper level.
	C. Same as D2.		Same as remedies for Trouble D2.
D. Hydraulic pump not operating efficiently.	▶	Prime mover low on horsepower or R.P.M. Tune/adjust prime mover.	
		Check suction line for damage.	
		If pump is belt driven, belts are slipping. Replace/tighten belts	
3. Excessively worn or damaged internal winch parts.	▶	Pump worn. Replace pump.	
		Disassemble winch to inspect/replace worn parts.	
F			
Winch "chatters" while raising rated load.	1. Same as D2.	Same as remedies for Trouble D2.	
	2. Hydraulic oil flow to motor may be too low.	Same as remedies for Trouble E2.	
	3. Controls being operated too quickly.	Conduct operator training as required.	
G			
The wire rope does not spool smoothly on the drum.	1. The winch may be mounted too close to the main sheave, causing the fleet angle to be more than 1½ degrees.	Check mounting distance and fleet angle. Reposition winch as required.	
	2. The winch may not be mounted perpendicular to an imaginary line between the center of the cable drum and the first sheave.	Refer to "Winch Installation".	
	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.	Consult wire rope manufacturer for recommendation of wire rope that best suits your application.	
	4. The winch may have been overloaded, causing permanent set in the wire rope.	Replace wire rope and conduct operator/rigger training as required.	



# SERVICE PRECAUTIONS

Before any part is removed from the winch or drive gearbox, 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 re-use expendable parts such as O-rings and oil seals.

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.

Lubricate all bearings with an oil soluble grease prior to assembly.

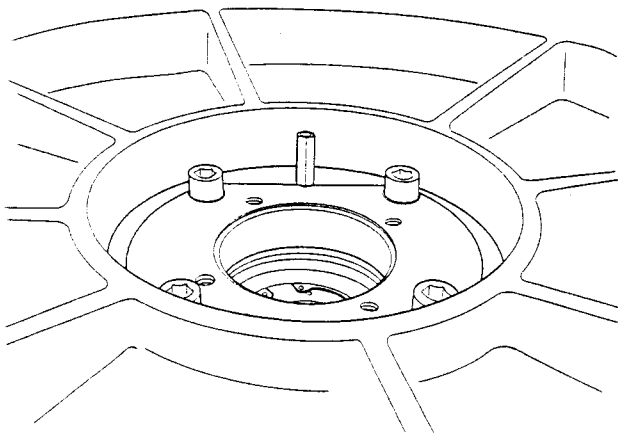
Use a sealing compound on the outside surface of oil seals and a light coat of thread sealing compound on pipe threads. Avoid getting sealing compound inside parts or passages which conduct oil.

Before beginning to disassemble the winch or drive gearbox, remove the wire rope, drain the oil and clean the outside surfaces to avoid contaminating gears and bearings.

Item numbers shown in service procedures are referenced to the exploded view drawing in the center of this manual.

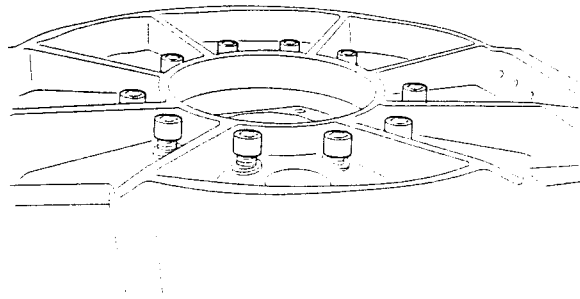
## WINCH DISASSEMBLY

1. Stand the winch on the end opposite the motor. Remove the hydraulic hose that connects the brake valve and motor to the brake release port. Remove the four (4) capscrews securing the motor to the winch and lift off the motor/brake valve assembly. Remove and discard the O-ring installed on the outside of the motor pilot.

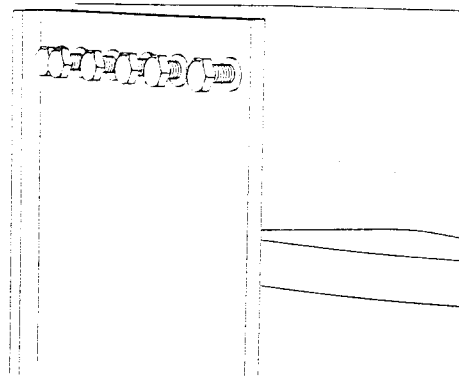


2. Remove the four (4) capscrews from the motor

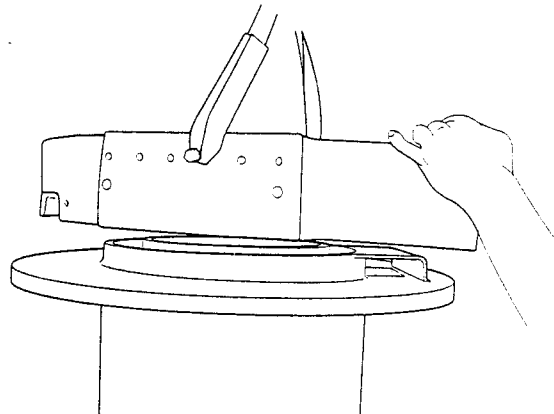
adapter and remove the motor adapter (item 27) from the drive gearbox. Remove and discard the O-ring (item 26) from the motor adapter.



3. Remove the ten (10) capscrews and lockwashers securing the end bracket (item 25) to the gearbox.

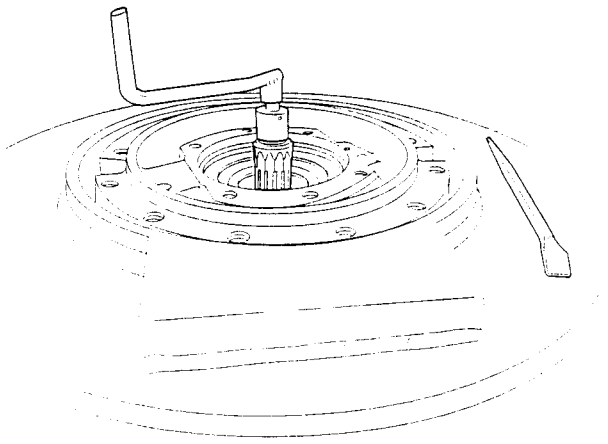


4. Remove the twenty four (24) capscrews and lockwashers securing the tie plates (item 1) to both end brackets and remove the tie plates. The tie plates have two dowel pins in each end and may have to be lightly tapped or pried from the end brackets. Install four large c-clamps around the drum support end bracket (item 2) and the drum flange. This will prevent the end bracket and drum from separating when the motor end bracket and winch drive are removed.



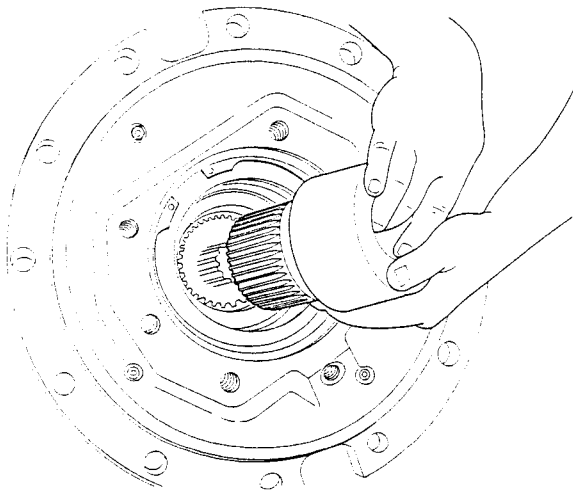
5. Lift the motor end bracket (item 25) from the drum/drive assembly.





6. There are two large notches in the end of the drive gearbox. These must be rotated to gain access to the capscrews and lockwashers (items 4 & 5) that secure the gearbox to the winch drum. This is done by rotating the motor coupling while keeping the drum from turning. Continue this procedure and remove all capscrews and lockwashers (items 4 & 5).

**NOTE:** To obtain relative movement between the two sections of the gearbox, the input shaft must be rotated in the same direction as the motor turns to haul-in cable. Rotating the shaft in the opposite direction results in the entire gearbox and drum turning as a single unit.

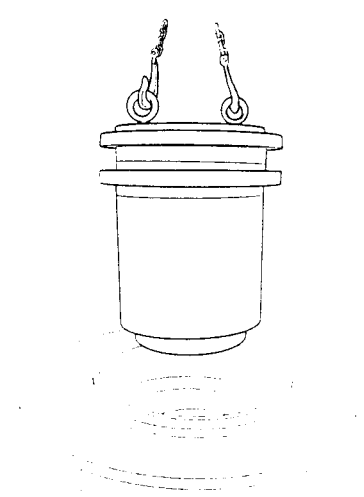


7. The brake clutch assembly and motor coupling should now be removed from the gearbox.

**NOTE:** The sun gear will remain in the gearbox and cannot be removed from this end.

## ⚠ WARNING

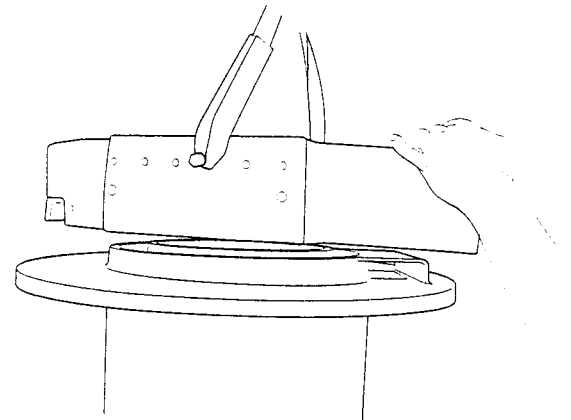
**DO NOT** attempt to remove the large retaining ring at this time. It is holding the static brake spring in compression. Removing this retaining ring at this time could result in property damage, personal injury, or death.



8. Lift the winch drive gearbox out of the drum using two (2) 7/8 NC eye bolts spaced 180° apart as lifting lugs. Refer to Winch Drive/Gearbox Service section for further disassembly of winch drive.

## DRUM SUPPORT END BRACKET SERVICE

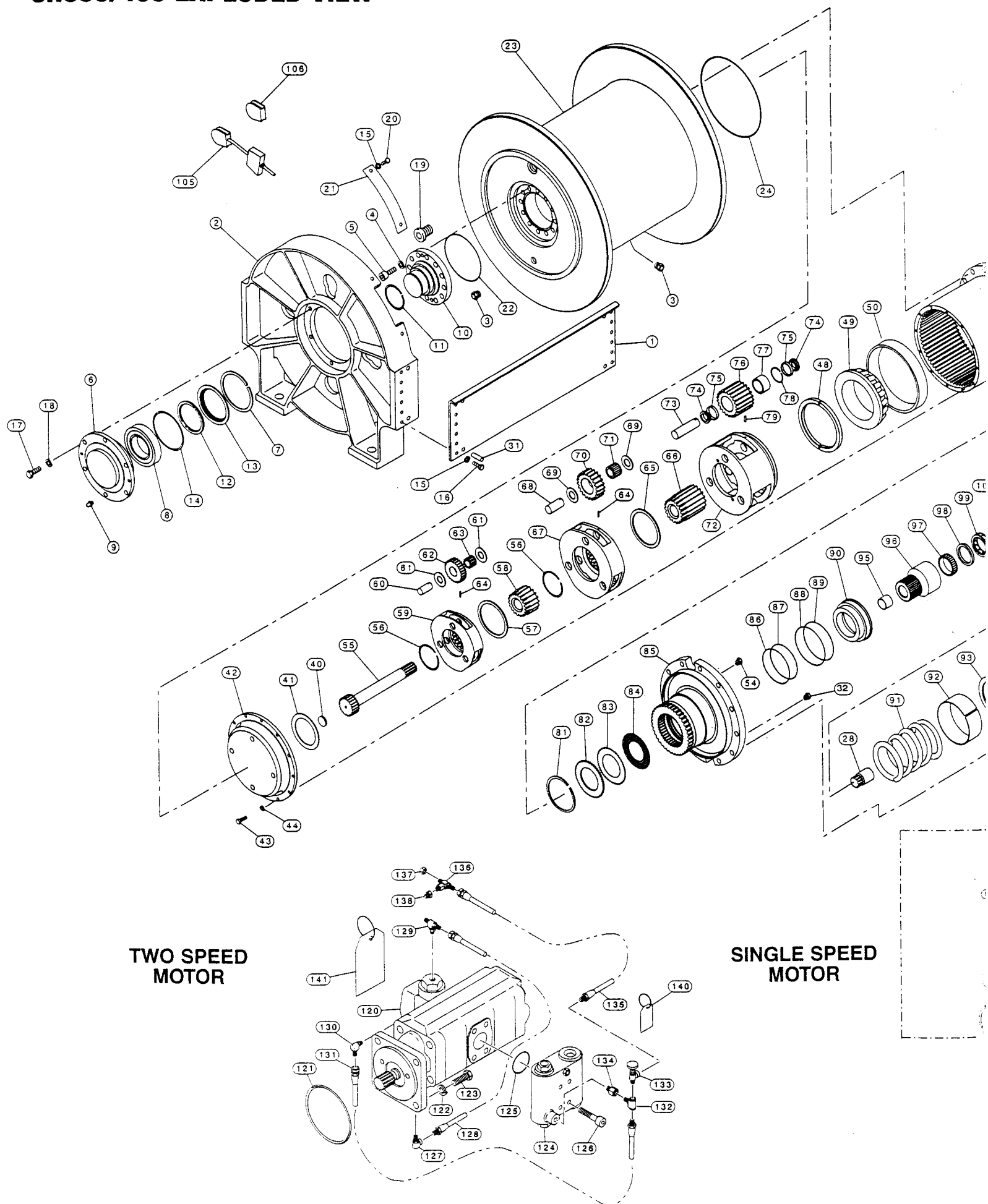
If the winch disassembly procedure has been followed to this point, remove the c-clamps installed in step 4. If only this end of the winch is being serviced, support the winch on the motor end bracket and remove the twelve (12) capscrews and lockwashers securing the end of both tie plates (item 1), to the drum support end bracket (item 2). Loosen the twelve (12) capscrews on the other end of both tie plates just enough to allow the tie plates to be pried free of the dowel pins in the drum support end bracket.



1. Lift the support end bracket from the drum. **NOTE:** If the winch disassembly procedure was followed and the drum is on top of the end bracket, lift the drum from the support end bracket.



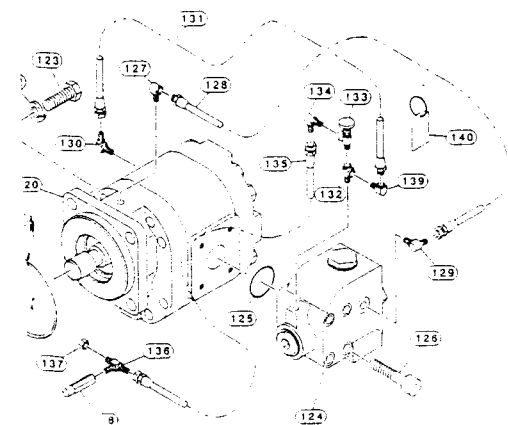
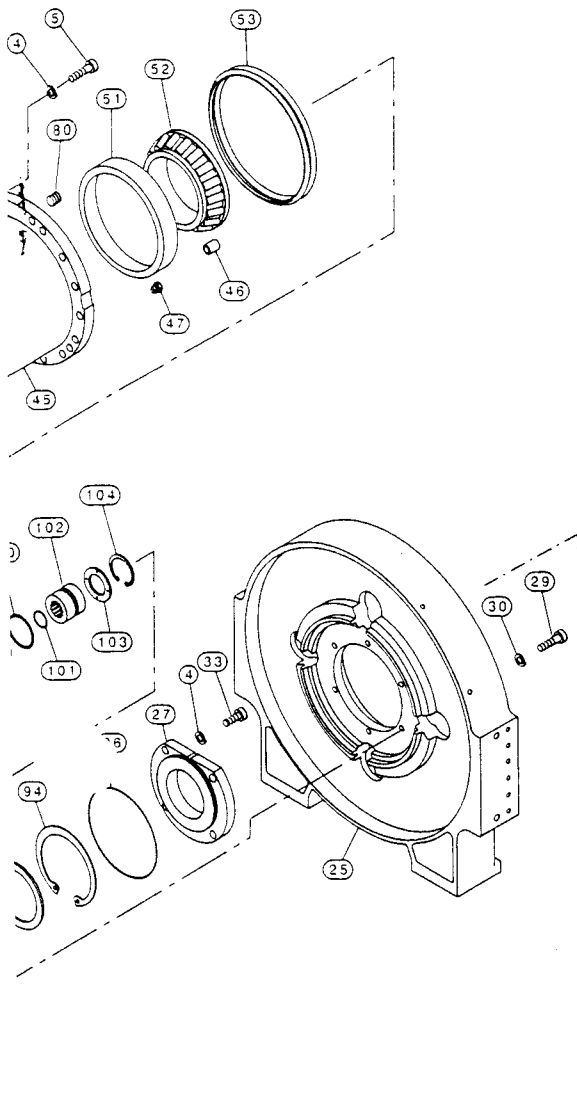
# CH330/400 EXPLODED VIEW



**TWO SPEED  
MOTOR**

**SINGLE SPEED  
MOTOR**





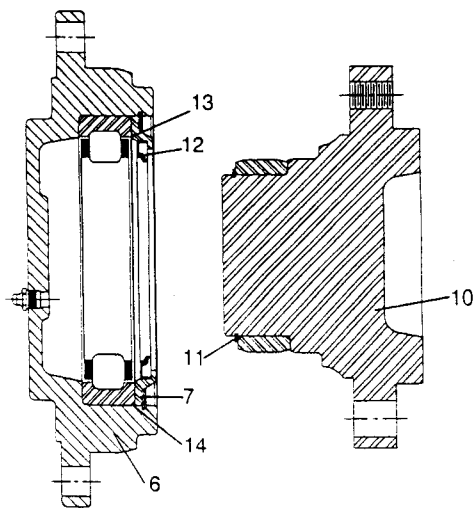
**ITEM  
NUMBER DESCRIPTION**

1	Tie Plate
2	Support End Plate
3	O-Ring Flush Plug
4	Lockwasher
5	Capscrew
6	Outer Bearing Hub
7	Internal Retaining Ring
8	Roller Bearing
9	Grease Fitting
10	Inner Bearing Hub
11	External Retaining Ring
12	Seal
13	Seal Carrier
14	O-Ring
15	Lockwasher
16	Capscrew
17	Capscrew
18	Lockwasher
19	Sight Gauge
20	Capscrew
21	Cover Plate
22	O-Ring
23	Cable Drum
24	O-Ring
25	Motor End Plate
26	O-Ring
27	Motor Adapter
28	Motor Coupling
29	Capscrew
30	Lockwasher
31	Dowel Pin
32	Pipe Plug
33	Capscrew
40	Thrust Washer
41	Thrust Washer
42	Primary Ring Gear/End Cover
43	Capscrew
44	Lockwasher
45	Ring Gear
46	Drain Tube
47	Plug
48	Split Ring
49	Bearing Cone
50	Bearing Cup
51	Bearing Cup
52	Bearing Cone
53	Metal Face Seal
54	Vent Plug
55	Primary Sun Gear
56	External Retaining Ring
57	Thrust Washer
58	Second Stage Sun Gear
59	Primary Planet Carrier
60	Planet Pin
61	Thrust Washer
62	Primary Planet Gear
63	Loose Rollers
64	Rollpin
65	Thrust Washer
66	Output Sun Gear
67	Second Stage Planet Carrier

**ITEM  
NUMBER DESCRIPTION**

68	Planet Pin
69	Thrust Washer
70	Second Stage Planet Gear
71	Loose Rollers
72	Output Planet Carrier
73	Planet Pin
74	Bearing Cone
75	Bearing Cup
76	Output Planet Gear
77	Bearing Spacer
78	Internal Retaining Ring
79	Rollpin
80	Plug
81	Internal Retaining Ring
82	Brake Spacer/Support Plate
83	Steel Brake Disk
84	Friction Brake Disk
85	Motor Support/Brake Cylinder
86	Back-Up Ring
87	O-Ring
88	O-Ring
89	Back-Up Ring
90	Brake Piston
91	Brake Spring
92	Brake Piston Stop
93	Spring Stop
94	Internal Retaining Ring
95	Bushing
96	Sprag Clutch Outer Race
97	Roller Bearing
98	Spacer
99	Sprag Clutch Assembly
100	Spacer
101	Internal Retaining Ring
102	Sprag Clutch Inner Race
103	Spacer
104	Internal Retaining Ring
105	Cable Wedge (01 & 02 Drum)
106	Cable Wedge (03 & 04 Drum)
120	Hydraulic Motor
121	O-Ring
122	Lockwasher
123	Capscrew
124	Brake Valve
125	O-Ring
126	Capscrew
127	Reducer Elbow
128	Hydraulic Hose
129	Elbow Fitting
130	Elbow Fitting
131	Hydraulic Hose
132	Tee Fitting
133	Needle Valve
134	Elbow Fitting
135	Hydraulic Hose
136	Male Branch Tee Fitting
137	Cap Nut
138	Nipple
139	Elbow Fitting
140	Warning Tag





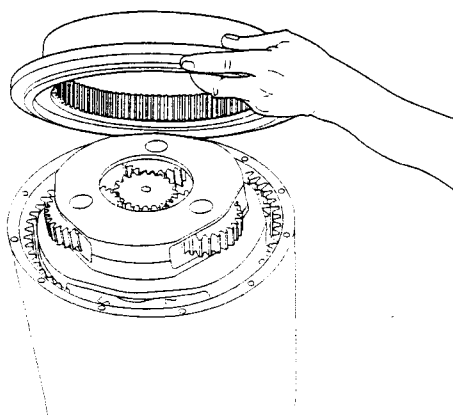
2. The bearing carrier/end cap (item 6) is in the end bracket, and the bearing support (item 10) is in the drum. Remove the retaining ring (item 7) and the seal carrier and seal (items 13 & 12). Remove and discard O-ring (item 14). Remove the seal from the seal carrier and discard.

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.

Apply a non-hardening sealant to the outside diameter of a new seal. Install the seal into the seal carrier as shown above. Install a new O-ring against the outer race of the bearing and install the seal carrier into the bearing carrier/end cap. Install a new retaining ring into the groove in the end cap. Liberally pack the bearing and end cap with grease. The end bracket can now be placed on the drum, or the drum placed on the end bracket, depending on your method of assembly.

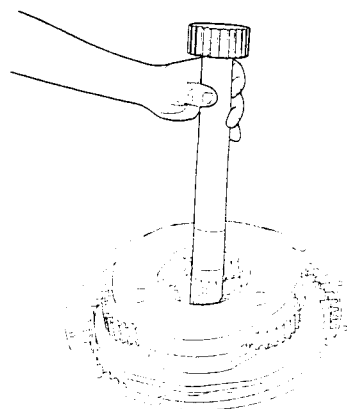
## WINCH DRIVE/GEARBOX SERVICE

### DISASSEMBLY

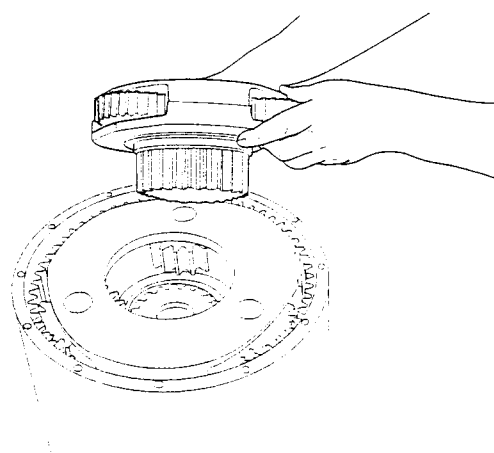


1. Stand the drive on the input end and remove the twelve (12) capscrews and lockwashers (items 43 & 44)

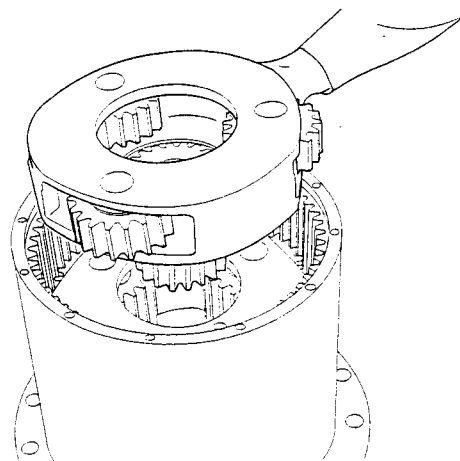
securing the end cover/primary ring gear to the drive assembly and remove the cover from the drive.



2. Remove the primary sun gear (item 55).



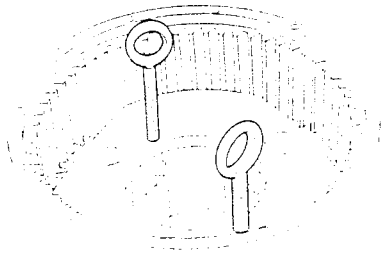
3. Remove the primary planet assembly. The second stage sun gear (item 58) will come out with the planet assembly. If the thrust washer (item 57) between the primary and second stage planet assemblies stayed in the gearbox, remove it and set it aside with the primary planet assembly.



4. Remove the second stage planet assembly. The output sun gear (item 66) will come out with the planet



assembly. If the thrust washer (item 65) between the second stage and output planet assemblies stayed in the gearbox, remove it and set it aside with the second stage planet assembly.



5. The output planet carrier has two (2) tapped holes ( $\frac{1}{2}$  - 13) which can be used to lift the assembly out of the ring gear. Install 2 eye bolts into these holes and use them to lift the output planet assembly out of the ring gear. Due to the weight of the assembly, it may be advisable to use a small hoist for this operation.

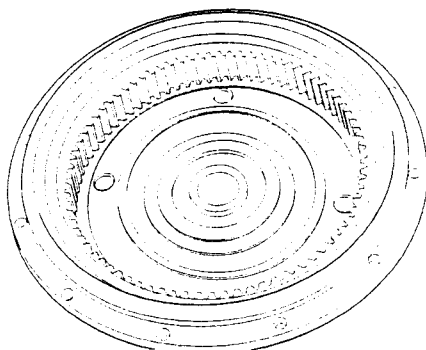
6. Using a long bar or blunt chisel, separate the ends of the split ring (item 48) and remove both halves of the split ring from the motor support. Turn the assembly over so the motor support is facing up. Since the bearing cone (item 49) will fall the length of the ring gear in the next step, the assembly should be setting on a wooden board or put several rags in the bottom of the ring gear to prevent damage to the bearing.

7. Install three (3)  $\frac{7}{8}$  - 9 x 6 inch long capscrews equally spaced around the motor support (item 85) until they contact the ring gear (item 45). Alternately tighten each capscrew  $\frac{1}{2}$  to 1 turn at a time to lift the motor support out of the ring gear. When the two pieces have been separated, you will hear the bearing cone (item 49) drop to the bottom of the ring gear.

8. Install two (2)  $\frac{3}{4}$  - 10 eye bolts in 2 of the motor mounting holes and use them to lift the motor support/brake assembly out of the ring gear.

## SUB-ASSEMBLY SERVICE

### PRIMARY RING GEAR/END COVER

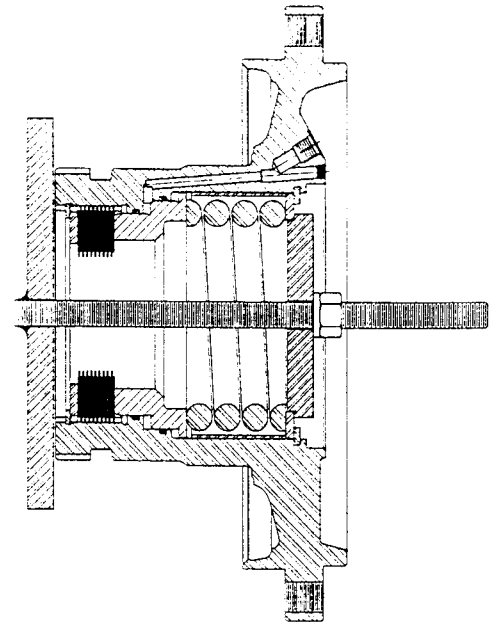


1. Thoroughly clean and inspect the cover/ring gear.

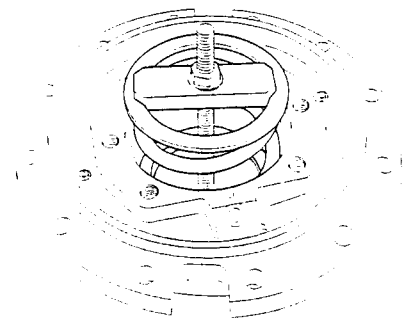
Check the ring gear teeth for nicks, spalling or excessive wear. Replace if wear is greater than 0.015 in. (0.4 mm) when compared to unworn area of teeth. The only serviceable parts in the ring gear/cover are the two thrust washers (items 40 & 41). Inspect them for signs of abnormal wear or damage and replace as required. Inspect the inside of the cover for signs of contact with the primary sun gear and/or primary planet carrier. If signs of contact are seen, replace both thrust washers.

## BRAKE ASSEMBLY

### DISASSEMBLY

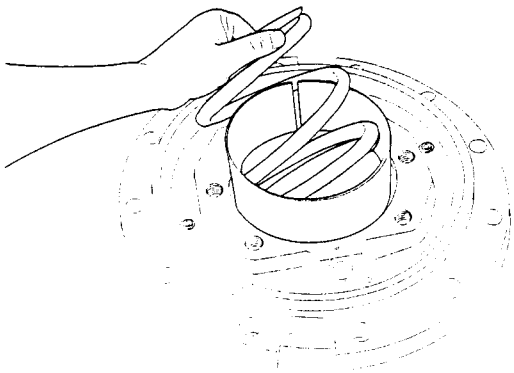


1. Install the spring compressor tool as shown. If a hydraulic press is available, only part "A" of the tool is required. Tighten the nut above part "A" or apply hydraulic pressure to slightly compress the spring and relieve load on the retaining ring (item 94). Carefully remove the retaining ring.

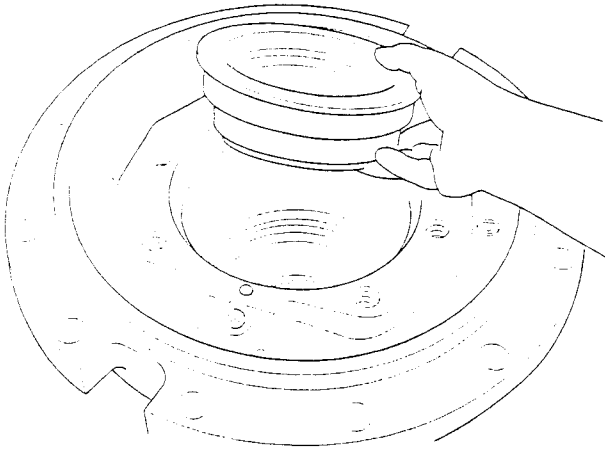


2. Slowly and carefully unscrew the nut above part "A" until spring pressure is completely released (spring travel is approximately 4 inches [10 cm]). Remove the compressor tool.

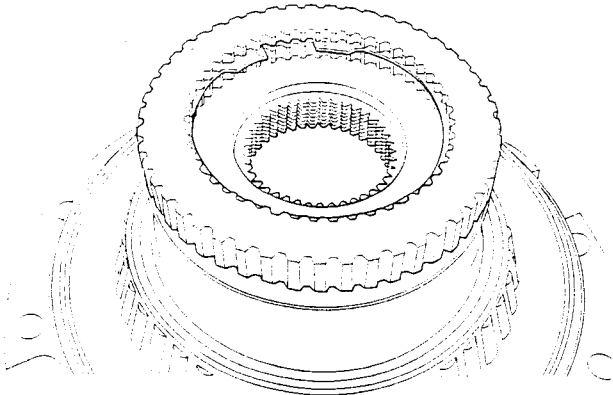




3. Remove the spring stop (item 93), spring (item 91) and piston stop (item 92) from the brake cylinder.



4. Remove the brake piston (item 90). Remove and discard both sets of piston O-rings and backup rings (items 86, 87, 88, & 89).



5. Turn the assembly over to access the brake plates. Remove the retaining ring (item 81). Remove the spacer plate (item 82), steel separator disks (item 83) and friction disks (item 84).

Thoroughly clean and inspect all parts, paying close attention to the sealing surfaces of the brake piston. Place each friction disk on a flat surface and check for distortion with a straight edge. Friction material should appear even across the entire surface and the groove pattern should be visible. Replace friction disks if

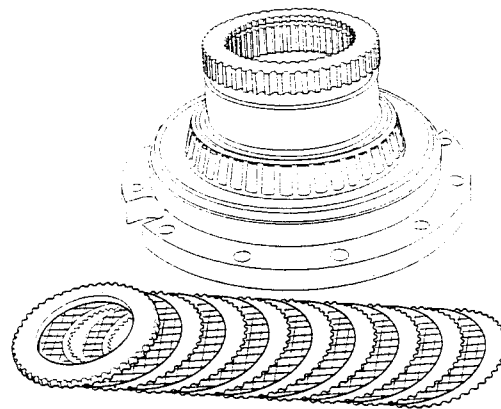
splines are worn to a point, disk is distorted, friction material is worn unevenly or groove pattern is no longer visible. Place each steel brake plate on a flat surface and check for distortion with a straight edge. Check surface for signs of material transfer or heat. Replace steel disks if splines are worn to a point, disk is distorted or heat discolored.

Check the brake release passage to be sure it is clean and completely open.

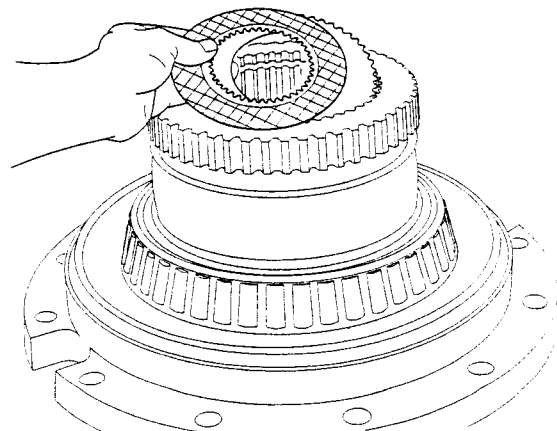
Inspect both sets of large tapered roller bearings (items 49, 50, 51 & 52) for signs of damage or excessive wear. The bearing rollers should not exhibit any irregularities. If the rollers show any sign of spalling, corrosion, discoloration, material displacement or abnormal wear, the bearing should be replaced. Likewise, the cage should be inspected for wear or deformation. If there is any damage that would impair the cage's ability to separate, retain and guide the rollers properly, the bearing should be replaced.

Carefully inspect both halves of the metal face seal between the motor support/brake cylinder and the ring gear. If the metal contact faces show signs of excessive wear or mechanical damage, or the rubber rings are brittle or damaged, the seal should be replaced.

## ASSEMBLY



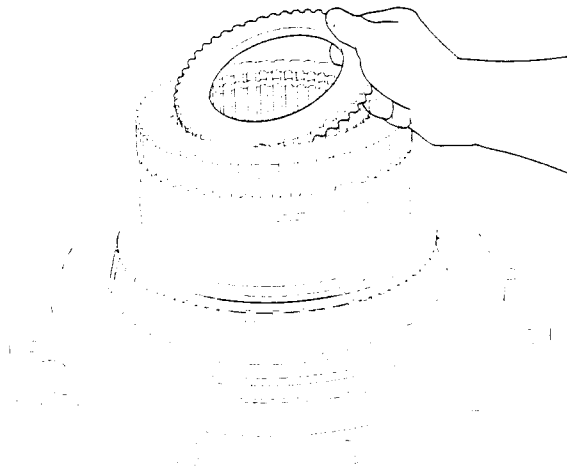
1. Set the motor support/brake cylinder on a bench with the motor end down.



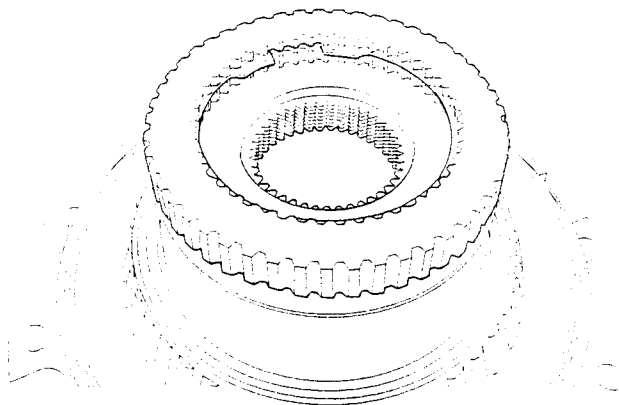
2. Starting with a steel disk, alternately install a steel



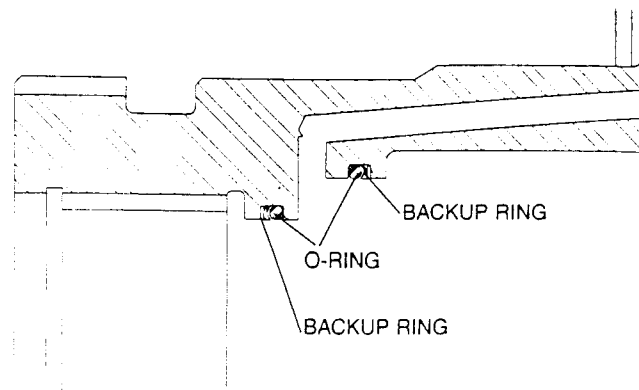
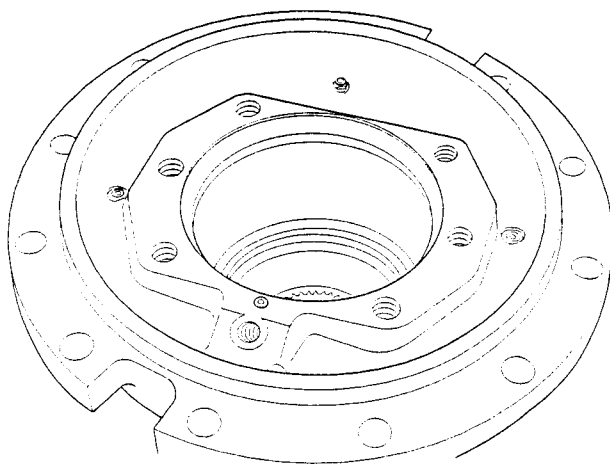
then a friction disk until eight (8) of each type disk have been installed (ending with a friction disk). It is advisable to lightly lubricate the brake disks with oil that will be used in the winch prior to assembly.



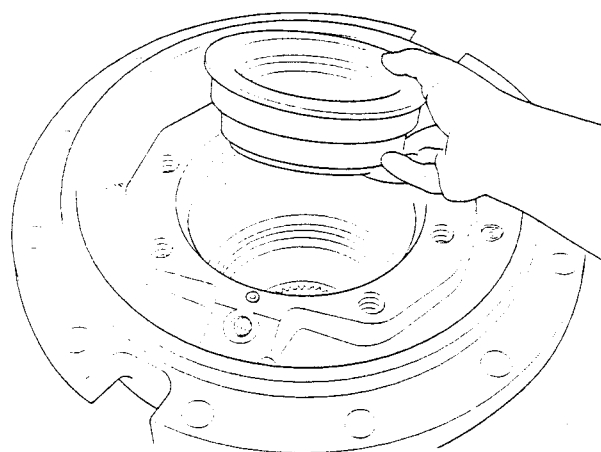
3. Install the spacer plate (item 82) on top of the last friction disk.



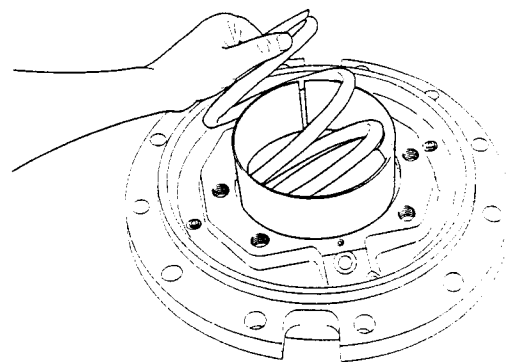
4. Install the retaining ring (item 81). Turn the assembly over with the motor end up and be sure all brake plates are stacked squarely against the spacer plate.



5. Install new O-rings and backup rings (items 86, 87, 88 & 89) into the brake cylinder as shown. It is VERY important to position the O-rings and backup rings as shown above to prevent brake cylinder leakage.

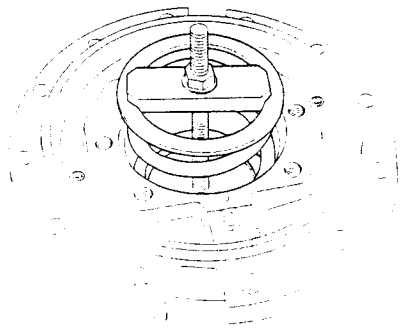


6. Lightly lubricate the sealing surfaces of the brake piston (item 90) and install it into the brake cylinder until it touches the brake disks.



7. Install the piston stop (item 92) and the brake spring (item 91).





8. Set the spring stop (item 93) on the spring and install the spring compressor tool, or move the assembly to a press. Be sure the step on the compressor tool is squarely seated on the spring stop.

## ⚠ CAUTION

The brake spring must be compressed approximately 4 inches (10 cm) and has a compressed force of approximately 1,500 lb (680 kg). Extreme care should be observed while completing this step to avoid sudden release of the spring. **DO NOT** stand directly in front of the spring while it is being compressed.

9. Slowly compress the spring until the spring stop is slightly below the retaining ring groove in the motor support. Install the retaining ring (item 94). **NOTE:** The holes in the ends of the retaining ring are slightly tapered. The smaller end of the hole **MUST** be installed away from the spring stop, or toward the motor, to prevent the ring from slipping off the pliers when installed or removed. Be sure the retaining ring is completely seated in its groove, and slowly release the spring compressor until the force of the spring is held by the retaining ring. Remove the spring compressor tool.

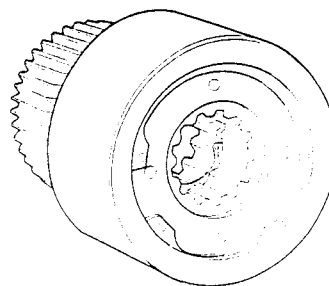
## Brake Cylinder Pressure Test

1. Connect a hydraulic hand pump with an accurate gauge and shut-off valve to the brake release port of the motor support. Apply 500 psi (3,450 kPa) to the brake. Close the shut-off valve and let stand for five (5) minutes. If there is any loss of pressure, the brake cylinder should be disassembled for inspection of the sealing surfaces and O-rings.

WHILE PRESSURE IS APPLIED AND THE BRAKE IS RELEASED, install the sprag clutch assembly. Rotate the clutch back and forth to align the splines in all brake disks. When the sprag clutch has engaged all the disks, release the pressure on the brake cylinder and remove the sprag clutch.

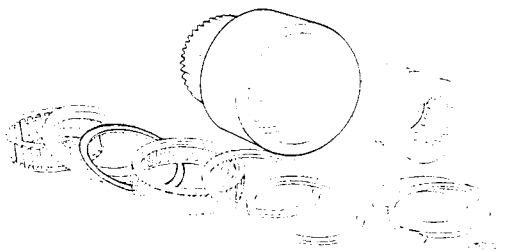
## Sprag Clutch Assembly

Before disassembling the sprag clutch, make note of the freewheeling direction of the inner brake race (item 102). Hold the outer race (item 96) and try to turn the inner race in both directions. It should turn free of the outer race in one direction only. If the inner race will not turn freely in either direction, or turns freely in both



directions, the sprag clutch assembly has been damaged and must be replaced.

1. Remove the retaining ring (item 104). All other internal parts can now be removed, including the sprag assembly (item 99) and the roller bearing (item 97).



2. Thoroughly clean all parts in solvent and inspect for signs of wear and/or damage. Inspect the sprag clutch and roller bearing closely for abnormal wear, cracks, pitting or corrosion. Check small clips for breakage or bright spots; the signs of excessive wear.

## ⚠ WARNING

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

3. Apply a light coat of gear box lubricant to all components as they are assembled. Install the roller bearing (item 97) into the outer race (item 96). Install spacer (item 98) on top of roller bearing. Install the sprag clutch assembly (item 99). **NOTE:** The sprag assembly consists of three parts; two u-shaped bronze spacers and a cam assembly. The bronze spacers are installed with their open end toward the cam assembly, one spacer on each side. Rotate the cam assembly while gently pressing it into the outer race.

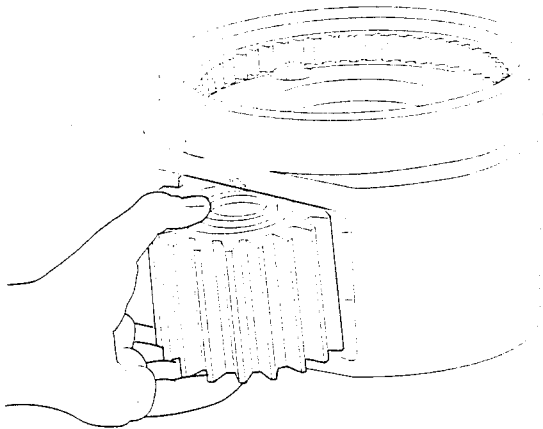
Before installing the inner race (item 102), be sure the internal retaining ring (item 101) is installed and fully seated. Slide the inner race through the sprag clutch (the race will have to be rotated in the freewheeling direction to start it into the clutch). Be sure the inner race turns freely in the same direction determined before the unit was disassembled. If it turns freely in the opposite direction, the sprag clutch has been installed backwards and must be reversed. Install spacers (items 100 & 103), and retaining ring (item 104).



# PLANET CARRIER SERVICE

## OUTPUT PLANET CARRIER

1. The preferred method of removing the planet pin (item 73), is to first remove the roll pin (item 79). This can usually be done by using a punch or small pry bar to drive or push the roll pin out of the planet carrier (item 72). Access to the roll pin is gained through a drilled hole in the end of the planet pin. If this method is not successful, the roll pin must be sheared by driving or pressing the planet pin 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 one planet pin, shearing the roll pin.



2. Slide the planet gear out of the carrier and remove the bearing cones. Clean and inspect the bearing cups in each end of the gear. If they are determined to be in serviceable condition, no further disassembly is required.

3. If the bearings need to be replaced, remove the bearing cups, spacer and internal retaining ring from the bore of the planet gear.

4. Repeat steps 1, 2 and 3 for each planet gear.

Thoroughly clean all parts and inspect 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.

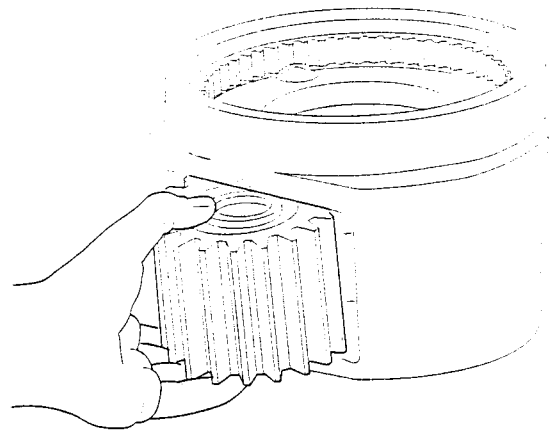
**NOTE:** Steps 5 through 8 are necessary only if the planet gear bearings are being replaced.

5. Install a retaining ring (item 78) in the bore of a planet gear. Be sure it is completely seated in the groove.

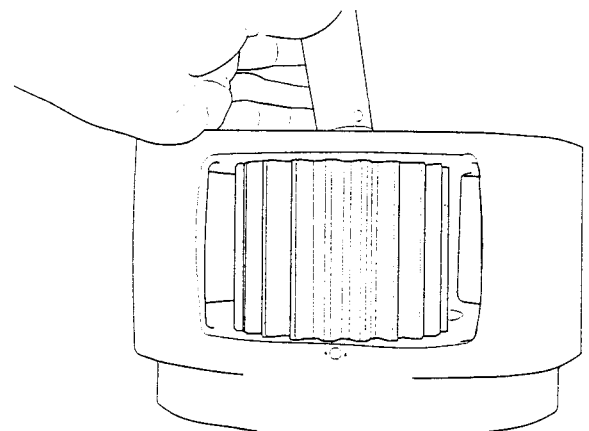
6. Install a bearing spacer (item 77) into the bore of the planet gear. Be sure the step on the spacer is toward the retaining ring.

7. Install a bearing cup (item 75) into each end of the gear. The cups should firmly contact the spacer.

8. Repeat steps 5, 6 and 7 for each planet gear.



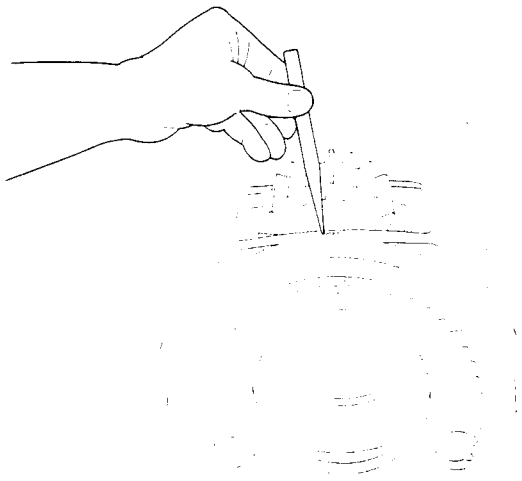
9. Install a bearing cone (item 74) into each end of a planet gear and slide the gear and bearings into the planet carrier, aligning the bearing bores with the planet pin bore.



10. Install a planet pin through the planet carrier and bearings, aligning the hole in the pin with the roll pin hole in the carrier. Drive a new roll pin (item 79) into place in the carrier.

**NOTE:** Always use NEW roll pins.





11. 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.

12. Repeat steps 9, 10 and 11 for each planet gear.

## PRIMARY AND SECOND STAGE PLANET CARRIERS

1. The preferred method of removing the planet pin, is to first remove the roll pin. This can usually be done by using a punch or small pry bar to drive or push the roll pin out of the planet carrier. Access to the roll pin is gained through a drilled hole in the end of the planet pin. If this method is not successful, the roll pin must be sheared by driving or pressing the planet pin 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 one planet pin, shearing the roll pin.

2. Slide the planet gear out of the carrier and remove the thrust washers and loose roller bearings.

3. Repeat steps 1 and 2 for each planet gear.

4. Remove the retaining ring holding the sun gear in the planet carrier and remove the sun gear.

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, the rollers 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.

5. Engage the sun gear with the splines on the planet carrier and install the retaining onto the sun gear.

6. Liberally coat the bore of a planet gear with a good grade of oil soluble grease.

7. 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.

8. 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 one of the planet pin bores 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.

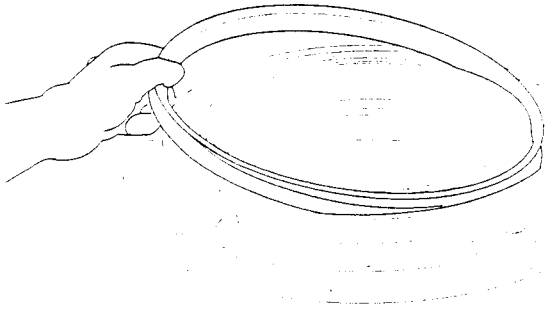
9. The roll pin should be slightly recessed in the carrier when properly installed. Use a punch to stake the carrier next to the pin hole so the pin will not back out when the unit is in operation.

10. Repeat steps 5 through 9 for the remaining planet gears.



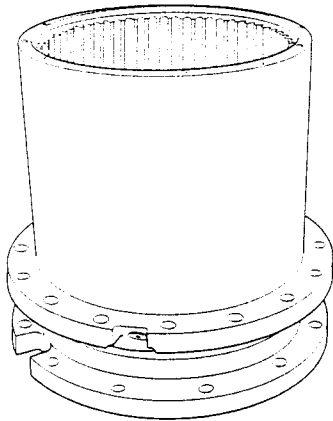
# UNIT ASSEMBLY

The following procedure should be used to assemble a complete winch and drive gearbox. It assumes all sub-assemblies have been properly serviced as described in previous sections of this manual.

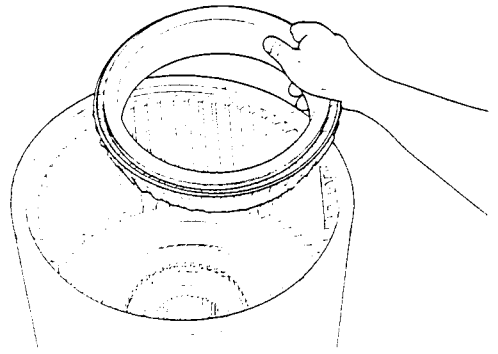


1. If the metal seal (item 53) is being replaced, install one half of the seal in the motor support and the other half in the ring gear. The old seal is simply pried out of its seat. Clean the seal seat area in both the motor support and ring gear. **NOTE:** handle the new seals with care. The metal contact areas must remain perfectly flat and free of nicks or dents for the seal to operate leak free.

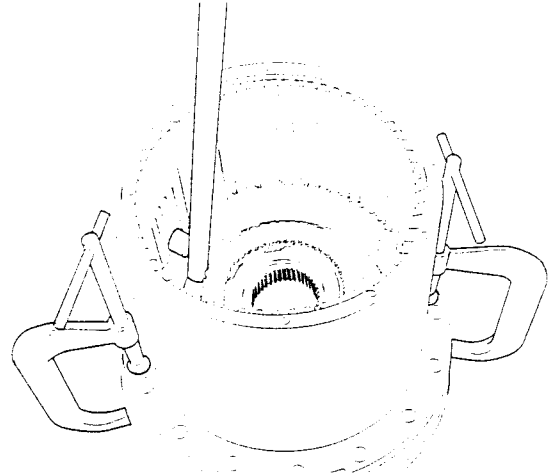
Apply a liberal coat of oil soluble grease to the new seal O-rings and install one O-ring on each seal half. Each seal half can then be gently worked into its seat in the motor support and ring gear.



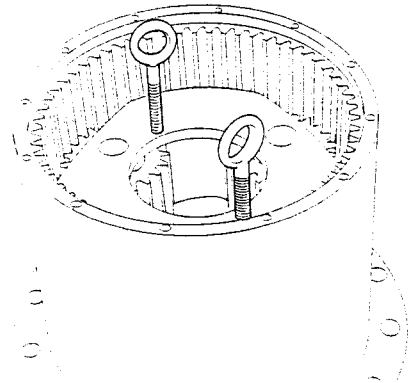
2. If the tapered roller bearings (items 49, 50, 51 & 52) are being replaced, install bearing cone (item 52) onto the motor support. Install both bearing cups (items 50 & 51) into the ring gear. Set the motor support on your workbench with the motor end down. Apply a light coat of oil to the mating surfaces of the metal seal, and set the ring gear down onto the motor support. Mating surfaces of the seal should be in contact with each other and the ring gear should rotate smoothly.



3. Install the bearing cone (item 49) onto the motor support. Use a bar or flat ended punch to fully seat the bearing. Again check that the ring gear rotates freely.

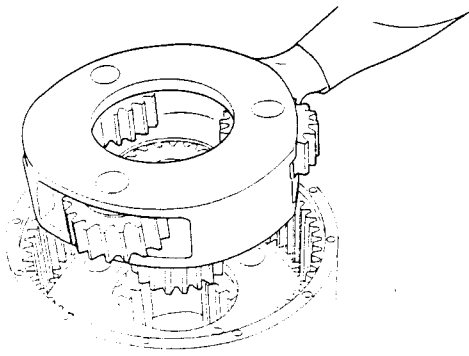


4. Install two large c-clamps between the flanges of the motor support and ring gear. Tighten the c-clamps firmly and again fully seat the bearing installed in step 3. Install both halves of the split ring (item 48) into the groove on the motor support. A 1 inch diameter bar and various sizes of steel blocks or key stock can be used, if necessary, to force the split ring halves into the groove. Be careful to avoid damaging the ring gear teeth while installing the split ring. Remove the two c-clamps.

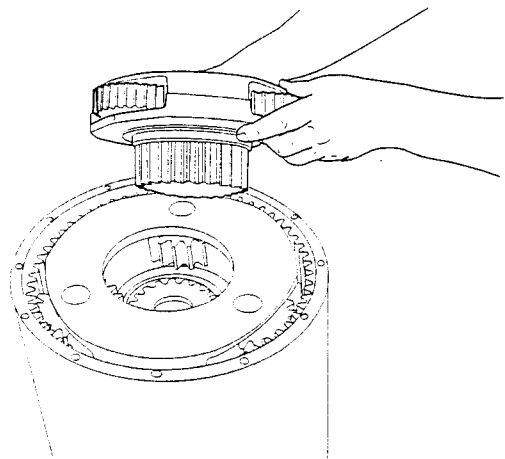


5. Install 2 each 1/2 - 13 eye bolts into the output planet carrier and use them to set the planet assembly into the ring gear. Rotate the planet carrier to engage the splines on the motor support. In addition to engaging the splines, the planet carrier must drop down over the split ring halves, holding them in position.

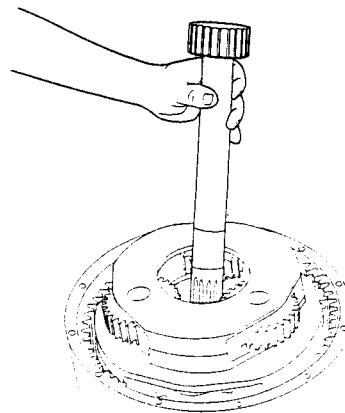




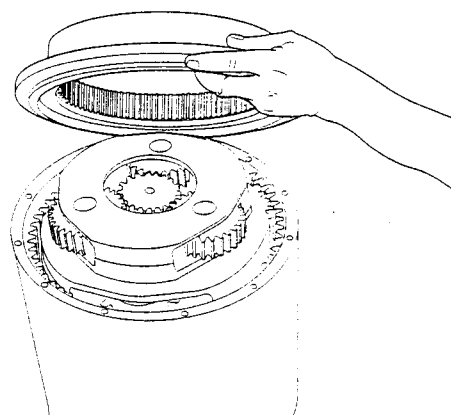
6. Install thrust washer (item 65), onto the second stage planet assembly (with output sun gear). A light coat of oil soluble grease should be used to hold it in place during assembly. Slide the planet assembly into the ring gear and engage the output sun gear with the output planet gears. The second stage planet gears should now be at least  $\frac{1}{8}$  inch (3 mm) below the top of the teeth cut into the ring gear. If they are above the ring gear teeth, the unit is not properly assembled to this point. Either the thrust washer (item 65) is improperly positioned, or the output planet carrier is not fully engaged onto the motor support (possibly caused by the split ring not being fully seated). Remove the second stage planet assembly and/or the output planet assembly to determine and correct the cause of the problem before proceeding.



7. Install thrust washer (item 57), onto the primary planet assembly (with second stage sun gear). A light coat of oil soluble grease should be used to hold it in place during assembly. Install the primary planet assembly onto the second stage planet assembly, engaging the second stage sun gear with the second stage planet gears. Visually check to be sure the thrust washer is properly positioned.



8. Install the primary sun gear (item 55) through the center of the primary planet assembly.

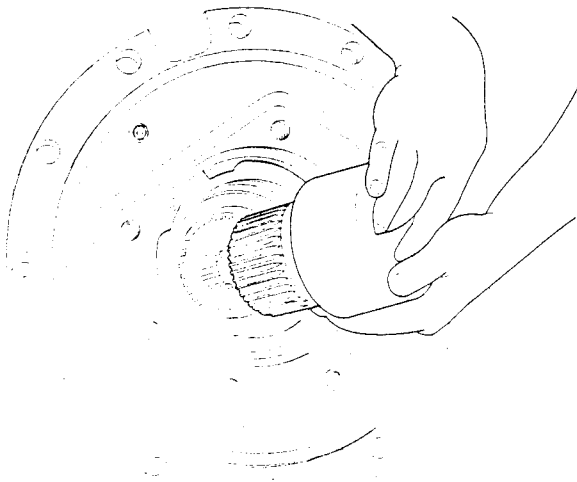


## ⚠ CAUTION

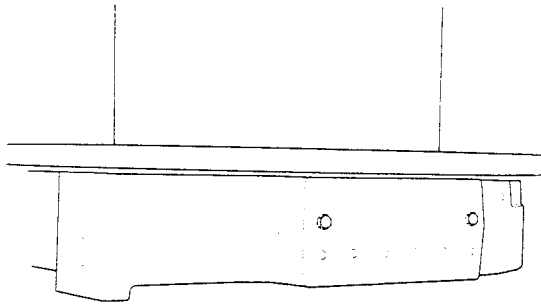
In the following step, the primary ring/cover may suddenly drop onto the main ring gear when all primary sun gear teeth are aligned with those in the cover. DO NOT work with your fingers between the cover and the main ring gear.

9. Carefully set the cover (item 42) onto the main ring gear, engaging the primary planet gears with the gear teeth machined into the cover. Turn the cover to align the bolt holes with those in the main ring gear and install all twelve (12) capscrews and lockwashers (items 43 & 44).

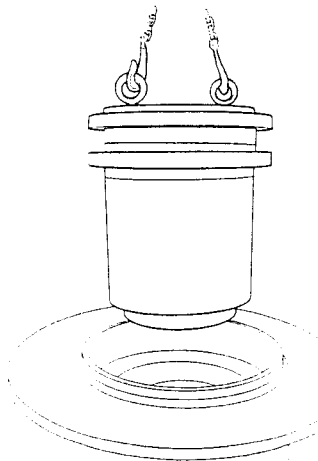




10. Turn the unit over and visually check to see if all internal teeth on the brake disks are aligned. If they are not aligned, connect a hand operated hydraulic pump to the brake release port and apply 500 psi (3,450 kPa). This will allow the brake plates to be rotated and aligned as the sprag clutch assembly is installed. Install the sprag clutch assembly. The top of the sprag assembly should be just below the spring stop (item 93) when installed completely. If a hand pump was used, release the pressure and remove the pump.

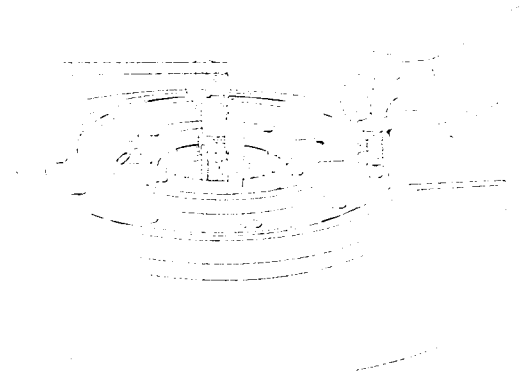


11. Carefully set the cable drum onto the support end bracket (item 2). Pay careful attention that the bearing is not damaged and engages properly.

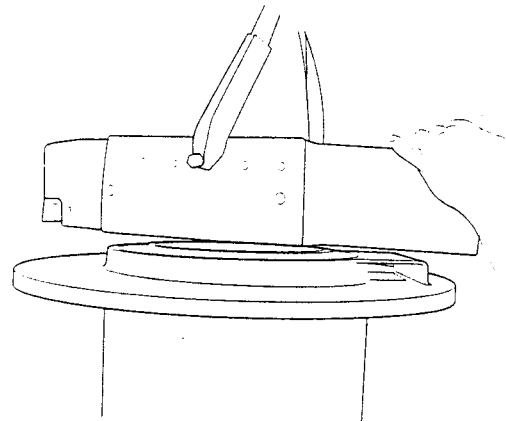


12. Install 2 eye bolts into the winch drive assembly and

use them to lift the drive. While the drive is suspended, install a new O-ring (item 24) under the lower flange of the drive. Carefully set the drive into the winch drum, aligning the holes in the drum with those in the bottom flange of the drive.

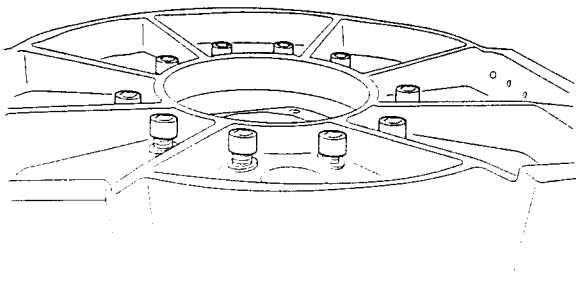


13. There are two large notches in the end of the drive gearbox. These must be rotated to install the capscrews and lockwashers (items 4 & 5) that secure the gearbox to the winch drum. This is done by rotating the motor coupling while keeping the drum from turning. Continue this procedure and install all capscrews and lockwashers (items 4 & 5). **NOTE:** To obtain relative movement between the two sections of the gearbox, the input shaft must be rotated in the same direction as the motor turns to haul-in cable. Rotating the shaft in the opposite direction results in the entire gearbox and drum turning as a single unit.

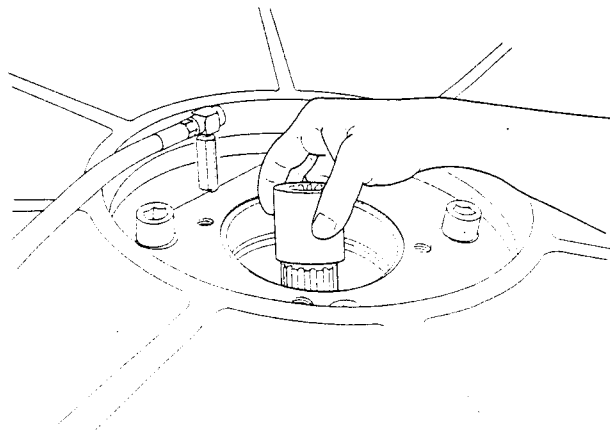


14. Install the motor end bracket (item 25) onto the winch drive. Be sure to orient the end bracket so the vent plug will be as close as possible to the 12:00 o'clock position when the winch is installed.

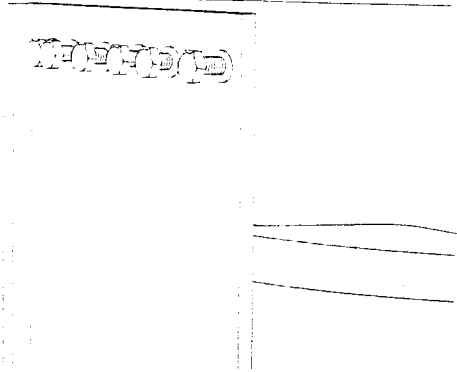




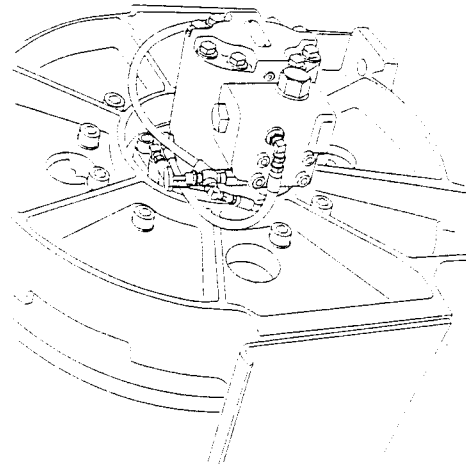
15. Install the ten (10) capscrews and lockwashers (items 29 & 30) securing the end bracket to the winch drive. If necessary, rotate the motor end bracket until it is aligned with the support end bracket.



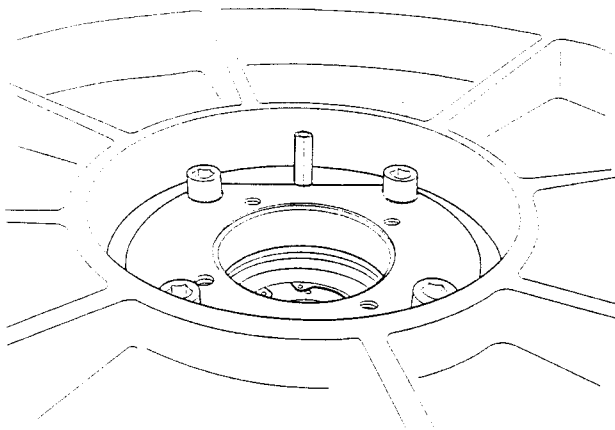
18. Install the motor coupling into the inner race of the sprag clutch.



16. Install the two tie plates between the two end brackets, using the dowels in the end brackets to align and position them. Install all twenty four (24) capscrews and lockwashers (items 15 & 16) securing the tie plates to the end brackets.



19. Install a new O-ring (item 121) onto the pilot of the hydraulic motor. Install the hydraulic motor into the motor adapter, engaging the motor splines with the motor coupling. Install the four (4) capscrews and lockwashers (items 122 & 123), securing the motor to the motor adapter. Connect the brake release hose to the brake release port on the winch drive.



17. Install a new O-ring (item 26) onto the motor adapter. Install the motor adapter into the winch drive using four (4) capscrews and lockwashers (items 33 & 4).



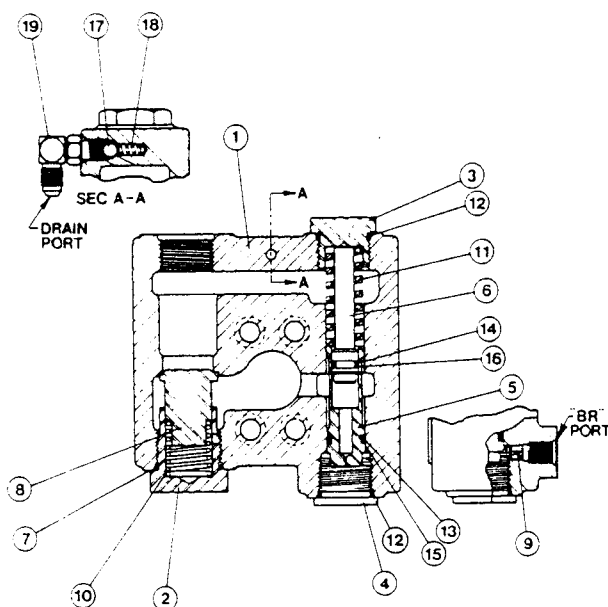
# BRAKE VALVE SERVICE

Braden CH330 and CH400 winches are supplied with one of two brake valves, depending on the hydraulic motor used. Both are reliable hydraulic valves 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 trouble shooting operations and are certain the brake valve is causing the malfunction.

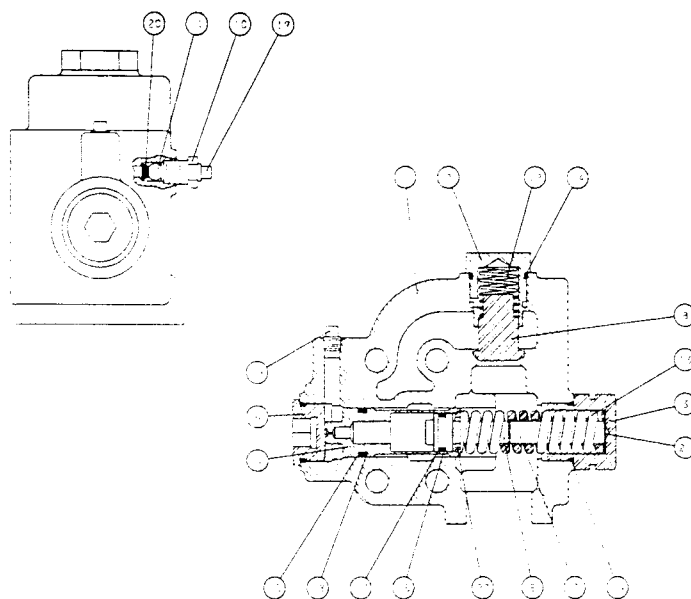
Thoroughly clean the outside surfaces of the valve and work in a clean dust free area, as cleanliness is of utmost importance when servicing hydraulic components.

## 1 1/2 INCH BRAKE VALVE



1 1/2 INCH BRAKE VALE ASSEMBLY		
ITEM	QUANTITY	DESCRIPTION
1	1	VALVE HOUSING (NSS)
2	1	SPRING RETAINER (NSS)
3	1	SPRING RETAINER (NSS)
4	1	PLUG (NSS)
5	1	SPOOL (NSS)
6	1	DAMPER PISTON (NSS)
7	1	O-RING
8	1	CHECK VALVE POPPET (NSS)
9	1	PILOT ORIFICE
10	1	CHECK VALVE SPRING
11	1	SPOOL SPRING
12	2	O-RING
13	1	O-RING
14	1	O-RING
15	1	BACK-UP RING
16	1	BACK-UP RING
17	1	CHECK BALL (1/4")
18	1	CHECK BALL SPRING
19	1	ELBOW FITTING

## 1 1/2 INCH BRAKE VALVE



1 1/2 INCH BRAKE VALE ASSEMBLY		
ITEM	QUANTITY	DESCRIPTION
1	1	VALVE HOUSING (NSS)
2	1	SPRING RETAINER (NSS)
3	1	SPRING RETAINER (NSS)
4	1	PLUG (NSS)
5	1	SPOOL (NSS)
6	1	DAMPER PISTON (NSS)
7	1	DAMPER PISTON EXTENSION
8	1	CHECK VALVE POPPET (NSS)
9	1	PILOT ORIFICE
10	1	REDUCER
11	1	CHECK BALL
12	1	CHECK VALVE SPRING
13	1	SPOOL SPRING
14	2	O-RING
15	1	BACK-UP RING
16	1	O-RING
17	1	BACK-UP RING
18	1	O-RING
19	2	PIPE PLUG
20	1	CHECK BALL SPRING
21	as req'd.	SHIM
22	1	SPRING SEAT

NSS - NOT SERVICED SEPARATELY.  
ORDER COMPLETE VALVE ASSEMBLY.

1 1/2 inch brake valves built after mid-March 1997 contain a spring seat (item 22 above) 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 the pressure/flow modulation over the full compression range of the spring.

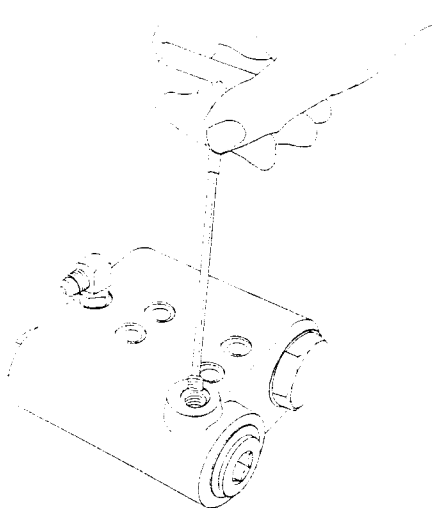
The spring retainer has been modified to allow for the additional thickness of the spring seat and a groove machined into the hex end cap serves as a visual indicator that the valve contains the new spring seat. The spring seat improvement may be added to early brake valves by installing kit (Part No. 62805). Items 3, 7, 13, 14 and 22 shown above are included in the kit. We rec-



ommend that this kit be installed whenever the brake valve is removed for inspection or service.

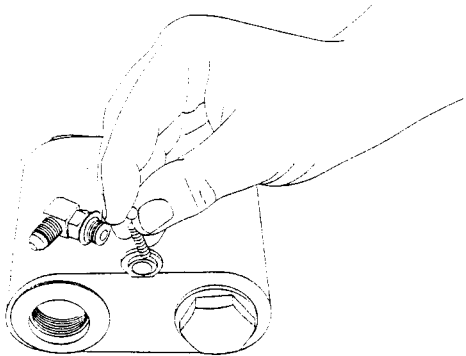
It is always a good practice to check the initial opening or "cracking" pressure of the brake valve whenever the hoist is serviced or inspected. Refer to Braden Service Bulletin number 527 for complete brake valve test and adjustment procedures.

## DISASSEMBLY

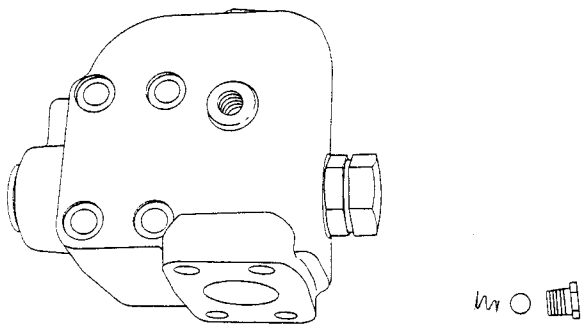


1. On the 1½ in. valve only, remove the pilot orifice from the brake release (BR) port using a 5/32 in. Allen wrench.

1½ in. valve

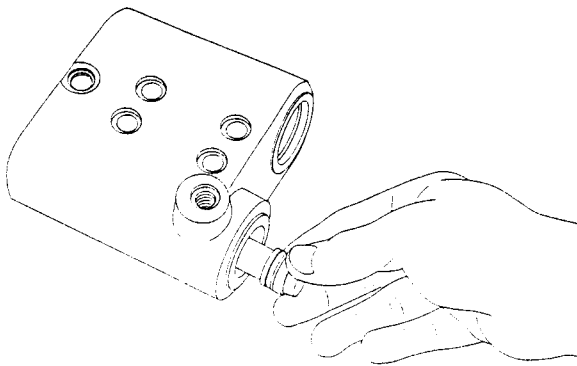


1½ in. valve

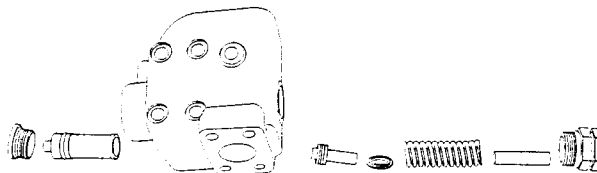


2. Remove the fitting, motor drain check ball and spring.

1½ in. valve

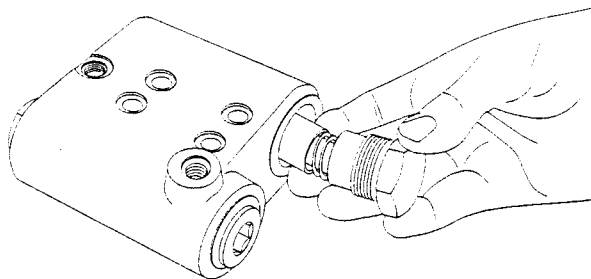


1½ in. valve

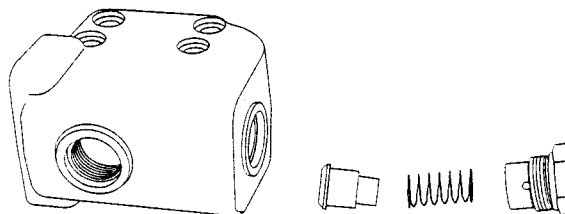


3. Remove the spool spring retainer and spool spring. Remove the spool plug and carefully remove the spool assembly. Remove the damper piston from the spool. The piston will come out of the spool slowly, because of a partial vacuum formed between the two. Use extreme care to avoid damaging the polished surfaces of either piece.

1½ in. valve



1½ in. valve



4. 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

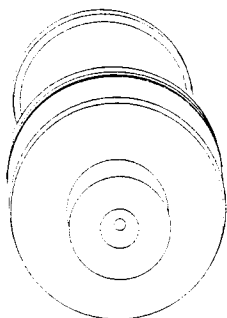


spool and damper piston for damage that may cause binding or leakage. Inspect spool bore in valve housing for damage or scoring. Inspect check valve seat in valve housing and check valve poppet. If the spools, bores or valves are damaged, the entire valve must be replaced as these parts are not serviced separately. Check the free length of the main piston spring. For the 1¼ inch valve, replace if less than 1<sup>15</sup>/<sub>16</sub> inches (49.2 mm) long. For the 1½ inch valve, replace if less than 3<sup>7</sup>/<sub>16</sub> inches (87.3 mm) long. Check the free length of the check valve spring. Replace if less than 1½ inches (38.1 mm) long.

#### 1¼ in. valve



#### 1½ in. valve

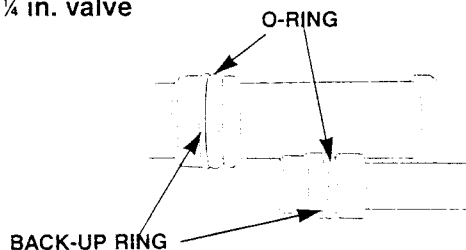


2. Inspect the 0.020 inch (0.5 mm) orifice in the end of the spool to be certain it is open. On the 1¼ in. valve, also inspect the pilot orifice to be certain it is open.

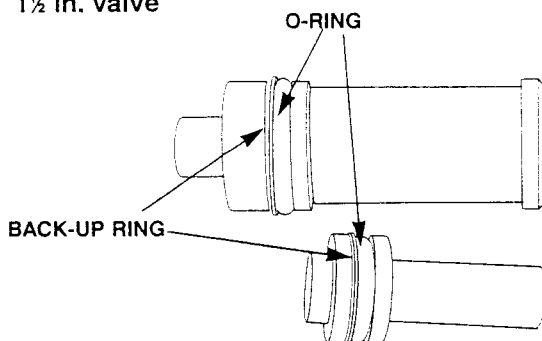
## ASSEMBLY

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

#### 1¼ in. valve



#### 1½ in. valve



2. 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 minutes before installing them in their respective bores. This will allow the O-rings to return to their original size after being stretched.

#### 1¼ in. valve



#### 1½ in. valve



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. On either valve, always install the spool into the valve body so the O-ring enters the bore first, or the plug end of the valve body. Install the plug. On the 1¼ in. valve, install the spool spring and spring retainer. On the 1½ in. valve, install the spring seat, spool spring, damper piston extension and spring retainer.

4. Install the check valve poppet, spring and check valve spring retainer.

5. Install the motor drain check ball, spring and fitting.

6. On the 1¼ in. valve only, install the pilot orifice into the BR port on the valve housing.

7. The brake valve is now complete and ready to be installed on the winch motor.



## RECOMMENDED FASTENER 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.

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

BOLT DIA. INCHES	THD PER INCH	TORQUE LB-FT. (N·m)	
		DRY	LUBED
1/4	20 28	9 (12)	6 (8)
5/16	18 24	18 (24)	13 (18)
3/8	16 24	31 (42)	23 (31)
7/16	14 20	50 (68)	37 (50)
1/2	13 20	75 (102)	55 (75)
9/16	12 18	110 (149)	80 (109)
5/8	11 18	150 (203)	115 (156)

BOLT DIA. INCHES	THD PER INCH	TORQUE LB-FT. (N·m)	
		DRY	LUBED
3/4	10 16	265 (359)	200 (271)
7/8	9 14	420 (569)	325 (441)
1	8 14	640 (868)	485 (658)
1 1/8	7 12	790 (1071)	590 (800)
1 1/4	7 12	1110 (1505)	835 (1132)
1 3/8	6 12	1460 (1980)	1095 (1485)
1 1/2	6 12	1940 (2630)	1455 (1973)

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



# METRIC CONVERSION TABLE

MULTIPLY:	BY:	TO GET:	MULTIPLY:	BY:	TO GET:
<b>LINEAR</b>					
inches (in.)	× 25.4	= millimeters (mm)	× 0.03937		= inches (in.)
feet (ft.)	× 0.3048	= meters (m)	× 3.281		= feet (ft.)
miles (mi.)	× 1.6093	= kilometers (km)	× 0.6214		= miles (mi.)
<b>AREA</b>					
inches <sup>2</sup> (sq.in.)	× 645.15	= millimeters <sup>2</sup> (mm <sup>2</sup> )	× 0.000155		= inches <sup>2</sup> (sq.in.)
feet <sup>2</sup> (sq.ft.)	× 0.0929	= meters <sup>2</sup> (m <sup>2</sup> )	× 10.764		= feet <sup>2</sup> (sq.ft.)
<b>VOLUME</b>					
inches <sup>3</sup> (cu.in.)	× 0.01639	= liters (l)	× 61.024		= inches <sup>3</sup> (cu.in.)
quarts (qts.)	× 0.94635	= liters (l)	× 1.0567		= quarts (qts.)
gallons (gal.)	× 3.7854	= liters (l)	× 0.2642		= gallons (gal.)
inches <sup>3</sup> (cu.in.)	× 16.39	= centimeters <sup>3</sup> (cc)	× .06102		= inches <sup>3</sup> (cu.in.)
feet <sup>3</sup> (cu.ft.)	× 28.317	= liters	× 0.03531		= feet <sup>3</sup> (cu.ft.)
feet <sup>3</sup> (cu.ft.)	× 0.02832	= meters <sup>3</sup> (m <sup>3</sup> )	× 35.315		= feet <sup>3</sup> (cu.ft.)
fluid oz. (fl. oz)	× 29.57	= milliliters (ml)	× 0.03381		= fluid oz. (fl.oz.)
<b>MASS</b>					
ounces (oz.)	× 28.35	= grams (g)	× 0.03527		= ounces (oz.)
pounds (lbs.)	× 0.4536	= kilograms (kg)	× 2.2046		= pounds (lbs.)
tons (2000 lb.)	× 907.18	= kilograms (kg)	× 0.001102		= tons (2000 lb.)
tons (2000 lb.)	× 0.90718	= metric tons (t)	× 1.1023		= tons (2000 lb.)
tons (long) (2240 lb)	× 1016.05	= kilograms (kg)	× 0.000984		= tons (lg) (2240 lb.)
<b>PRESSURE</b>					
inches Hg (60°F)	× 3600	= kilopascals (kPa)	× 0.2961		= inches Hg
pounds/sq.in. (PSI)	× 6.895	= kilopascals (kPa)	× 0.145		= pounds/sq.in. (PSI)
pounds/sq.in. (PSI)	× .0703	= kilograms/sq.cm (kg/cm <sup>2</sup> )	× 14.22		= pounds/sq.in. (PSI)
pounds/sq.in. (PSI)	× .069	= bars	× 14.50		= pounds/sq.in. (PSI)
inches H <sub>2</sub> O (60°F)	× 0.2488	= kilopascals (kPa)	× 4.0193		= inches H <sub>2</sub> O
bars	× 100	= kilopascals (kPa)	× 0.01		= bars
<b>POWER</b>					
horsepower (hp)	× 0.746	= kilowatts (kW)	× 1.34		= horsepower (hp)
ft.-lbs./min	× 0.0226	= watts (W)	× 44.25		= ft.-lbs./min.
<b>TORQUE</b>					
pound-inches(in.-lbs.)	× 0.11298	= newton-meters (N•m)	× 8.851		= pound-inches (in.lb.)
pound-feet (ft.-lbs.)	× 1.3558	= newton-meters (N•m)	× 0.7376		= pound-feet (ft.-lb.)
pound-feet (ft.-lbs.)	× .1383	= kilograms/meter(kg•m)	× 7.233		= pound-feet (ft.-lb.)
<b>VELOCITY</b>					
miles/hour (m/h)	× 1.6093	= kilometers/hour (km/hr)	× 0.6214		= miles/hour (m/h)
feet/sec. (ft./sec.)	× 0.3048	= meter/sec. (m/s)	× 3.281		= feet/sec. (ft./sec.)
feet/min. (ft./min.)	× .3048	= meters/min. (m/min)	× 3.281		= feet/min. (ft./min)

**TEMPERATURE**      °Celsius = 0.556 (°F - 32)      °F = (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>





**Bosnor S. A. DE  
C. V. / Pemex**

**PB-KU-H Platform**

**Vendor Data Book**

P.O. # 1550-0268/05-01

Serial # 24005C

Volume: 1

## **Nautilus Crane Model 340LA-100**

### **Section 4.10.2 (b) Auxiliary Hoist CH150A & Boom Hoist CH230B**



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA









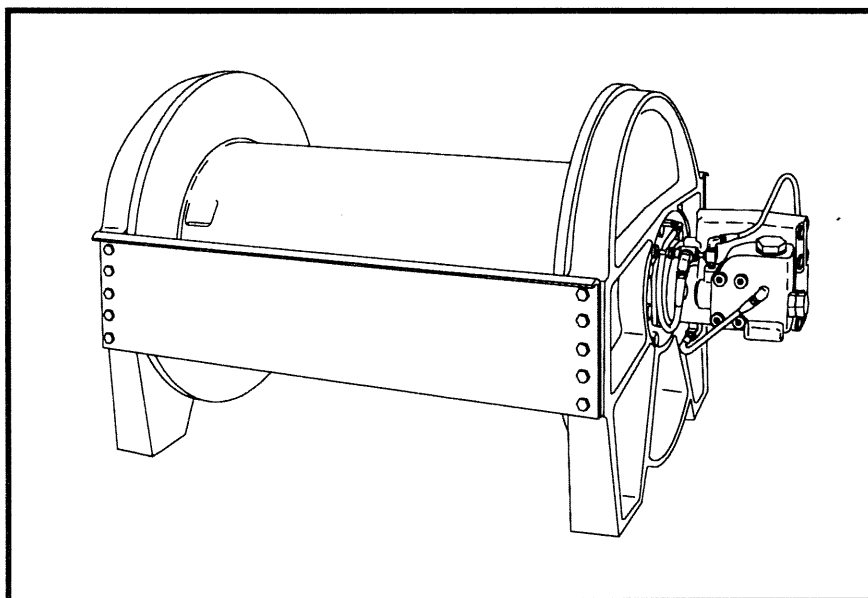
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# BRADEN

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## 2ND GENERATION “CH” SERIES PLANETARY HOISTS

CH150A  
CH175A  
CH185A  
CH230A  
C2H150A  
C2H175A  
C2H185A  
C2H230A



**INSTALLATION, MAINTENANCE AND SERVICE MANUAL**

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**PACCAR WINCH DIVISIONS**



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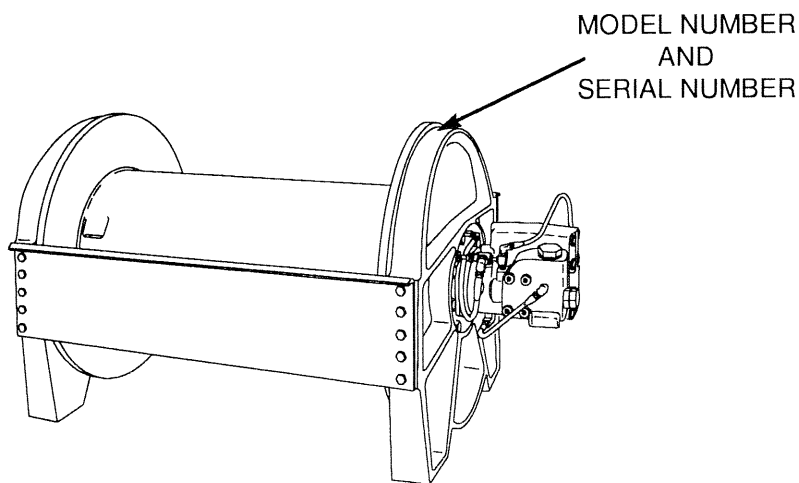
# FOREWORD

Read this entire publication and retain it for future reference.

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 at 1-918-251-8511, 08:00 - 16:30 hours, CST, Monday through Friday, 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

**CH**   **150**   **A**   -   **23**   **090**   **01**   **G**   -   **1**  
|   |   |   |   |   |   |   |  
CONSTRUCTION   MAX   DESIGN   GEAR   MOTOR   DRUM   DRUM   OPTION  
HOIST   RATING   MODEL   RATIO   SIZE   SIZE   OPTION

<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
<b>G</b>	DESIGNATES OTHER DRUM OPTIONS (G = GROOVED; M = MACHINED; P = RATCHET AND PAWL; U = UNDERWOUND)
<b>1</b>	PERMITS TESTING AND INSPECTION PRE API2C FOR OFFSHORE CRANES



# 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:

## **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 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 planetary reducer
9. Secondary planetary reducer
10. Ring gear and adapter

## THEORY OF OPERATION

The primary sun gear, being coupled to the hydraulic motor by the inner race of the brake clutch assembly, turns with the motor. As the primary sun gear turns, the primary planet gears, which are meshed with the primary sun gear and ring gear, walk around the stationary ring gear, causing the primary carrier to turn in the same direction as the motor shaft, but at a reduced speed. The primary carrier is meshed with the output sun gear which, therefore, turns in the same direction and at the same speed as the primary carrier. The output sun gear causes the output planet gears to walk around the ring gear, turning the output carrier and drum in the same direction as the primary carrier, but at a further reduced speed.

## DUAL BRAKE SYSTEM – DESCRIPTION

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

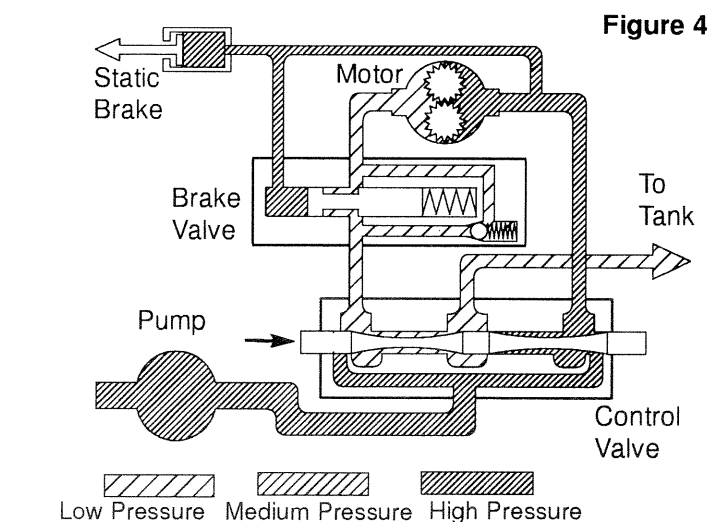
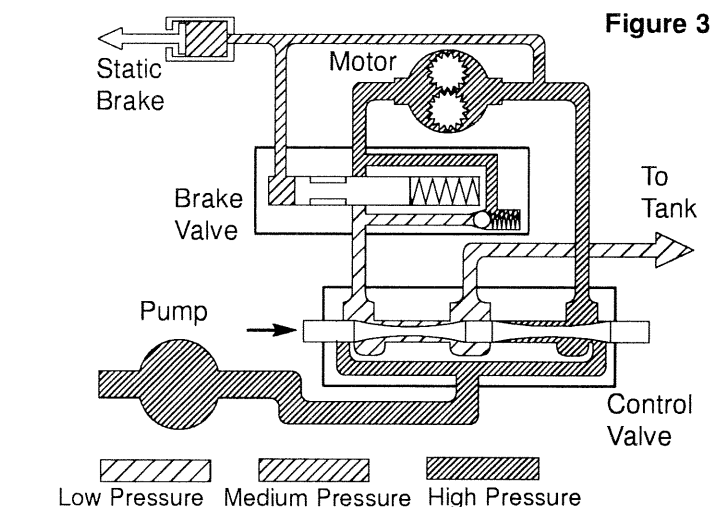
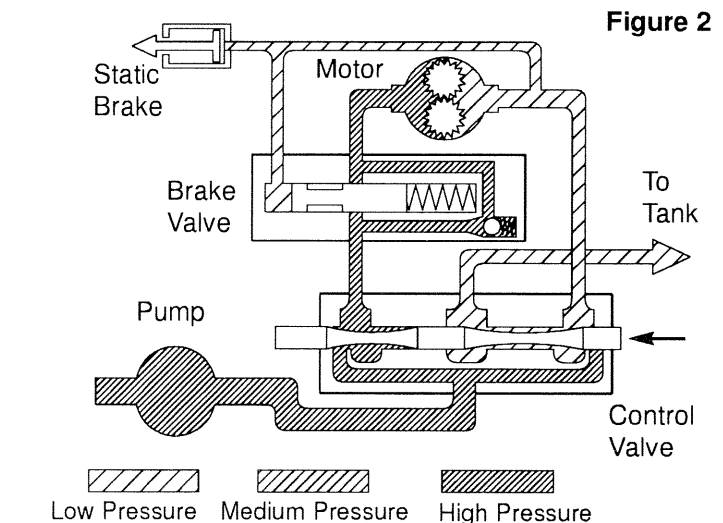
The dynamic brake system has two operating components:

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.

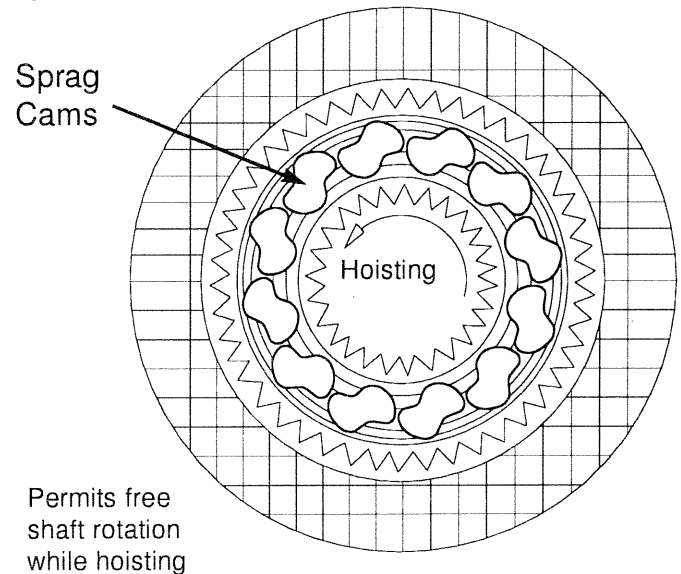
When the winch is powered in reverse, to lower the load, the motor cannot rotate until sufficient pilot pressure is present to open the brake valve. Figures 3 & 4. The friction brake within the winch will completely release at a pressure lower than that required to open the brake valve. The extent to 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.

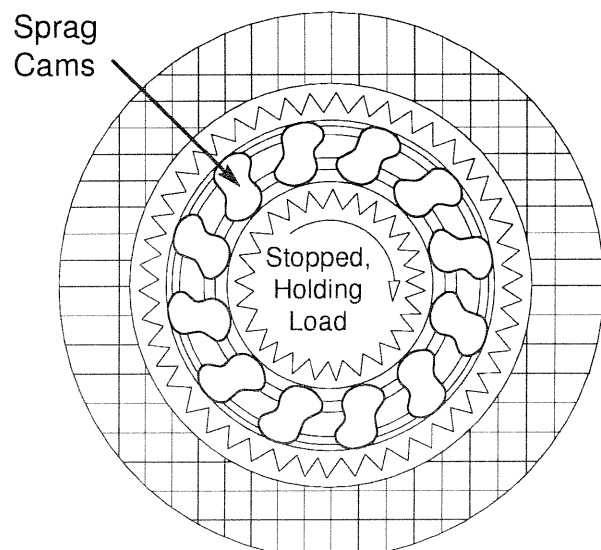
When lowering a load very slowly for precise positioning, no oil flow actually occurs through the winch motor. The pressure will build up to a point where the brake will release sufficiently to allow the load to rotate the motor through its own internal leakage. This feature results in a very slow speed 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 gate.
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 CH150A, CH175A, CH185A, CH230A, C2H150A, C2H175A, C2H185A and C2H230A hoists are 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 ½ 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

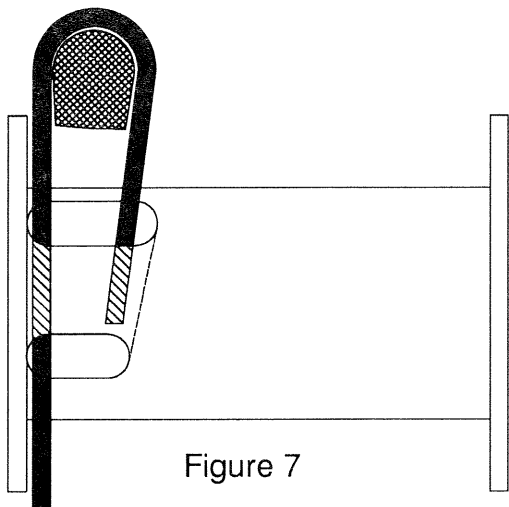


Figure 7

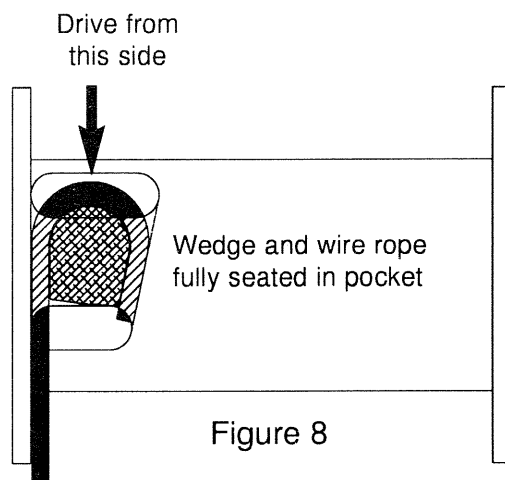
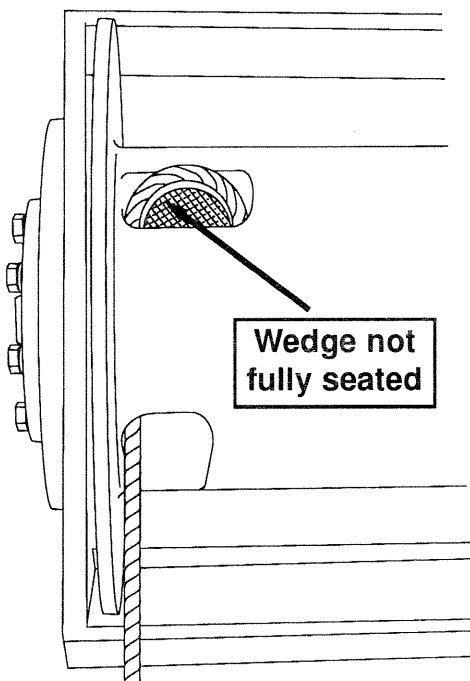


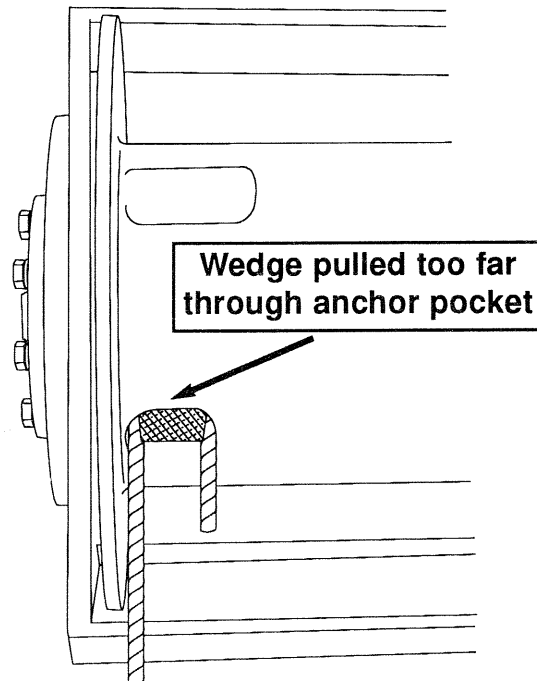
Figure 8

### 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

#### WINCH MODEL

#### WEDGE PART NO.

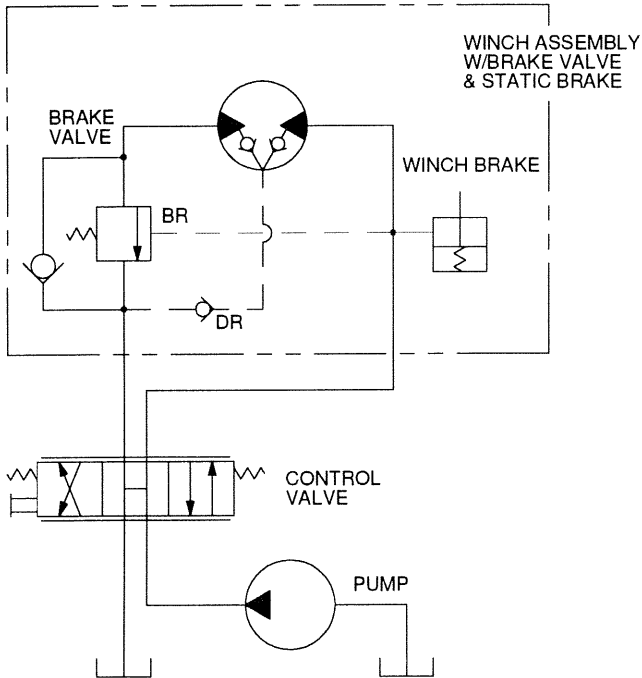
CH150A, C2H150A, CH185A, C2H185A	• <b>24493*</b> for 7/16 thru 5/8 in. (11 - 16 mm); <b>24494</b> 3/4 thru 1 in. (19 - 25 mm)
CH230A and C2H230A	• <b>24493</b> for 7/16 thru 5/8 in. (11 - 16 mm); <b>24494*</b> 3/4 thru 1 in. (19 - 25 mm)
CH175A and C2H175A	• <b>24492*</b> for 7/16 in. thru 7/8 in. (11 - 22 mm)

\* Standard Anchor

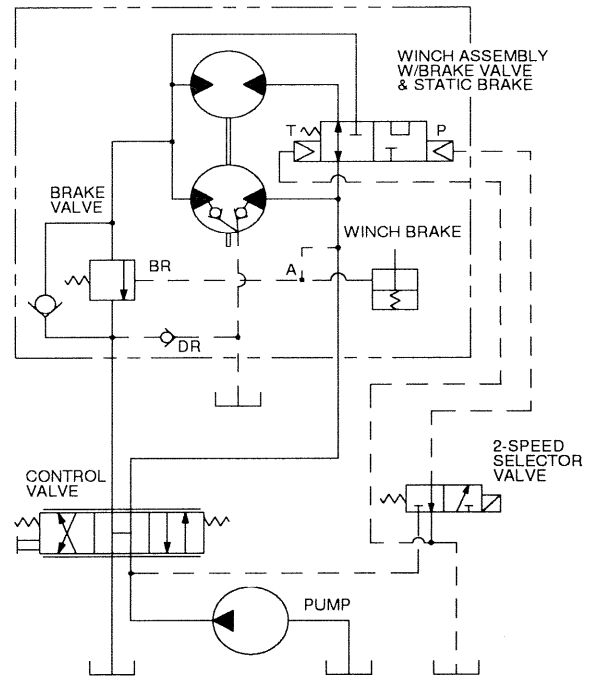


# HYDRAULIC CIRCUITS

## 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.

<b>Bolt Dia. Inches</b>	<b>Thds Per Inch</b>	<b>Torque LB-FT</b>	
		<b>Dry</b>	<b>Lubed</b>
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

<b>Bolt Dia. Inches</b>	<b>Thds Per Inch</b>	<b>Torque LB-FT</b>	
		<b>Dry</b>	<b>Lubed</b>
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



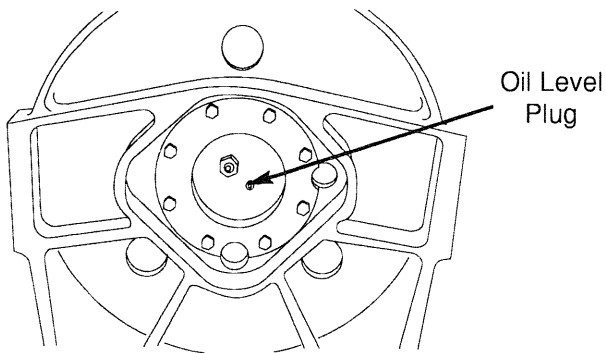
# PREVENTIVE MAINTENANCE

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.

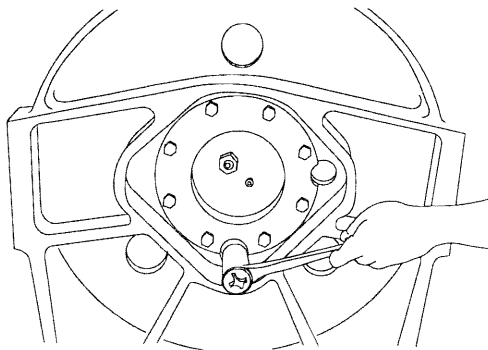
- **Regular Gear Oil Changes** — every 1000 hours or six (6) months
- **Use of Proper Gear Oil** — recommended type for prevailing ambient temperature
- **Annual Disassembly and Inspection of All Wear Items** — in compliance with American National Standards Institute (ANSI) specification B30.5c 1987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

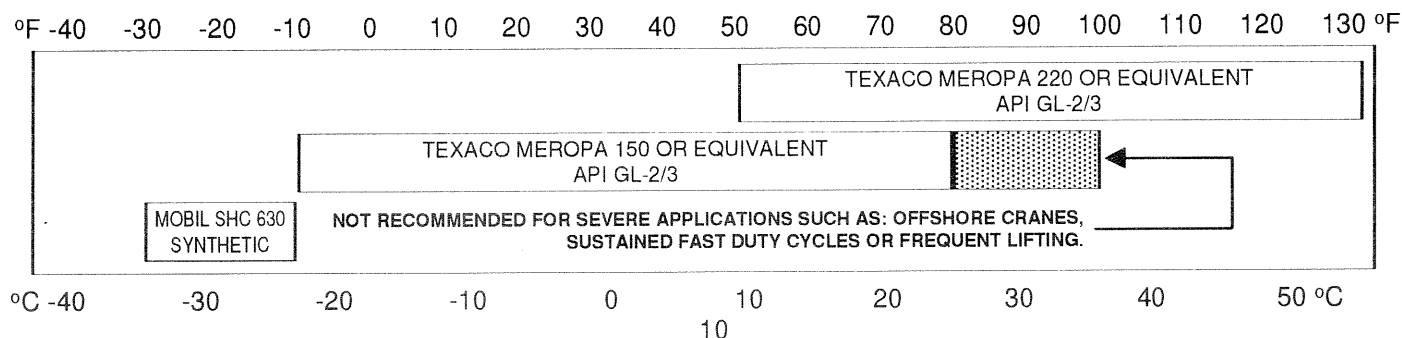
## 9. Inspection

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><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> <ol style="list-style-type: none"> <li>A. Install an accurate 0-4000 psi gauge into the inlet port of the brake valve.</li> </ol>



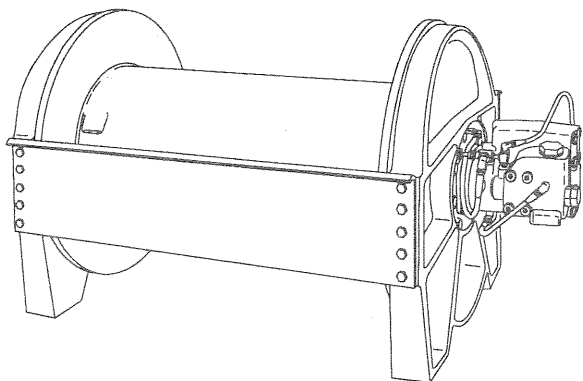
TROUBLE	PROBABLE CAUSE	REMEDY
TROUBLE "D" CONTINUED FROM PREVIOUS PAGE	<p>3. Be certain hydraulic system temperature is not more than 180 degrees F. Excessive hydraulic oil temperatures increase motor internal leakage and reduce motor performance.</p> <p>4. Winch line pull rating is based on 1<sup>st</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>



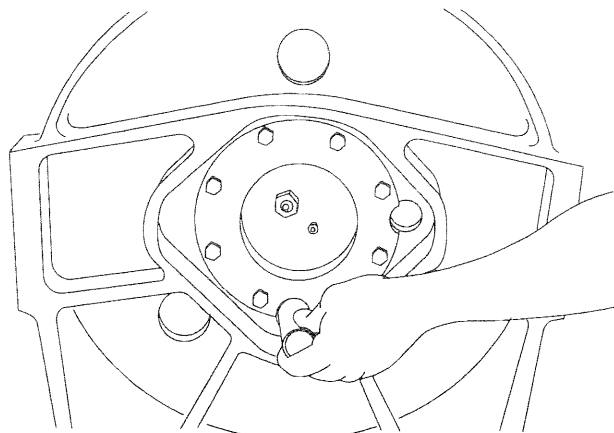
TROUBLE	PROBABLE CAUSE	REMEDY
<p style="text-align: center;"><b>F</b></p> <p>Winch "chatters" while raising rated load.</p>	<ol style="list-style-type: none"> <li>1. Same as D2.</li> <li>2. Hydraulic oil flow to motor may be too low.</li> <li>3. Controls being operated too quickly.</li> </ol>	<p>Same 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>



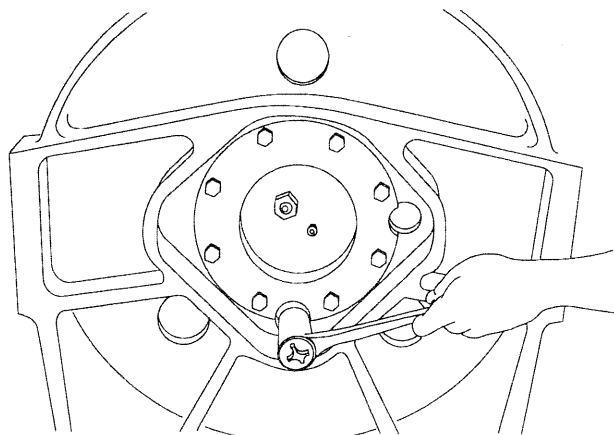
## DISASSEMBLY PROCEDURE FOR HOIST



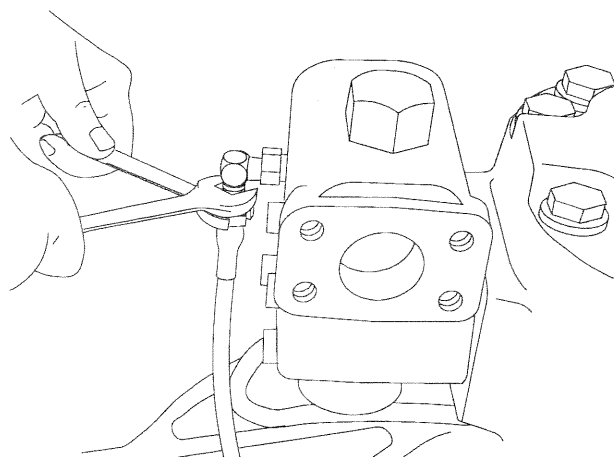
1. Remove the wire rope from the hoist drum and align the drain plug in the drum with the hole in the support end plate before removing the hoses and mounting bolts. After the hoist is removed from its mounting, clean the outside surfaces.



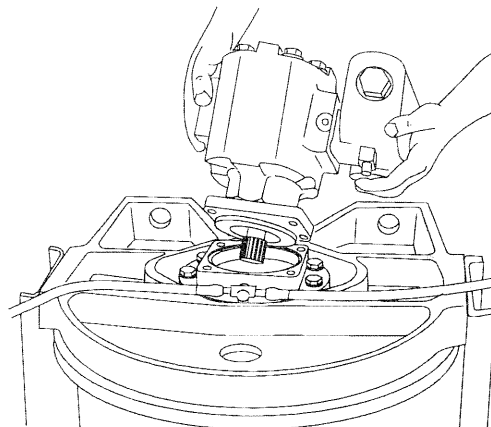
2. To drain the oil, screw a short piece of 1" pipe into the larger threads of the drain hole.



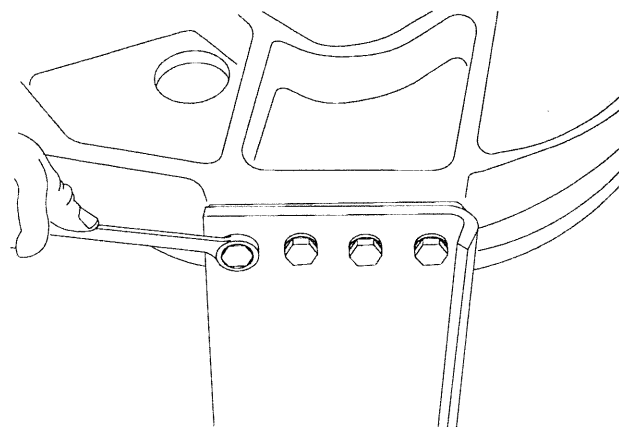
3. Use a 3/8" drive extension to remove the drain plug through the pipe. If the drain holes were not aligned before the hoist was removed from its mounting, the oil can be drained through the fill/vent plug in the bearing support by turning the hoist up on the bearing support end.



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.

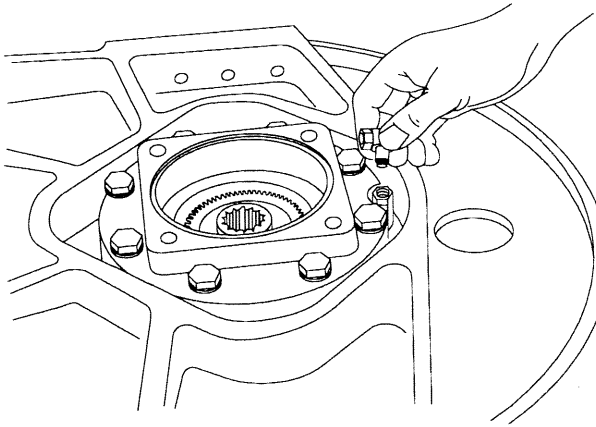


5. Remove the four (4) capscrews and lockwashers securing the motor and lift the motor off the hoist. Remove and discard the O-ring installed on the outside of the motor pilot.

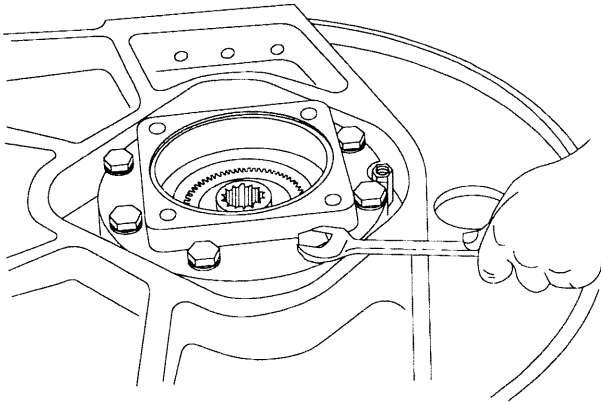


6. Remove the sixteen (16) capscrews and lockwashers (20 in the CH185A and C2H185A models) from the two (2) tie plates, and remove the plates.

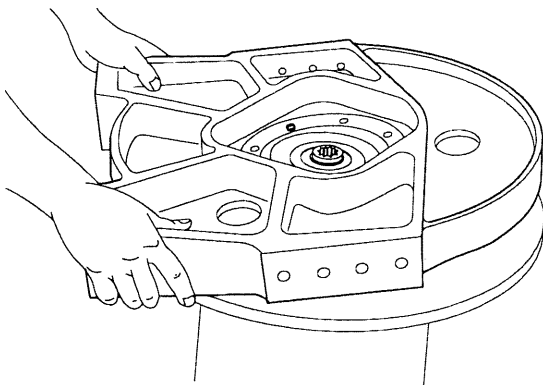




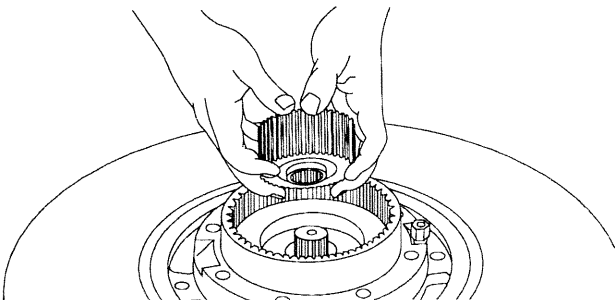
7. Remove the tee fitting from the brake cylinder nipple.



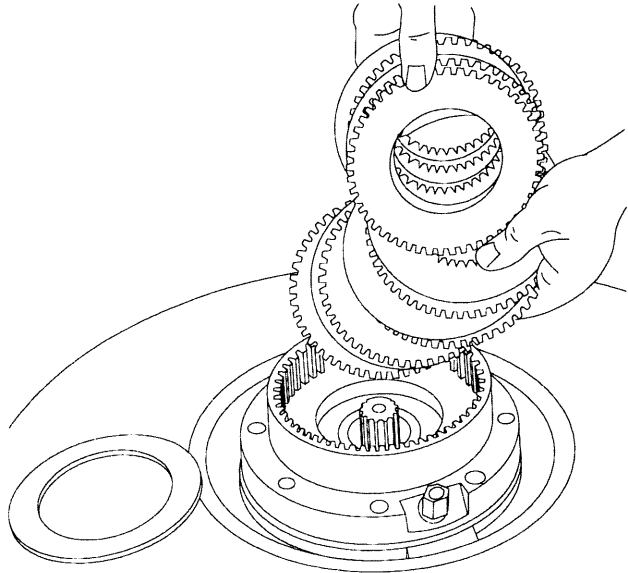
8. Remove the eight (8) cap screws and lockwashers from the motor adapter, and remove the motor adapter. Remove and discard the O-ring that was under the motor adapter.



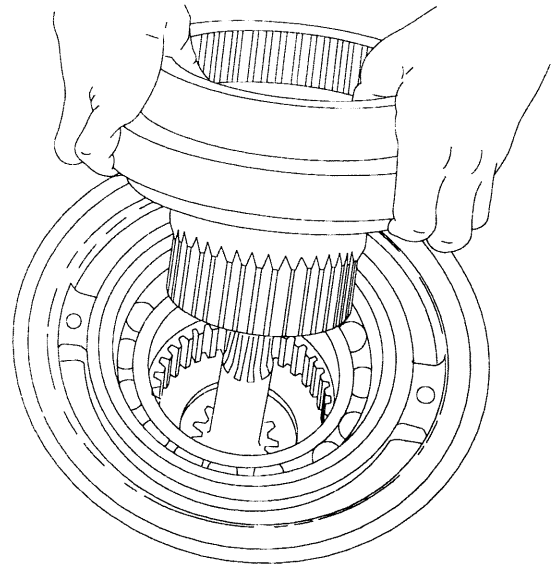
9. Remove the brake cylinder nipple, then remove the motor end plate.



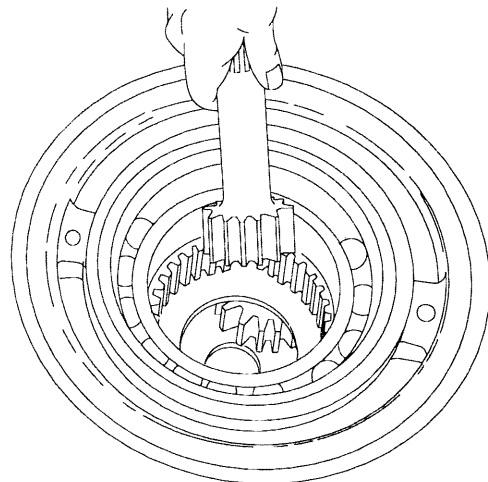
10. Remove the brake clutch assembly from the brake cylinder. Refer to the section on disassembly of the brake clutch assembly.



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

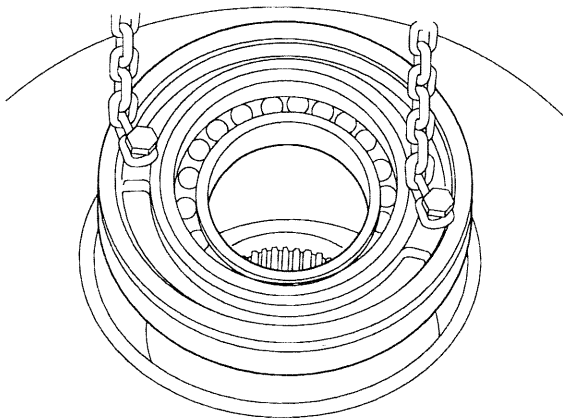


12. Remove the brake cylinder assembly, and place it on a clean, dry surface so as not to damage the splines. Refer to the section on disassembly of the brake cylinder assembly.

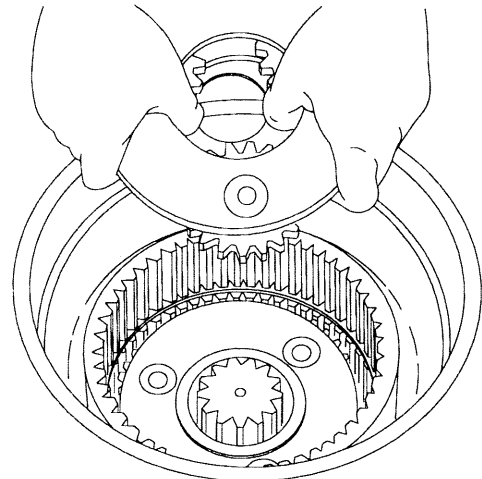


13. Next, remove the primary sun gear.

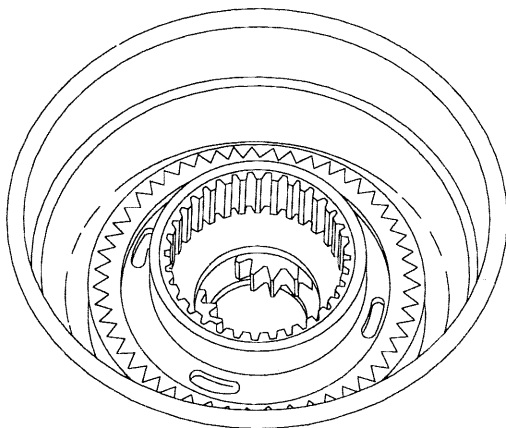




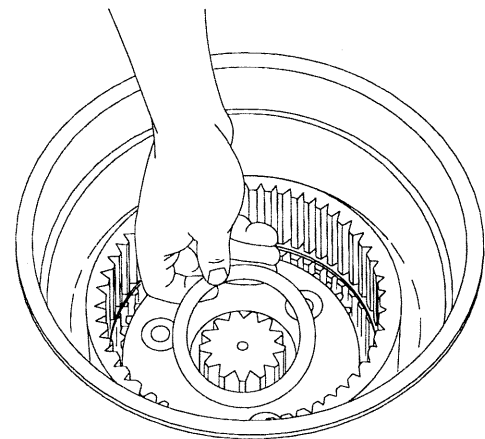
14. Remove the cable drum closure by using two (2) cap-screws from the motor adapter and a short piece of chain. Lift the closure out of the drum. Remove and discard the O-ring and the seal. Inspect the bearing for wear. If replacement is necessary, use a bearing driver to remove the bearing.



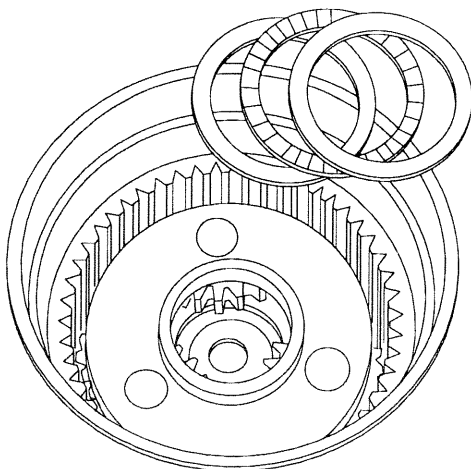
17. Remove the primary planet carrier assembly. Refer to the section on disassembly of the primary planet carrier assembly.



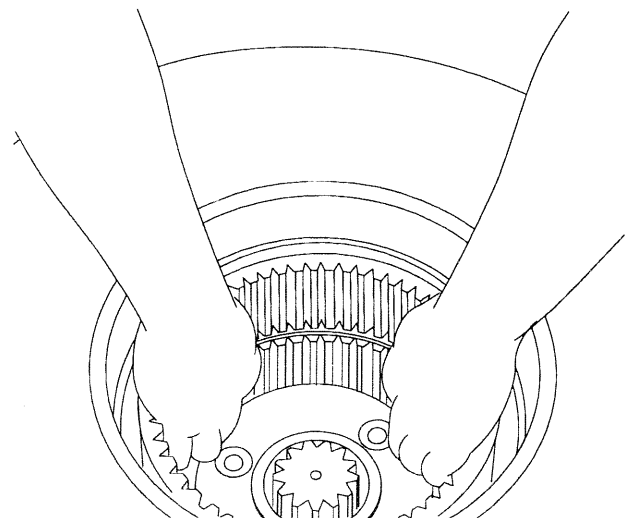
15. Lift out the ring gear adapter.



18. Remove the thrust bearing that was under the primary planet carrier assembly, then remove the output sun gear.

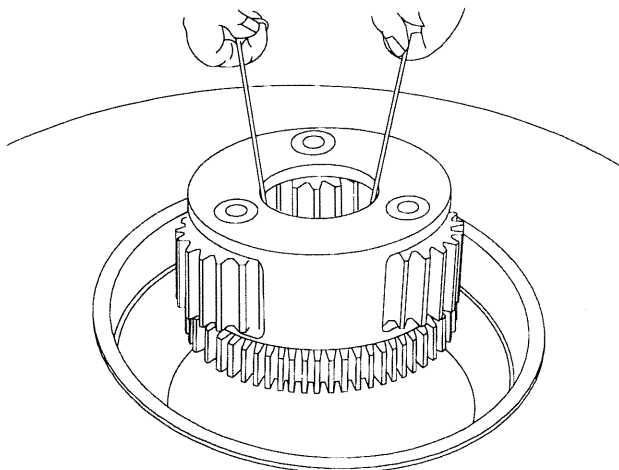


16. Remove thrust bearing and two races.

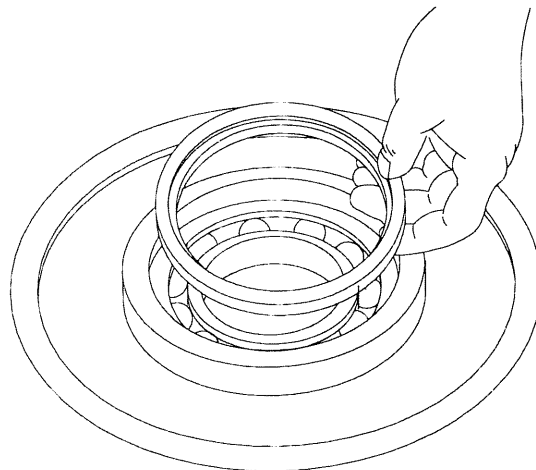


19. Lift out the ring gear. Inspect the gear for abnormal wear or pitting.

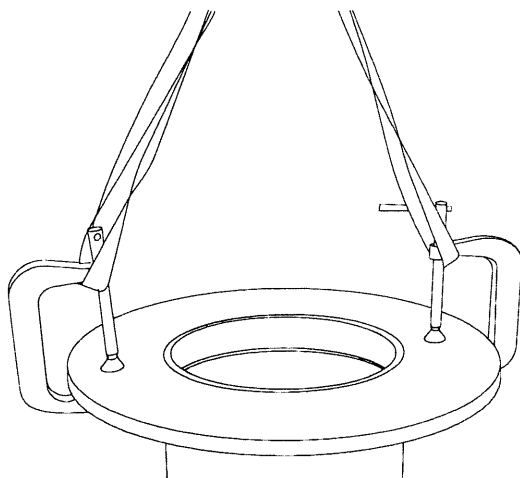




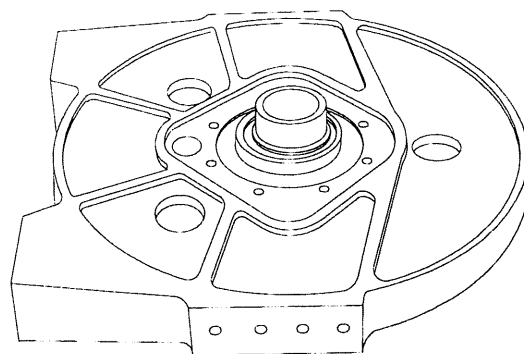
20. Remove the output planet carrier assembly. You can make hooks like the ones shown to make removal easier. Refer to the section on disassembly of the output planet carrier assembly.



22. 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.



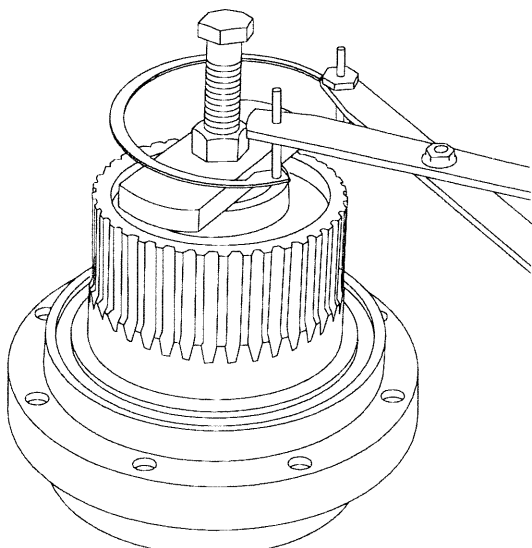
21. Lift the drum off the support end plate.



23. 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

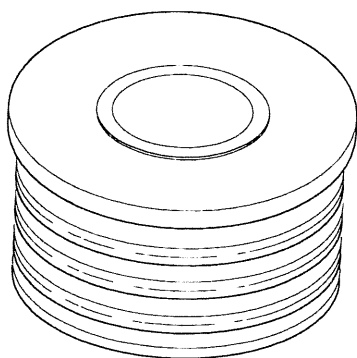


1. Turn the brake cylinder on end with the large end down. Use the special compression tool or a shop press to compress the backup plate in order to remove the retaining ring.

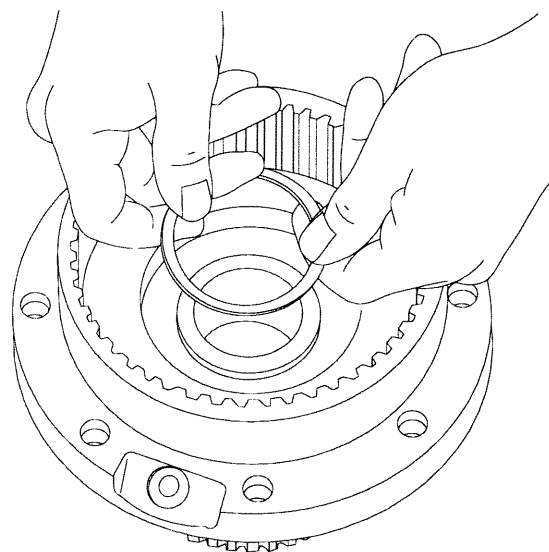
### ⚠ CAUTION ⚠

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.

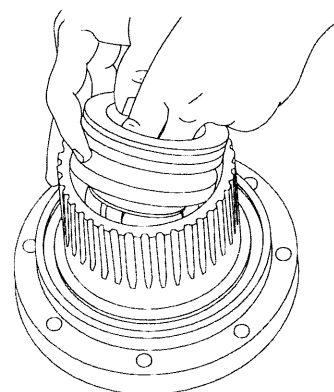
Remove the retaining ring with snap ring pliers. Be careful to not let the pliers slip out of the retaining ring. Release the compression tool by holding the threaded rod stationary while backing off the nut.



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.

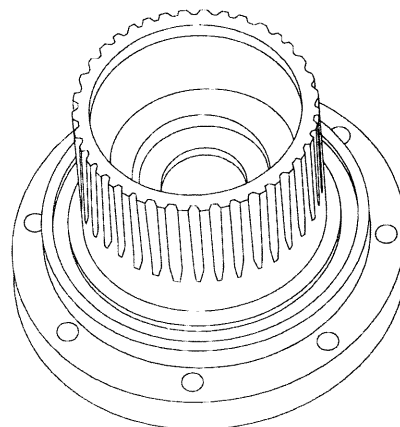


3. Turn the brake cylinder on end with the large end up. Remove the spiral retaining ring and lift out the brake piston plate.



4. Turn the brake cylinder over and pull the piston out.

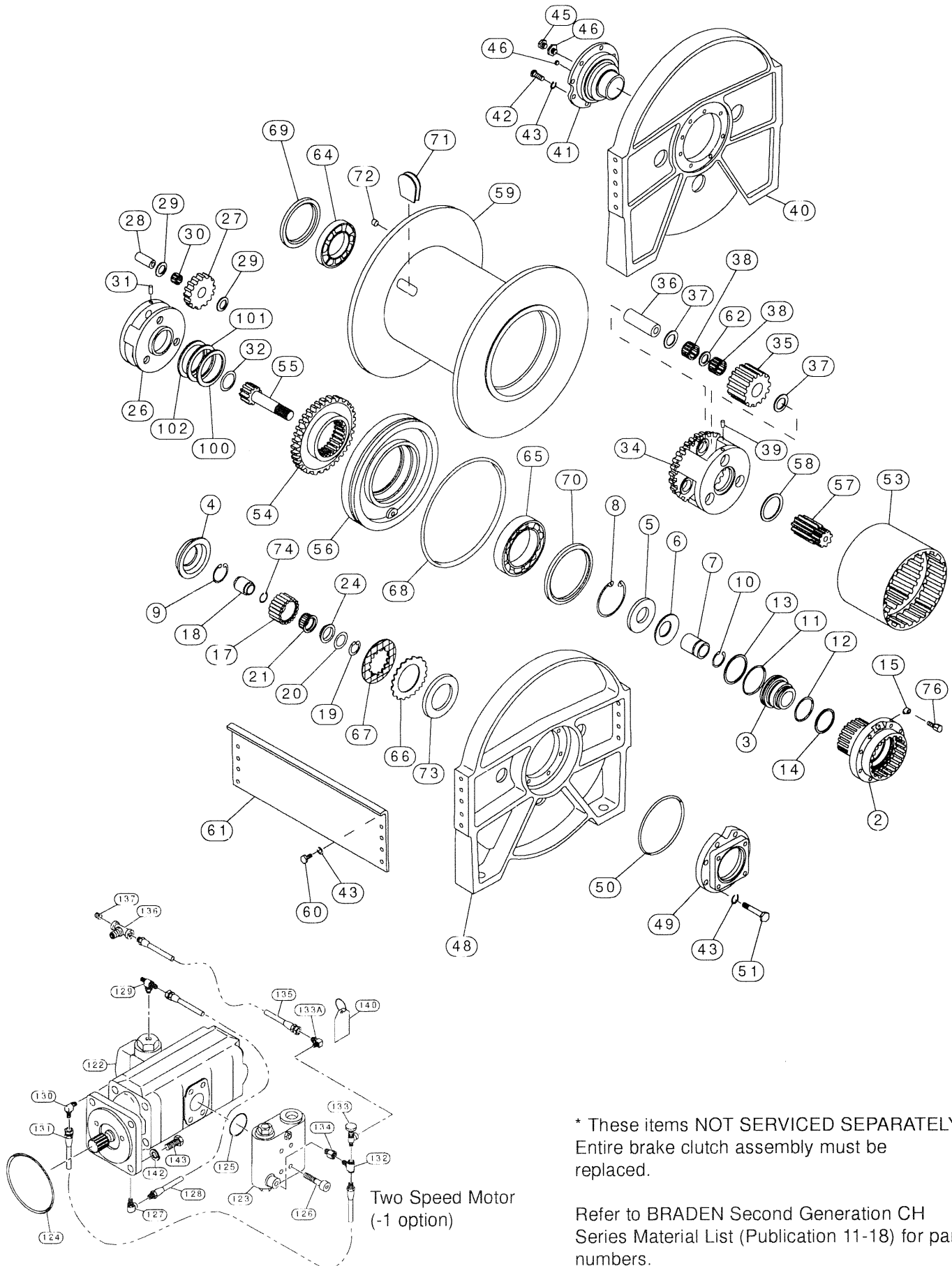
Remove and discard the O-rings. Inspect the backup rings for nicks or cuts, and replace if necessary. Be careful not to damage the O-ring groove surfaces.



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.

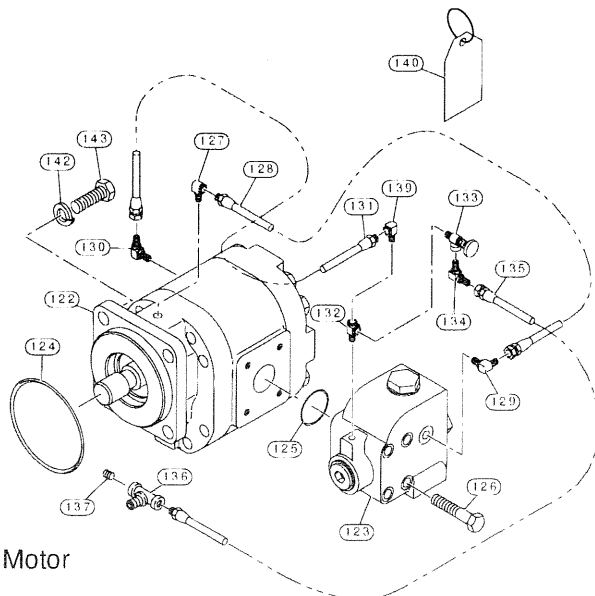


# SECOND GENERATION CH SERIES EXPLODED VIEW AND PARTS KEY





ITEM	DESCRIPTION	QTY.
2	Brake Cylinder	1
3	Brake Piston	1
4	Brake Piston Plate	1
5	Backup Plate	1
6	Belleville Spring	8
7	Spring Guide	1
8	Retaining Ring	1
9	Snap Ring	1
10	Snap Ring	1
11	O-Ring	1
12	O-Ring	1
13	Backup Ring	1
14	Backup Ring	1
15	Street Elbow - 45°	1
17	Outer Brake Race*	1
18	Inner Brake Race*	1
19	Snap Ring	2
20	Sprag Bearing Retainer	2
21	Sprag Clutch*	1
24	Sprag Bearing	1
26	Primary Planet Carrier	1
27	Primary Planet Gear	3
28	Primary Planet Gear Shaft	3
29	Thrust Washer	6
29	Thrust Washer	6
30	Roller Bearing	3
31	Spirol Pin	3
32	Thrust Washer	1
34	Output Planet Carrier	1
35	Output Planet Gear	3
36	Output Planet Gear Shaft	3
37	Thrust Washer	6
38	Roller Bearing	6
39	Spirol Pin	3
40	Support End Plate	1
41	Bearing Support	1
42	Capscrew	8

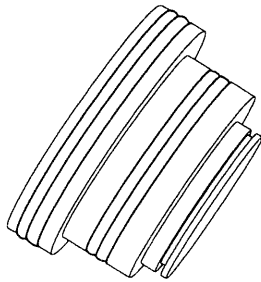


Single Speed Motor  
(-1 option)

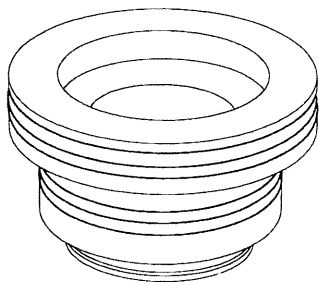
ITEM	DESCRIPTION	QTY.
43	Lockwasher	36
44	Reducer Bushing	1
45	Relief Valve	1
46	Sight Glass	1
46	Pipe Plug	1
48	Motor End Plate	1
49	Motor Adapter	1
50	O-Ring	1
51	Capscrew	8
53	Ring Gear	1
54	Ring Gear Adapter	1
55	Primary Sun Gear	1
56	Cable Drum Closure	1
57	Output Sun Gear	1
58	Thrust Washer	1
59	Cable Drum	1
60	Capscrew	16
61	Tie Plate	2
62	Bearing Spacer	3
64	Ball Bearing	1
65	Ball Bearing	1
66	Brake Disc	10
67	Friction Disc	9
68	O-Ring	1
69	Oil Seal	1
70	Oil Seal	1
71	Cable Anchor Wedge	1
72	Plug	1
73	Brake Plate Spacer	1
74	Retaining Ring	1
76	Pipe Nipple	1
100	Bearing Race (.092" thick)	1
101	Thrust Bearing	1
102	Bearing Race (.063" thick)	1
122	Hydraulic Motor	1
123	Brake Valve	1
124	O-Ring	1
125	O-Ring	1
126	Capscrew	4
127	Elbow Fitting (90°)	1
128	Hose Assembly	1
129	Fitting	1
130	Elbow Fitting (90°)	1
131	Hose Assembly	1
132	Tee Fitting	1
133	Needle Valve	1
133a	Elbow Fitting (90°)	1
134	Fitting	1
135	Hose Assembly	1
135	Tee Fitting	1
136	Tee Fitting	1
137	Plug	1
139	Elbow Fitting (90°)	1
140	Warning Tag	1
142	Lockwasher	4
143	Capscrew	4



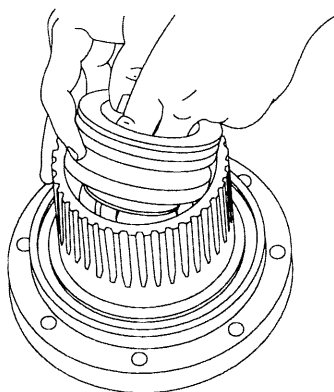
## BRAKE CYLINDER ASSEMBLY



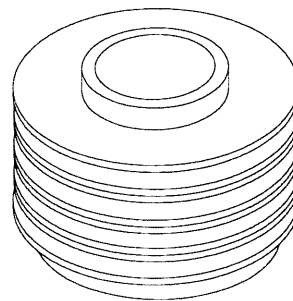
1. Lubricate O-rings and backup rings with oil and install them on the brake piston. The concave surface of the backdrop ring must be next to the O-ring. Let the assembly set for 10 minutes in order for the O-rings and backup rings to return to their original shape.



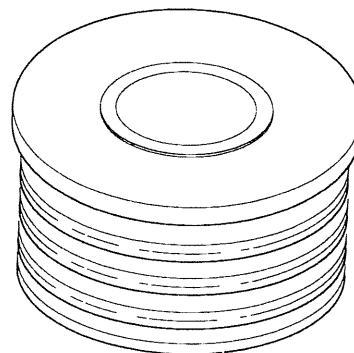
2. Here are the backup rings and O-rings installed correctly. The backup rings must be to the outside of the O-rings.
3. Lubricate the outside of the piston with oil or grease.



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.

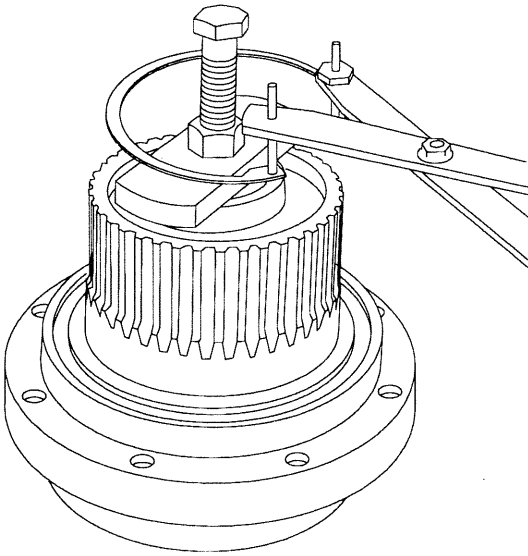


5. Install the eight (8) belleville springs over the spring guide. The first one should rest against the snap ring on the spring guide, with the concave side facing the snap ring. The second spring should be installed with its convex side facing the snap ring. Alternate the remaining six (6) springs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



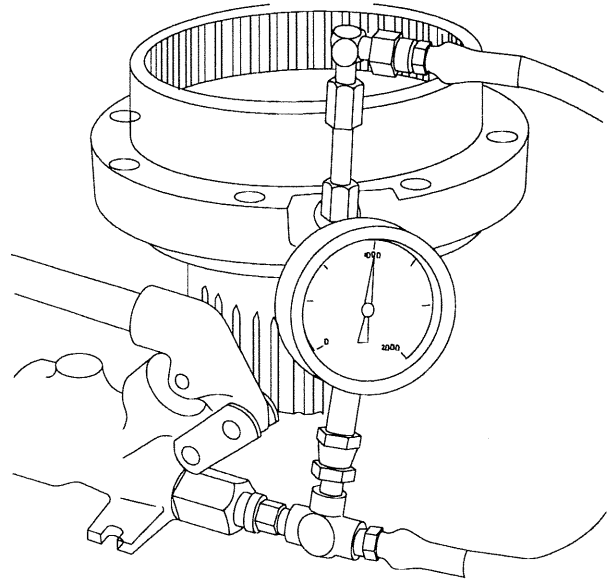
6. Next, place the backup plate over the spring guide so that it rests on the top spring. Then, insert the spring guide, springs and backup plate into the brake cylinder.





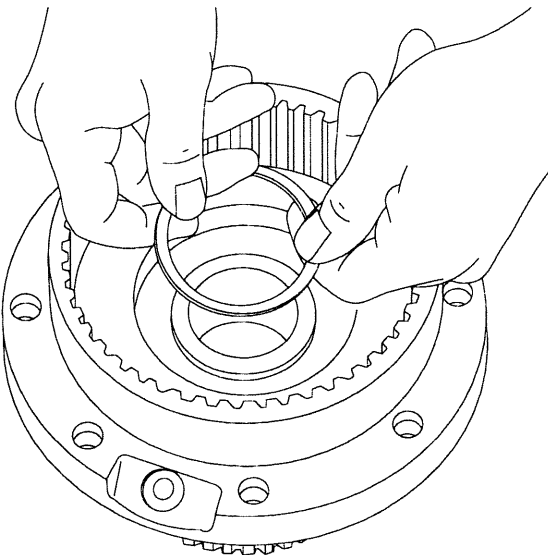
7. Use a press or the special compression tool to compress the springs. Make certain the threaded portion of the compression tool fully engages the lower plate. Install the retaining ring using snap ring pliers. Be careful to not let the pliers slip out of the retaining ring.

After making certain the retaining ring is in place, 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.

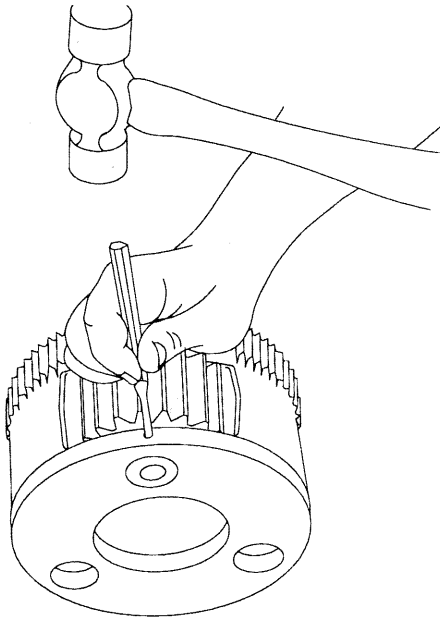
Apply 1000 psi and let the unit set for 5 minutes. If the gauge does not register a pressure drop, it means you have installed the O-rings and backup rings correctly.



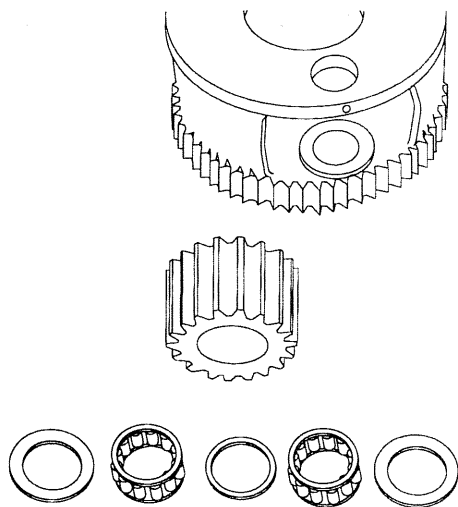
8. Turn the assembly over and place the brake piston plate over the brake piston. Install the spiral retaining ring in the groove in the brake piston.



## OUTPUT PLANET CARRIER SERVICE

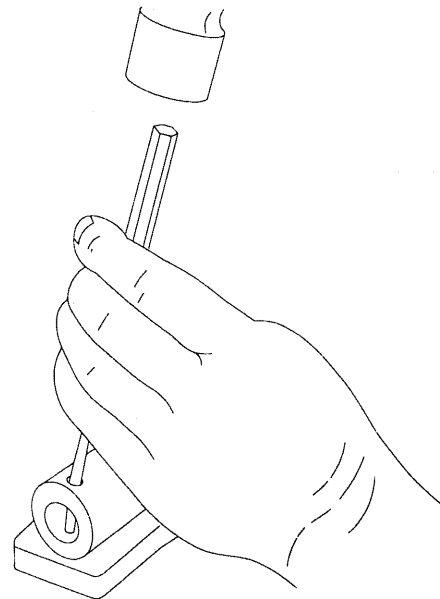


1. Drive the three (3) spiral pins into the center of the planet gear shafts.



2. Remove one (1) planet gear shaft, two (2) thrust washers, two (2) roller bearings and one (1) planet gear from each of three (3) locations in the carrier. The CH150A, C2H150A, CH175A and C2H175A also have a bearing spacer between each pair of bearings that has to be removed.

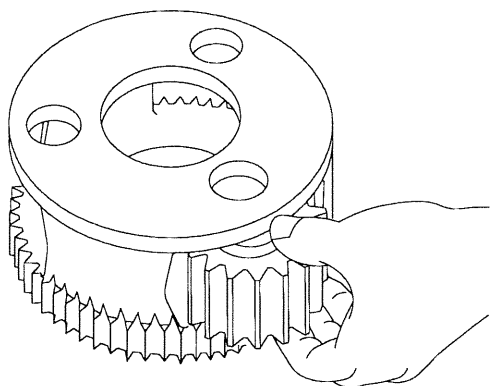
3. To disassemble the primary planet carrier assembly, the steps are the same as for the output planet carrier assembly, except there is only one bearing for each gear. Also, the primary carrier has a thrust washer inside that can be removed after the planet gears are removed.
4. If the rollers show 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 cause excessive abrasion or friction. The gears should be inspected for abnormal wear or pitting. Replace if necessary.



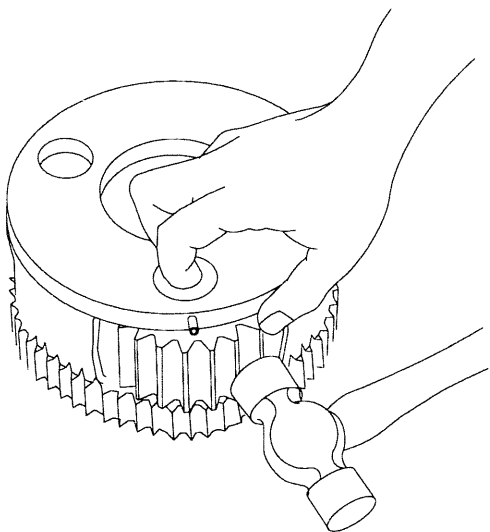
5. Use a punch to drive the spiral pins out of the planet gear shafts. The same surface and material conditions that are detrimental to the life of the bearings and thrust washers also apply to the contact areas on the shafts and carrier.



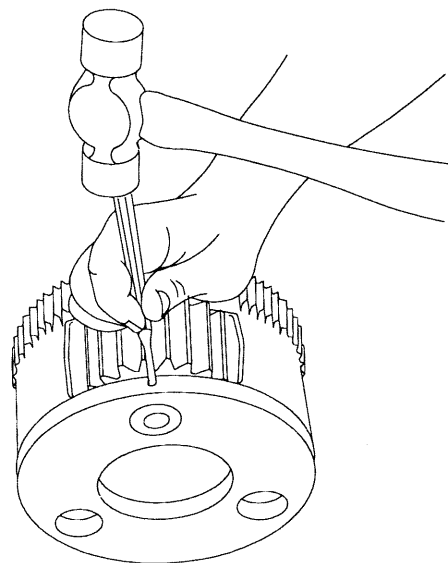
## OUTPUT PLANET CARRIER ASSEMBLY



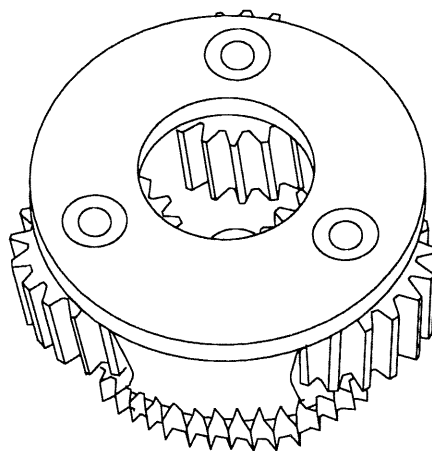
1. Insert two bearings into a gear (when assembling the output planet carrier assembly for a CH150A, C2H150A, CH175A or C2H175A, install a bearing spacer between the two bearings). Place a thrust washer on each side of the gear and install it in a carrier opening. Slide a shaft through the carrier, thrust washers, bearings and gear.



2. Align the hole in the carrier and shaft so a spiral pin can be installed. Always use a new 3/16" x 3/4" spiral pins when assembling these carriers. Use spiral pins, because they are much stronger than roll pins.



3. Drive a spiral pin into place. Note that it is slightly recessed in the carrier when it is in the proper position. Use a center punch to dent the carrier next to the hole as shown. This will distort the hole so the pin will not work itself out. Repeat these steps for each of the three planet gears.



4. This is how the output planet carrier should look after you assemble it.

To assemble the primary planet carrier assembly, the steps are the same as for the output planet carrier assembly, except there is only one bearing for each gear. Also, the thrust washer must be installed inside the carrier on the hub end before the planet gears are installed.



## CLEAN AND INSPECT

Thoroughly clean all of the parts in a good grade of cleaning solvent; one that is not flammable, not toxic and will not cause skin rashes. If necessary, use rubber gloves.

Inspect all parts for wear, nicks, scratches and damage that would render them unusable. If a part is questionable, it is better to replace it rather than take a chance on premature failure when the hoist is placed back in service.

Always replace O-rings, seals and spiral pins. Sometimes it is permissible to reuse bearings and bushings . . . it depends on how much use they have had.

At regular service intervals, the cage and roller bearing assemblies and thrust washers in the planet carrier assemblies should be inspected to insure beyond any doubt that they will function properly when re-installed.

The rollers should not exhibit any surface irregularities. If the rollers show any sign of spalling, corrosion, discoloration, material displacement or abnormal wear, the bearings 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 irregularity that causes excessive abrasion or friction.

Finally, the shafts and carrier should be checked where there is roller or thrust washer contact. The same surface and material conditions that are detrimental to the life of the bearing and thrust washer also apply to the contact areas on the shaft and carrier.

If the hoist was disassembled only to replace damaged seals after a short period of service, it is not necessary to replace the bearings. Experience and common sense, along with a good inspection, will determine if they can be used again.

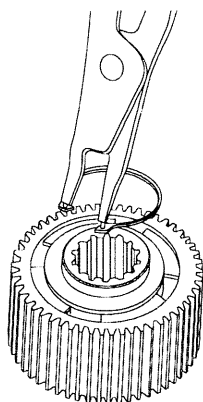
Always coat O-rings, bearings, bushings and the rubber parts of seals with oil or grease during assembly.

Use a sealing compound on the outside diameter of seals and a light coat of thread sealing compound or sealing tape on pipe fittings and plugs. Be careful not to get this compound or tape inside parts and passages which conduct oil.

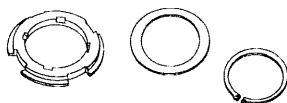
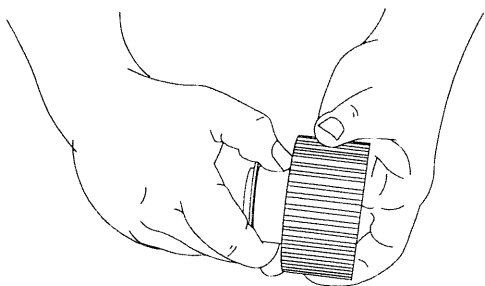


# BRAKE CLUTCH SERVICE

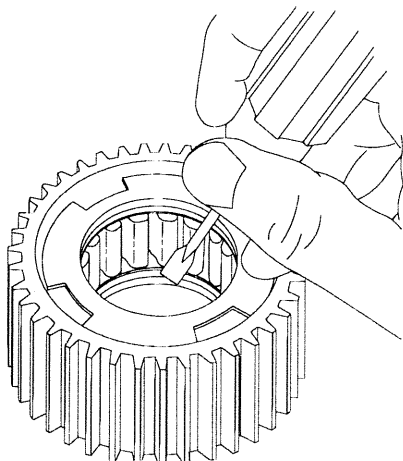
## DISASSEMBLY



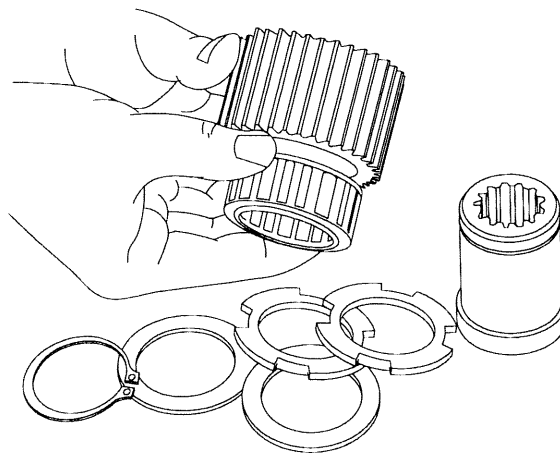
1. Remove the snap ring and sprag bushing retainer from one end only.



2. Pull the inner race out. Examine the race for scoring, wear or indentations caused by the sprag cams. If the inner race is not completely smooth, the entire brake clutch assembly must be replaced.



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.

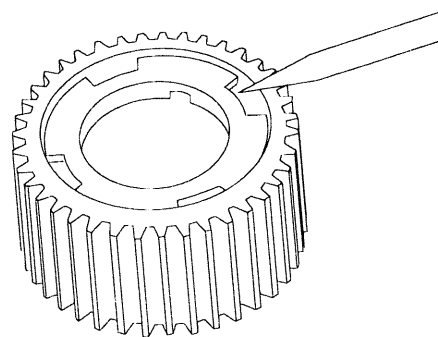


4. Next, slide the sprag clutch out, inspect the sprag clutch closely for abnormal wear, cracks, pitting or corrosion. Check small clips for breakage or bright spots; the signs of excessive wear. Unless the outer race or remaining sprag bushing is damaged or shows excessive wear, there is no need for 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 ⚠

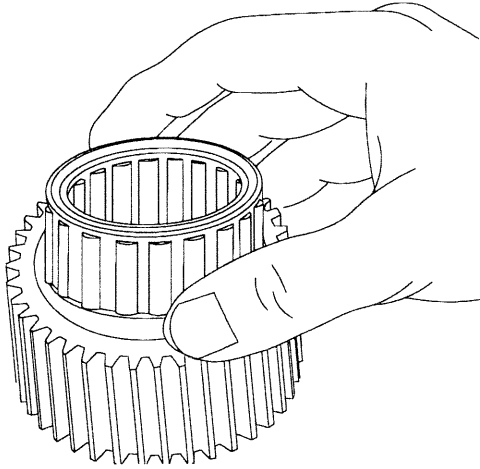
The polished surfaces of the races and sprag cams must be perfectly smooth to insure positive engagement of the clutch. The slightest defect may reduce brake clutch effectiveness, which could result in property damage, severe personal injury or death. It is generally recommended to replace the entire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

## ASSEMBLY

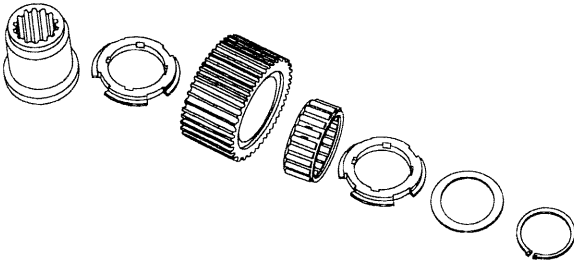


1. Press a sprag bushing into the outer race, using a mechanical or hydraulic press. A flat plate of approximately the same diameter as the bushing flange outside diameter should be placed between the press and bushing during assembly to protect the bushing. Be certain the bushing flange is against the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

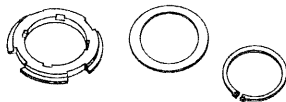
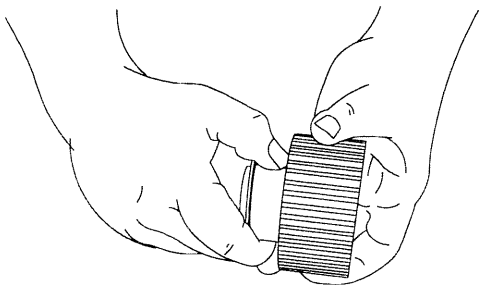




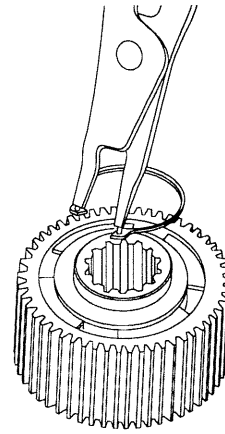
2. Turn the assembly over and install the sprag clutch in the bore of the outer race.
3. Press the remaining bushing into the race. Again, make sure the bushing is against the shoulder.



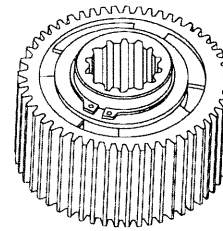
4. Next, install a sprag bushing retainer, then a snap ring on the inner race. Be sure the snap ring is seated in the snap ring groove.



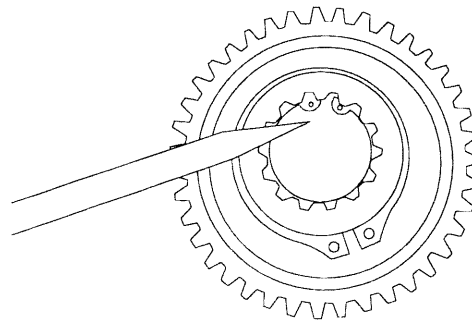
5. Slide the inner race through the bushings and sprag clutch (the race will have to be rotated in the free-wheeling direction to start it through the sprag clutch). If the inner race will not go through the bushings, the bushings have probably been damaged and should be replaced.



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.

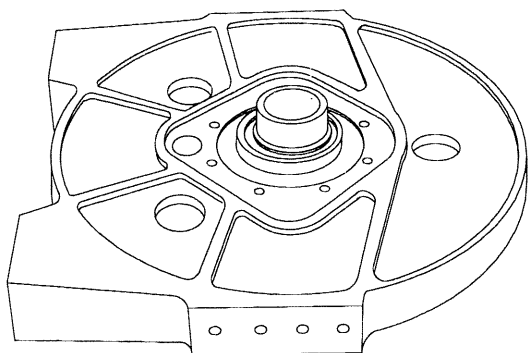


## ⚠ WARNING ⚠

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.

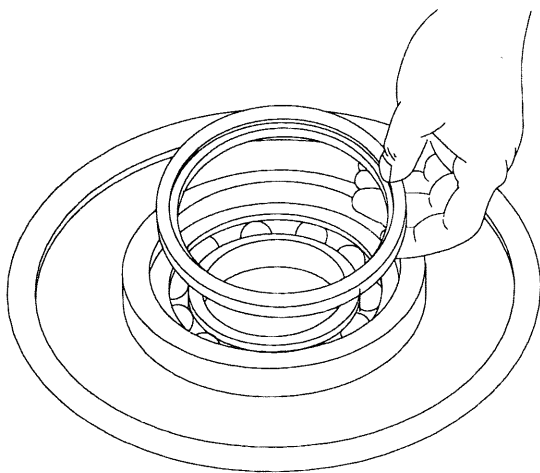


## HOIST ASSEMBLY

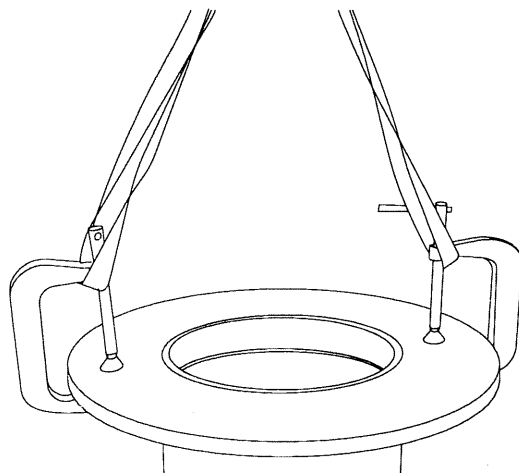


1. Clean all parts before reassembling. The first step is to lay the support end plate down with the bearing support up. Lubricate the sealing and bearing lands on the bearing support.

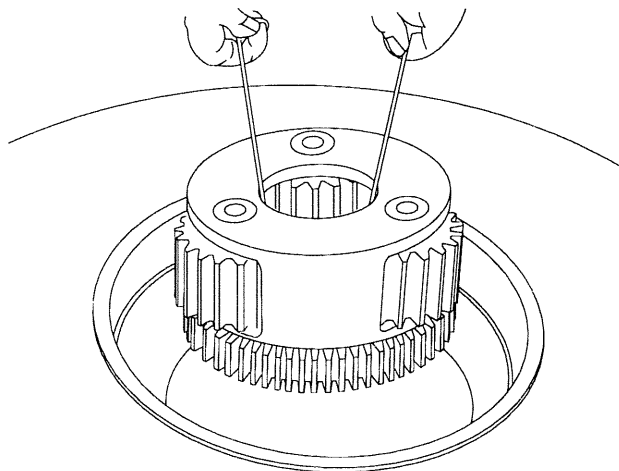
NOTE: If the bearing support was removed from the end plate, reinstall it with eight (8) capscrews and lock-washers, making certain two (2) large holes in the end plate line up with the cutouts in the bearing support.



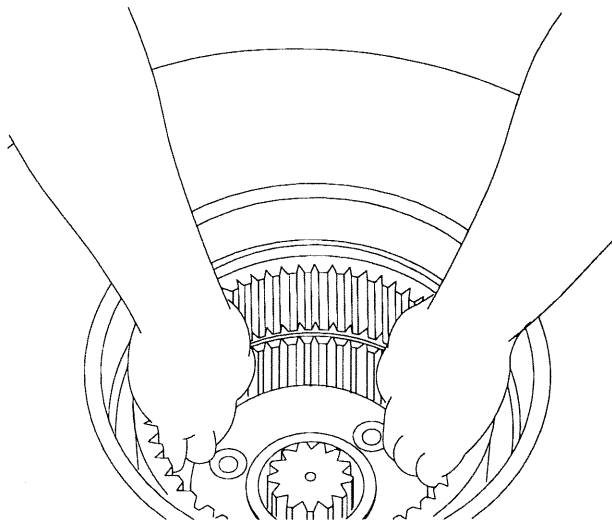
2. Install a new bearing in the drum if replacement is necessary, making certain to press it against the shoulder in the bottom of the bearing bore. Coat the outside diameter of the new seal with a good grade of sealant. Turn the spring side of the seal next to the bearing, and press the seal into the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



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.

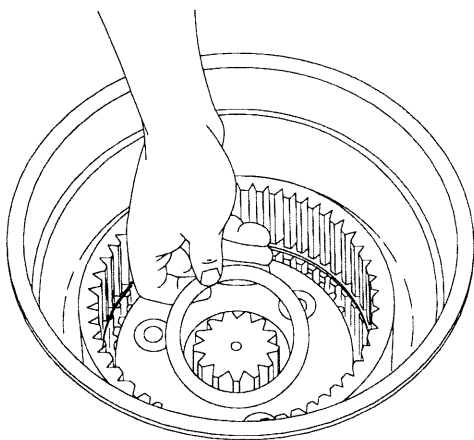


4. Lower the output planet carrier assembly into the drum, making certain that the teeth on the carrier mesh with the teeth in the drum.

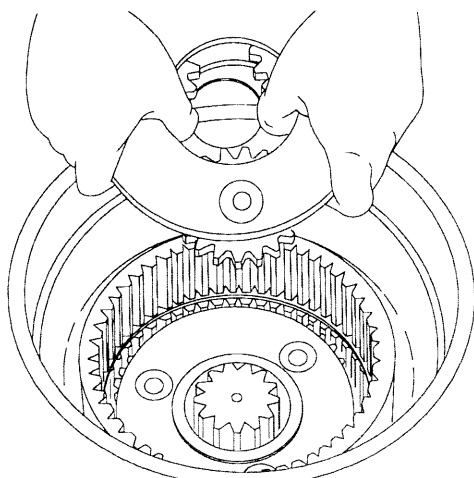


5. Install the ring gear. The ring gear teeth must mesh with the output planet gears.

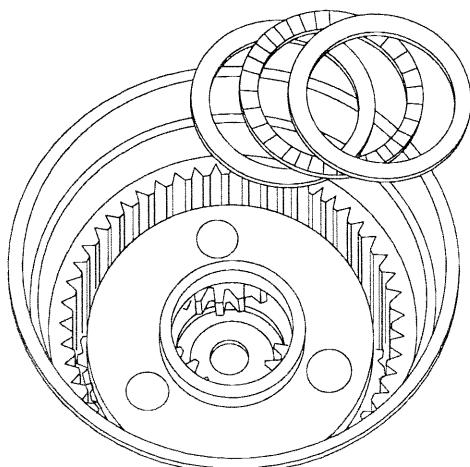




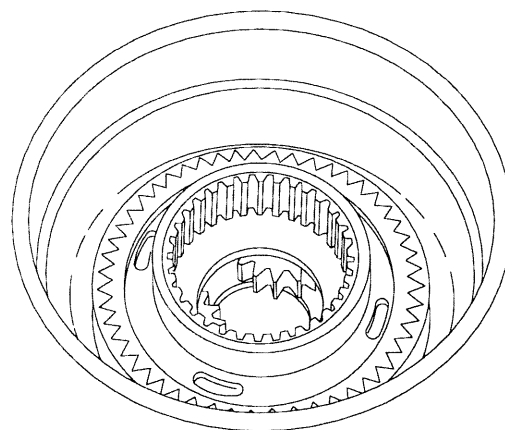
6. Install the output sun gear and the thrust washer. Center the thrust washer on the output carrier so the primary carrier pilot can be installed in it.



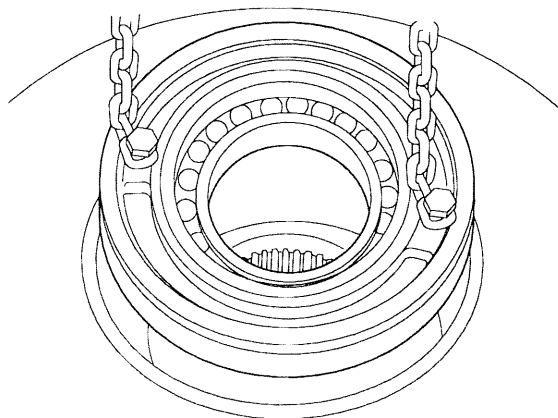
7. Install the primary planet carrier assembly in the ring gear, meshing the planet gears with the ring gear. The hub goes down, engaging the output sun gear. Be sure the pilot enters the thrust washer.



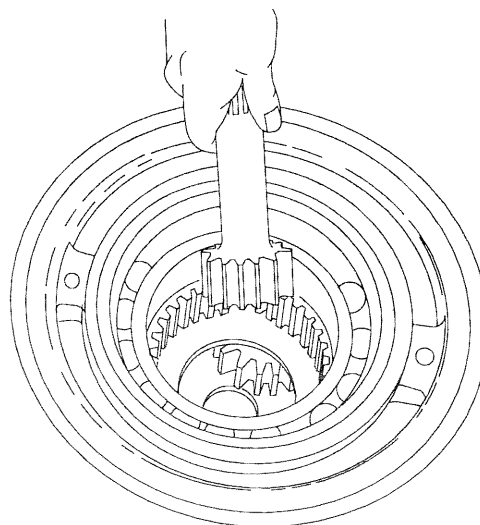
8. Install thrust bearing and two race as shown. The thinner thrust race (.063 thick) goes next to the planet carrier and the thicker thrust race (.092 thick) goes next to the ring gear adapter. The needle thrust bearing of course goes between the two races. Not all units have this design revision using the thrust washer (see Parts Breakdown for details).



9. Install the ring gear adapter, hub end up, meshing the adapter with the ring gear.

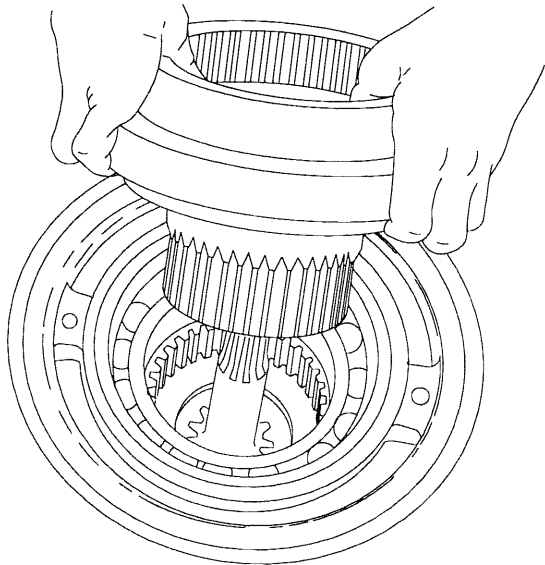


10. Install a new bearing in the drum closure if replacement is necessary, making certain to press it against the shoulder in the bottom of the bearing bore. Coat the outside diameter of the new seal with a good grade of sealant. Turn the spring side of the seal toward the bearing, and press the seal 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.

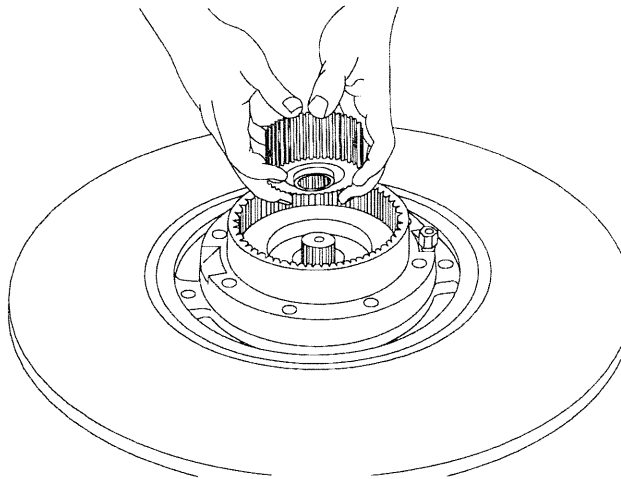


11. Install the primary sun gear, meshing its teeth with the primary planet gears.

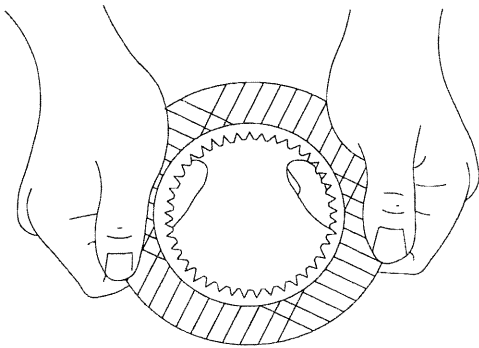




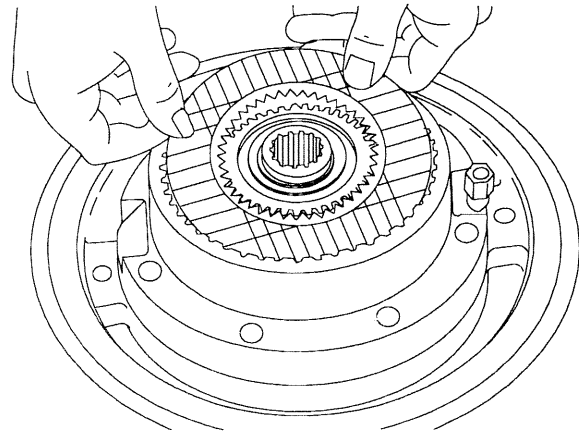
12. Install the brake cylinder assembly over the primary sun gear, making certain the brake cylinder engages the ring gear adapter teeth.



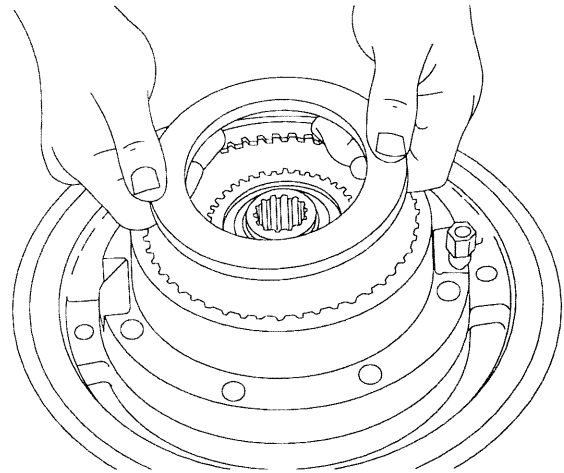
13. Install the brake clutch assembly over the primary sun gear. When installed correctly, the outer race should turn freely in the same direction as the drum turns to spool wire rope out. For most Braden assemblies, this will be clockwise as viewed from the motor end.



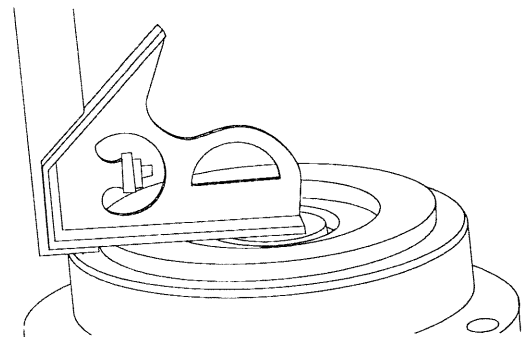
14. Before installing the brake discs and friction discs, check their condition. Both kinds of discs should be flat and their teeth should not be pointed. The friction discs should have groove in the friction material. Replace discs, if necessary.



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

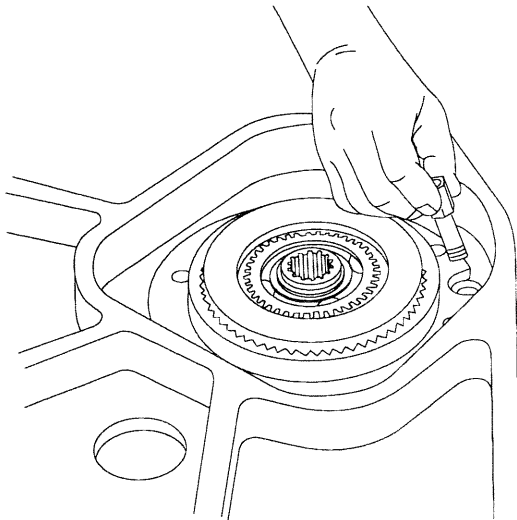


16. Install the brake plate spacer on top of the brake discs.

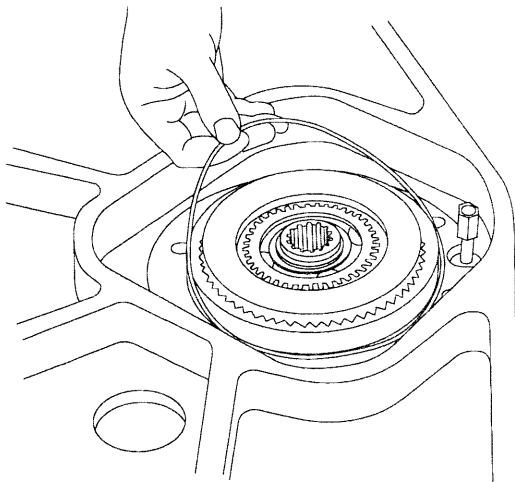


17. Measure the brake stack-up as shown. The measurement should be a minimum of  $\frac{3}{16}$ " from the top of the brake plate spacer to the top of the brake cylinder. If the measurement is less than  $\frac{3}{16}$ ", remove the brake plate spacer and add a brake disc to the top of the brake package.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

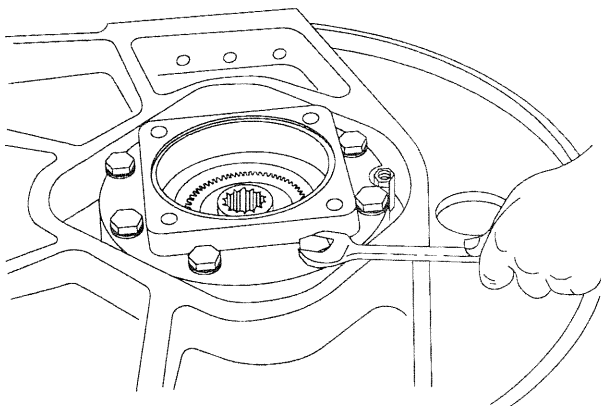




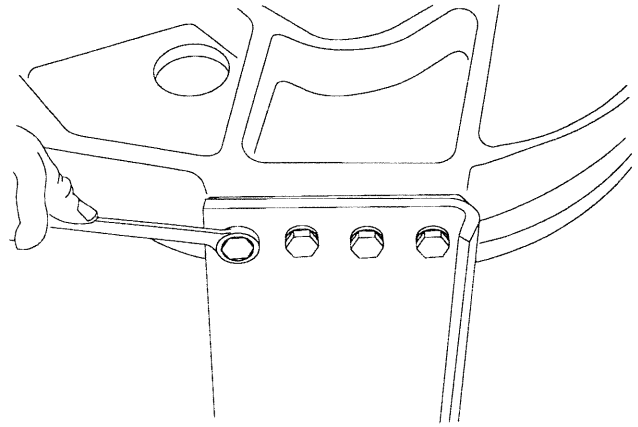
18. Install the motor end plate and then the brake cylinder nipple, using a good grade of thread sealant.



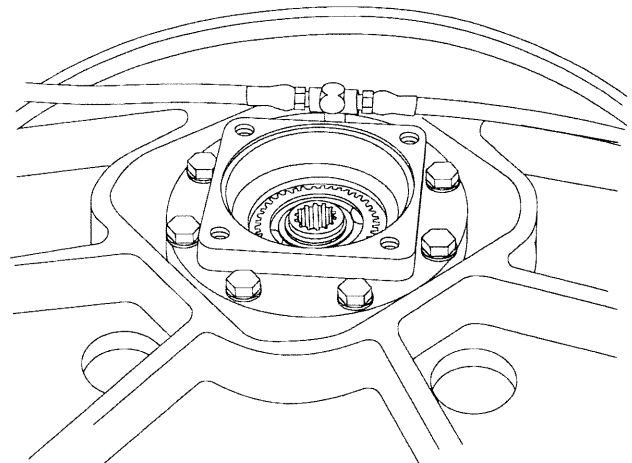
19. Lubricate the o-ring and install it on the outside of the brake cylinder. Push it down until it's resting against the motor end plate.



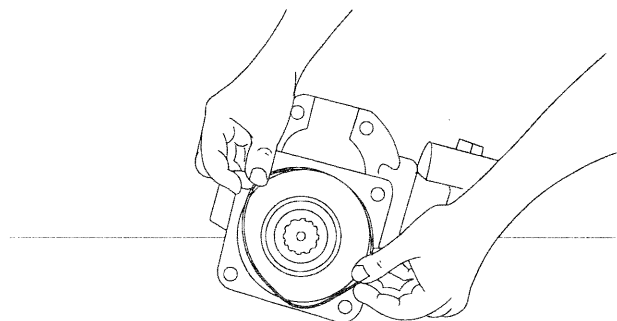
20. Install the motor adapter with eight (8) special BRADEN cap screws and lockwashers.



21. 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 sixteen (16) cap screws and lockwashers (twenty for CH185A and C2H185A).

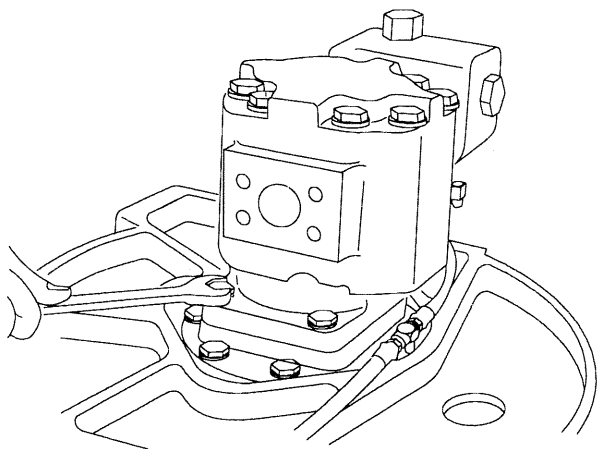


22. Install the tee and hydraulic hoses at this time. Use a good grade of thread sealant, being careful not to get it in the hydraulic lines, as it could block an orifice in the brake valve. The long hose should point to the right as viewed from the motor end.

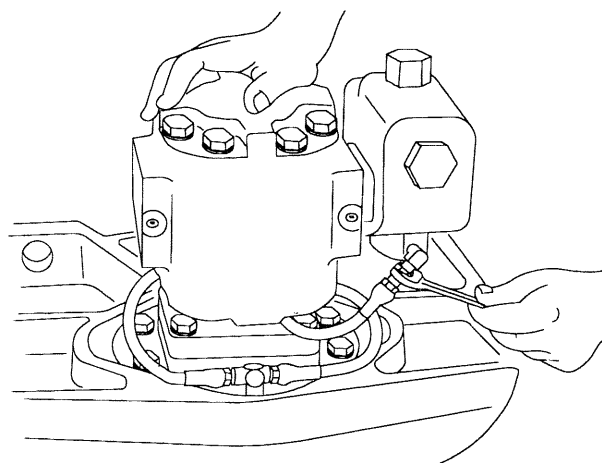


23. Lubricate and install a new O-ring around the pilot on the motor.

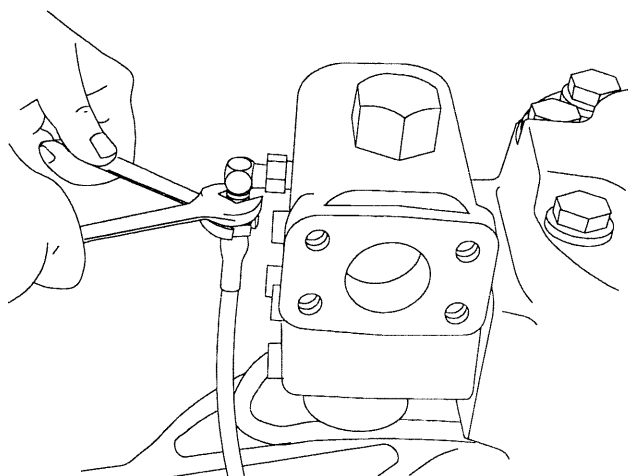




24. Engage the motor shaft in the brake clutch assembly inner race, and lower the motor into place. Install four (4) capscrews and lockwashers



26. 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.

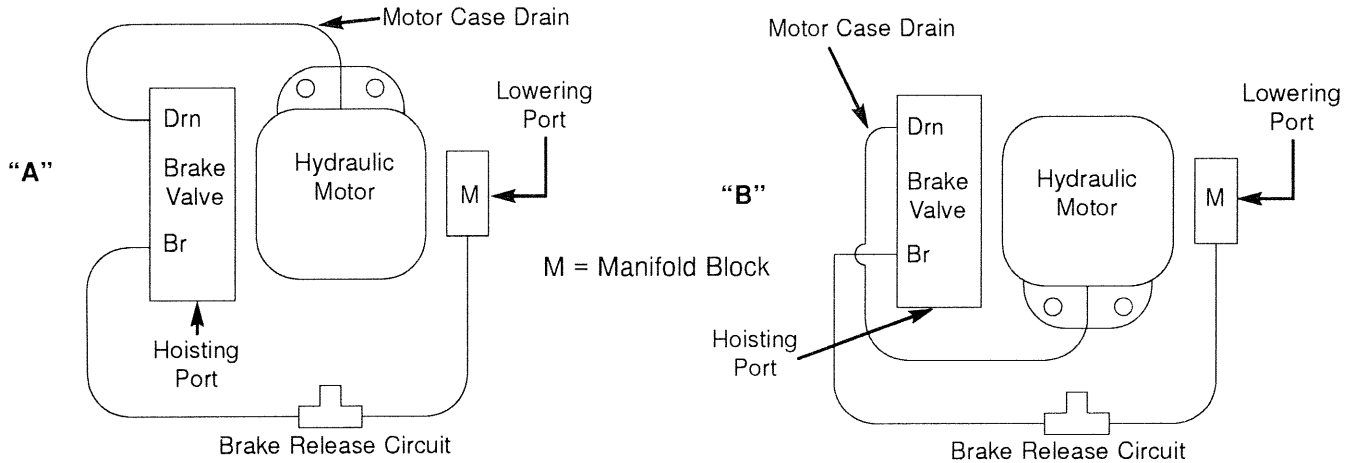


25. Install the hydraulic hoses as shown, then tighten.  
Continued on illustration no.26.



# REVERSING DIRECTION OF DRUM ROTATION

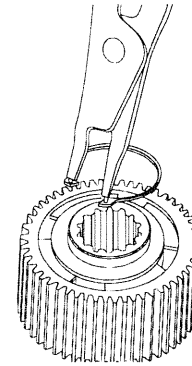
This procedure applies in general terms to standard hoists with Commercial Intertech gear motors. For information concerning hoists with other types of motors, consult the BRADEN Service Department at the phone number listed in the FOREWORD section of this manual.



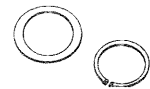
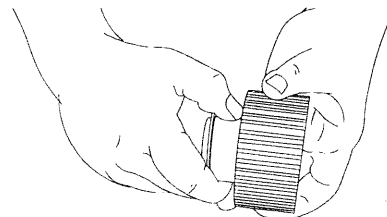
In order to change the direction of drum rotation, 2 things must be changed on the hoist. First, the motor must be made to rotate in the opposite direction. This is done by exchanging positions of the brake valve and manifold block on the motor. Secondly, the brake clutch assembly must be made effective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

Figures "A" and "B" above show typical 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 in figure "A" rotates clockwise when the hoisting port is pressurized, the motor shaft in figure "B" will rotate counterclockwise.

1. Stand the hoist up on the motor support with the motor up and secure in this position. Remove the four cap-screws 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 as shown above. In these cases, disconnect the brake release hose from the motor.
2. Before removing the motor, it is a good idea to mark the position of the motor in relation to the hoist, since it will be rotated 180° when re-installed. Remove the capscrews securing the motor to the hoist and carefully remove the motor.
3. Remove the brake clutch assembly from the hoist. Carefully inspect the splines on both ends of the inner race.
  - a. If they are the same, the entire brake clutch assembly can be turned over and re-installed in the hoist. **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. Proceed to step 8.
  - b. If the splines in each end of the inner race are not the same, proceed to step 4.

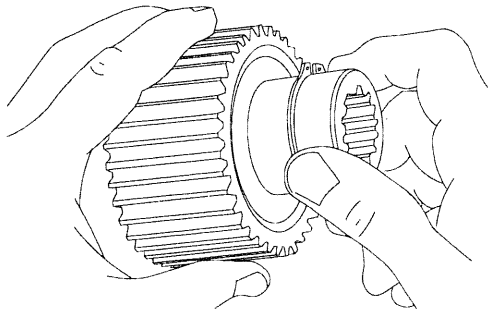


4. Remove the snap ring and sprag bushing retainer from one end only of the brake clutch assembly.



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 entire brake clutch assembly must be replaced.





6. Turn the sprag assembly around and slide the inner race (with 1 snap ring and bushing retainer) through the bushing 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 sure the snap ring is properly seated in the groove.
7. Install the brake clutch assembly into the hoist. **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.
8. Install a new O-ring on the motor pilot. Rotate the motor 180° from its original position and install it onto the hoist. 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 ports 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 hoist 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. The hoist should operate smoothly in both directions. Refer to "WIRE ROPE INSTALLATION" and properly install wire rope onto the winch 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 winch should also be able to slowly lower the load in a controlled manner. If the winch does not perform either of these functions, refer to "TROUBLE SHOOTING" FOR ADDITIONAL INFORMATION.



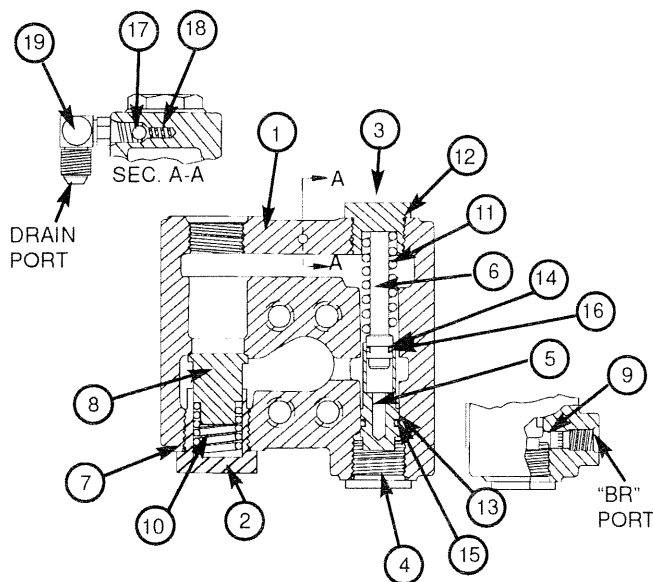
# BRAKE VALVE SERVICE

Standard Braden second generation CH series hoists are supplied with one of two types of brake valves. Both are reliable hydraulic valves 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 trouble shooting operations and are certain the brake valve is causing the malfunction.

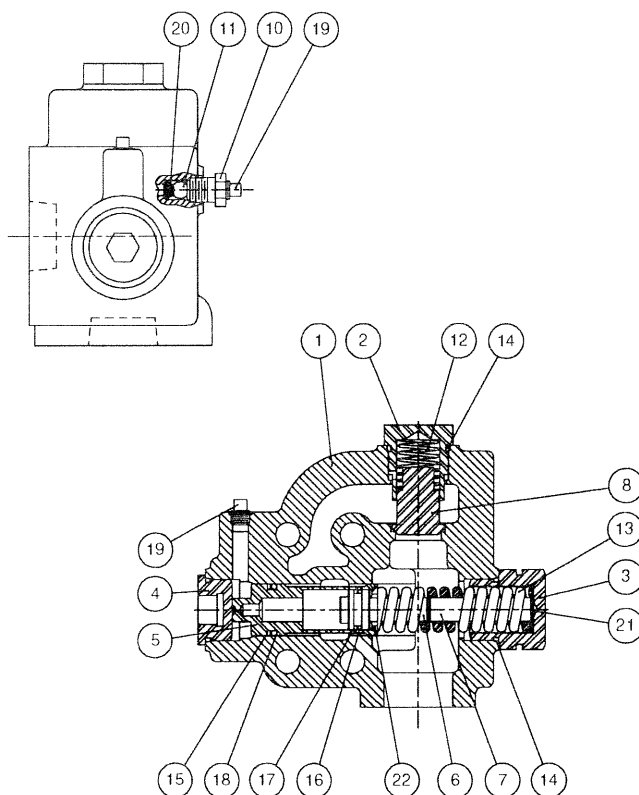
Thoroughly clean the outside surfaces of the valve and work in a clean dust-free area, as cleanliness is of utmost importance when servicing hydraulic components.

## 1 1/4 INCH BRAKE VALVE



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

## 1 1/2 INCH BRAKE VALVE



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	Damper Piston Extension	1
8	Check Valve Poppet (NSS)	1
10	Reducer	1
11	Check Ball	1
12	Check Valve Spring	1
13	Main Piston Spring	1
14	O-Ring	1
15	Back-up Ring	1
16	O-Ring	1
17	Back-up Ring	1
18	O-Ring	1
19	Pipe Plug	1
20	Check Spring	1
21	Shim	as req'd
22	Spring Seat	1

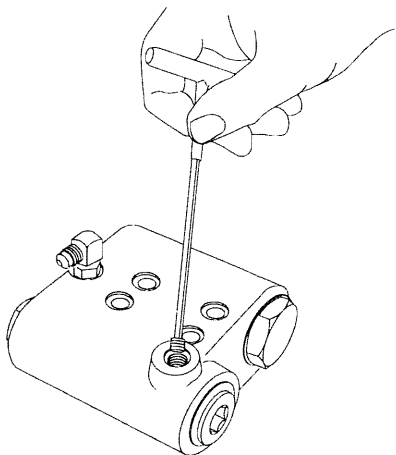
1 1/2 inch brake valves built after mid-March 1997 contain a spring seat (item 22) between the spool spring and the spool. This provides a slightly larger, more uniform area for the spring to seat against the spool. The result is increased spring service life and improved repeatability of pressure/flow 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.

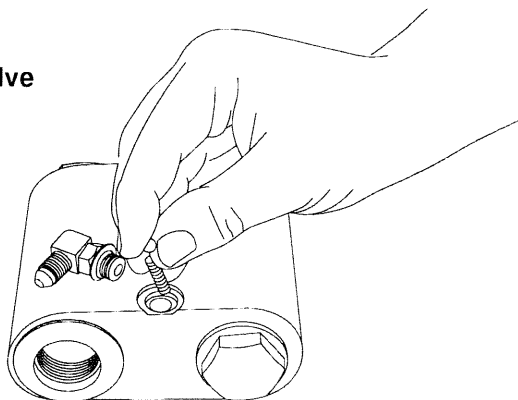
It is always a good practice to check the initial opening or "cracking" pressure of the brake valve whenever the hoist is serviced or inspected. Refer to Braden Service Bulletin 527 for complete brake valve test and adjustment procedures.

## DISASSEMBLY

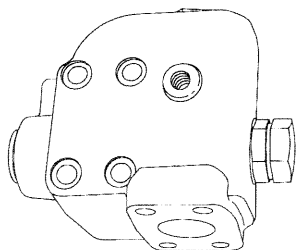


1. On the 1 1/4 inch valve only, remove the pilot orifice from the brake release (BR) port using a 5/32 inch Allen wrench

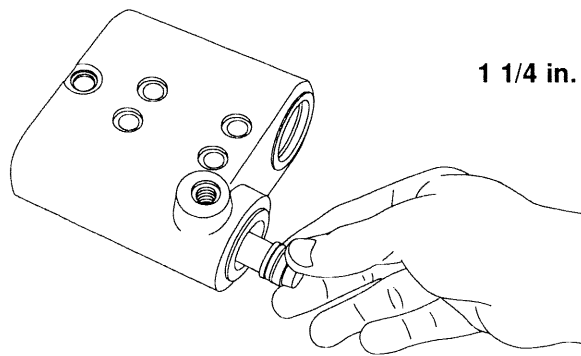
**1 1/4 in. valve**



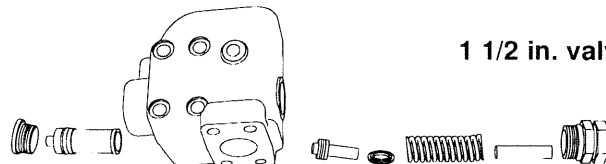
**1 1/2 in. valve**



2. Remove the fitting, motor drain check ball and spring.



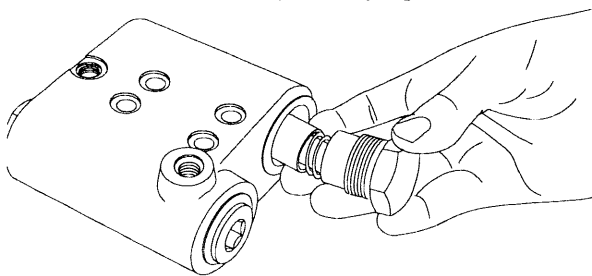
**1 1/4 in. valve**



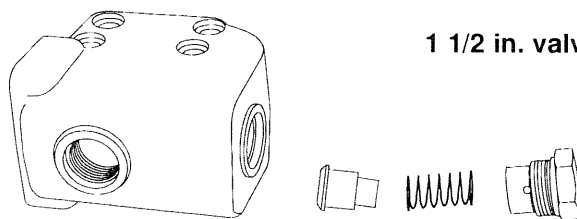
**1 1/2 in. valve**

3. 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.

**1 1/4 in. valve**



**1 1/2 in. valve**

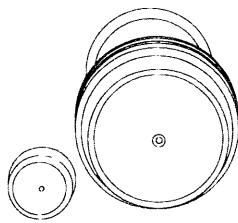


4. Remove the check valve spring retainer, spring and check valve poppet.



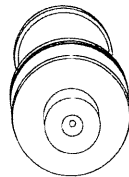
## CLEAN AND INSPECT

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. For the 1 1/4 inch valve, replace if less than 1 15/16 in. (49.2 mm) long. For the 1 1/2 inch valve, 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.



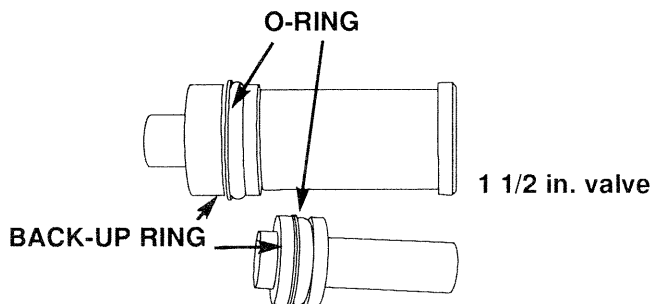
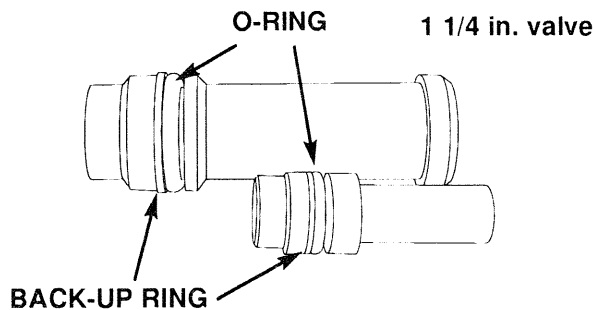
1 1/4 in. valve

1 1/2 in. valve



2. Inspect the 0.020 inch (0.5 mm) orifice in the end of the spool to be certain it is open. On the 1 1/4 in. valve, also inspect the pilot orifice to be certain it is open.

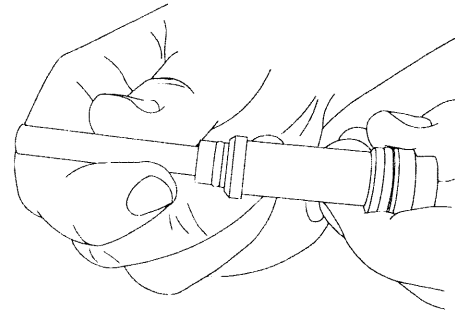
## ASSEMBLY



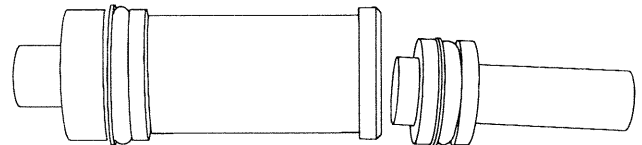
1. Install new O-rings and back-up rings on the spool and damper pistons as shown. It is important that each

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.

2. Install new O-rings on the plug and spool retainers.



1 1/4 in. valve



1 1/2 in. valve

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. On either valve, always install the spool into the valve body from the plug end, so the O-ring enters the bore first. On the 1 1/4 inch valve, install the spool spring and spring retainer. On the 1 1/2 inch valve, install the spring seat, spool spring, damper piston extension and spring retainer.
4. Install the check valve poppet, spring and check valve retainer.
5. Install the motor drain check ball, spring and fitting.
6. On the 1 1/4 inch valve only, install the pilot orifice into the "BR" port of the valve housing.
7. The brake valve is now completely assembled and ready to be installed on the winch motor.



# 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>





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PB-KU-H Platform

Vendor Data Book

P.O. # 1550-0268/05-01

Serial # 24005C

Volume: 1

## Nautilus Crane Model 340LA-100

### 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

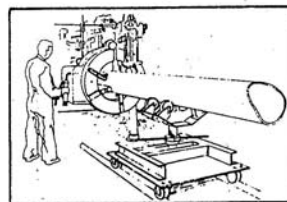
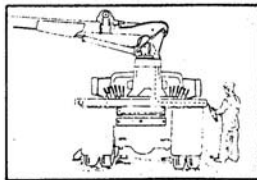
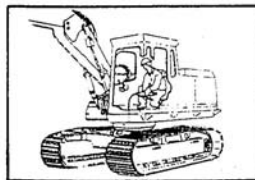
Use shorter intervals between greasings in tropical areas or where there is high humidity, dust, or wide ranges in temperature, or when there is continuous rotation.

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 fitting using one hundred operating hours for per machine manufacturer's recommendation. Apply 10 to 15 in. 2 Extreme Pressure Grease such as Texaco Multifak EP 2, Shell Alvania EP 2, or Mobilith AW2. Apply grease until it appears at the seal. Check for grease at seal. Lubricate gear with Texaco Crater Fluid or equivalent as required in present application. Check bearing seal integrity periodically per machine manufacturer's recommendation.

SERIAL NO.

# Rotek



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## **Vendor Data Book**

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### **Nautilus Crane Model 340LA-100**

#### **Section 4.12 Electrics**



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## **Nautilus Crane Model 340LA-100**

### **Section 4.12.1 Electrical Schematic Drawing N2005SK1-176**




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										OIL STATES INDUSTRIES INC. APPLIED HYDRAULIC SYSTEMS DIVISION									
										 <b>NAUTILUS</b> Marine Cranes Manufacturing Plant 1180 Mulberry Rd. Houma, LA 70363									
										Sales & Service (985) 868-0630 Fax No. (985) 851-0754									
										ELECTRICAL SCHEMATIC									
										MODEL 340LA-100									
										PEMEX									
										▲									
										DWG. NO.									
										N2005SK1-176 DRFT A-1									
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										CHK'D BY: RLB									
										DWN BY: HCM									
										DATE: 10/26/05									
										APP'D BY: RLB									
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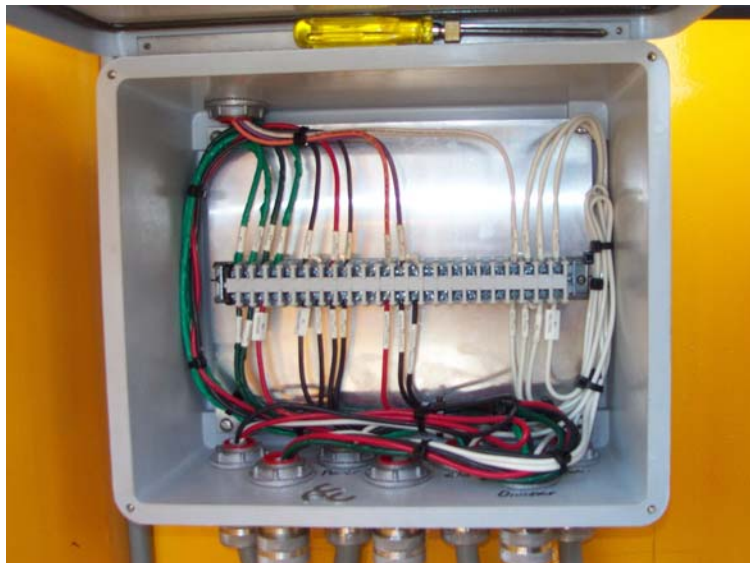
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Serial # 24005C

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## Nautilus Crane Model 340LA-100

### Section 4.12.2 Junction Box Terminal Pictures



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## **Nautilus Crane Model 340LA-100**

### **Section 4.12.3 Electrical Diagram Drawing N2005SK1-174**



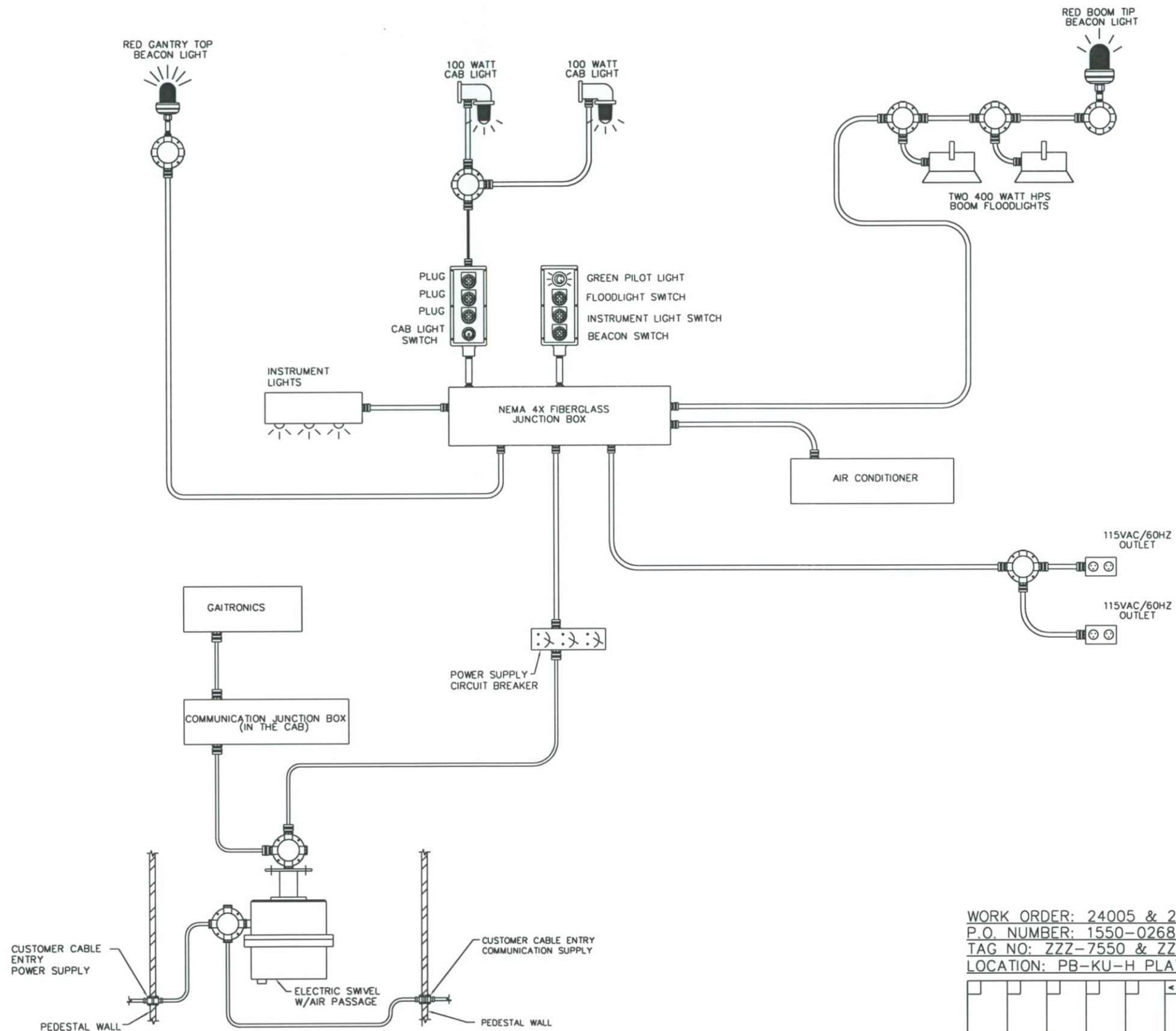
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HOUMA, LA 70363  
USA











# NOTES:

1. CUSTOMER SUPPLIED 220VAC, 60HZ, 3 PHASE, POWER SUPPLY.
2. THE ELECTRICAL SYSTEM IS DESIGNED FOR A MARINE DUTY CLASS 1, DIVISION 2, GROUP D AREA.
3. ARMORED MARINE SHIPBOARD CABLE UTILIZED.

ELECTRICAL  
SLIPRING ASSEMBLY  
(4-35 AMP SLIPRINGS)  
(7-10 AMP SLIPRINGS)

WORK ORDER: 24005 & 24105  
P.O. NUMBER: 1550-0268/05-01  
TAG NO: ZZZ-7550 & ZZZ-7555  
LOCATION: PB-KU-H PLATFORM

OIL STATES INDUSTRIES INC. APPLIED HYDRAULIC SYSTEMS DIVISION Manufacturer of <b>NAUTILUS</b> Marine Cranes Manufacturing Plant 1180 Mulberry Rd. Houma, LA 70363									
ELECTRICAL DIAGRAM MODEL 340LA-100 PEMEX									
DWG. NO. N2005SK1-174 DRFT A-1									
SCALE: NONE DATE: 10/26/05									
CHK'D BY: RLB APP'D BY: RLB									
SHT. 1 OF 1									









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## **Vendor Data Book**

P.O. # 1550-0268/05-01  
Serial # 24005C  
Volume: 1

### **Nautilus Crane Model 340LA-100**

#### **Section 4.13 RT – Series Roof Top A/C Unit**



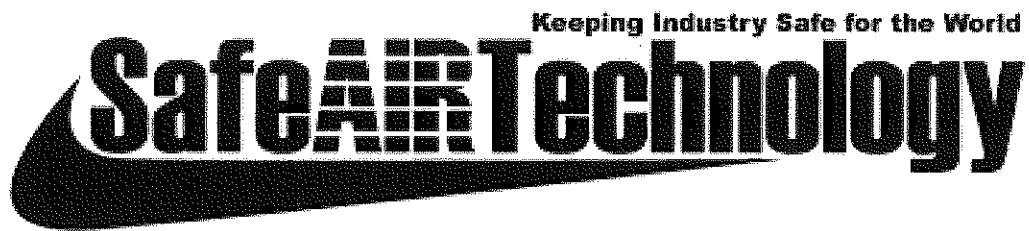
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## RT- Series Roof Top A/C Unit...

**Unit I. D. Number:** RT-XPC-13500-1-AU-ICD2-MG

**Unit Serial Number:** SAT 0506-1498



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[www.explosionproof.net](http://www.explosionproof.net) • Email: [sales@explosionproof.net](mailto:sales@explosionproof.net)



## 1. Inspection

All equipment should be carefully inspected for damage as it is received. If any damage is evident, a report must be filled at that time. A claim should then be filled against the carrier.

## 2. Selecting an Installation Location

Insure that the roof is strong enough to support the A/C unit without additional supports. Inspect the interior ceiling assembly area to avoid interference and complications with installation. The depth of the ceiling shroud is 3" (inch.)

### 2-2. Installing the Roof Top Unit

\*\*\*\* DANGER SHOCK HAZARD \*\*\*\*

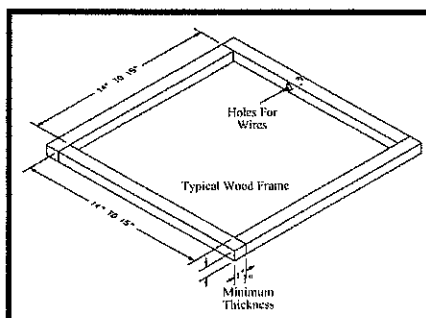
<b>DISCONNECT ALL POWER TO THE UNIT BEFORE PERFORMING SERVICE OR INSTALLTION WORK CONTACT WITH HIGH VOLTAGE CAN RESULT IN EQUIPMENT DAMAGE AND OR PERSONAL INJURY OR DEATH</b>	<b>Safety First</b>
--	---------------------

Once the location of the A.C unit has been determined a reinforced and frame roof hole opening must be provided. Only qualified service personal are allowed to install are service this equipment.

An opening will have to be cut into the roof and a matching opening will need to be cut into the ceiling. After cutting the two openings a reinforced frame must be installed between the roof and ceiling. This support must follow the following guidelines.

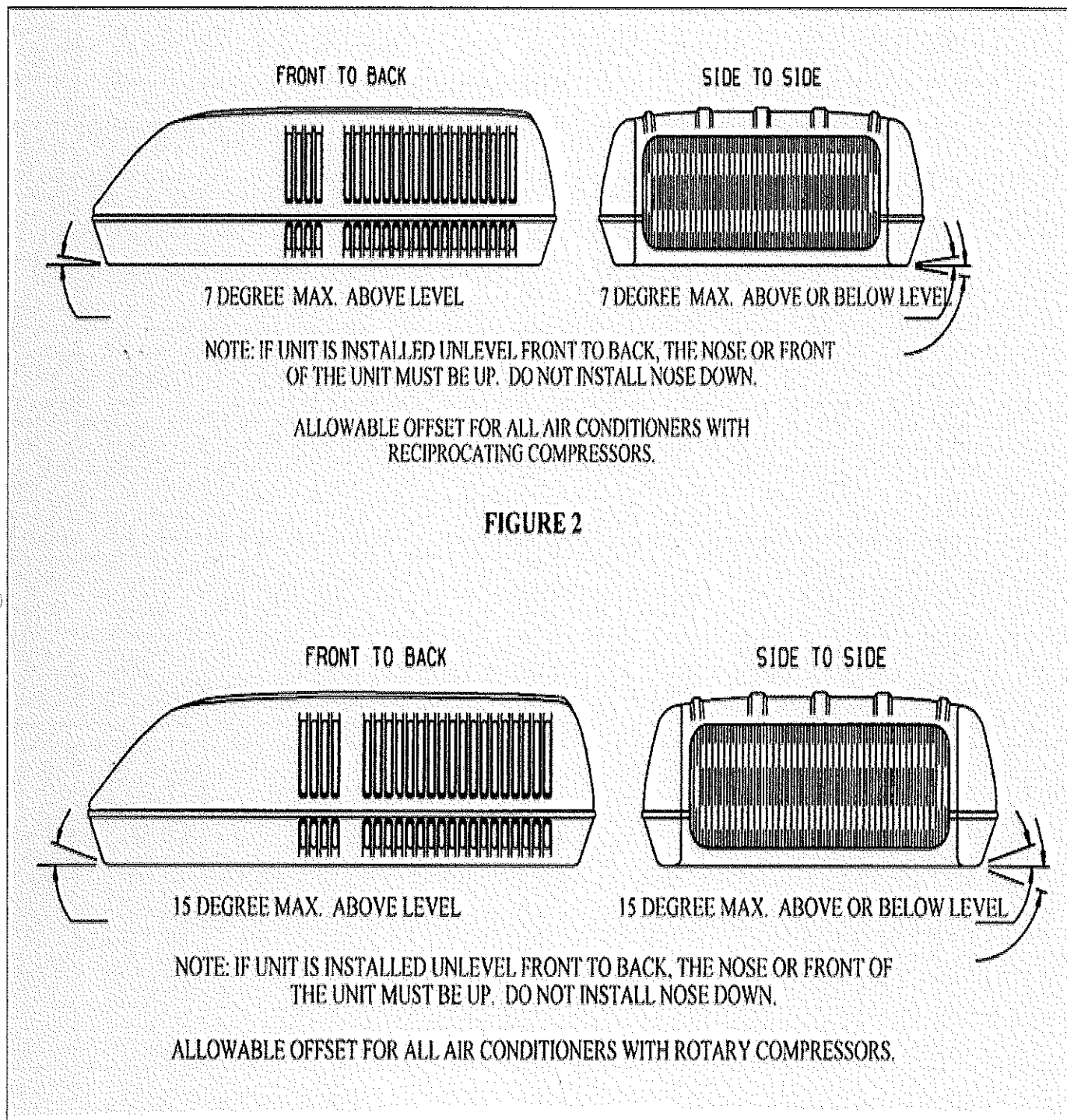
1. Capable of supporting both the weight of the roof top A/C unit and the interior ceiling section.
2. Capable of holding or supporting the roof outer surface and interior ceiling apart, so that when the rooftop A/C and ceiling assembly are bolted together, no collapsing occurs.

Note: Figure 1 showing typical frame





The roof top unit must be mounted as near level from front to rear and side to side as is possible. Figure 2 show maximum allowable degree deviations.

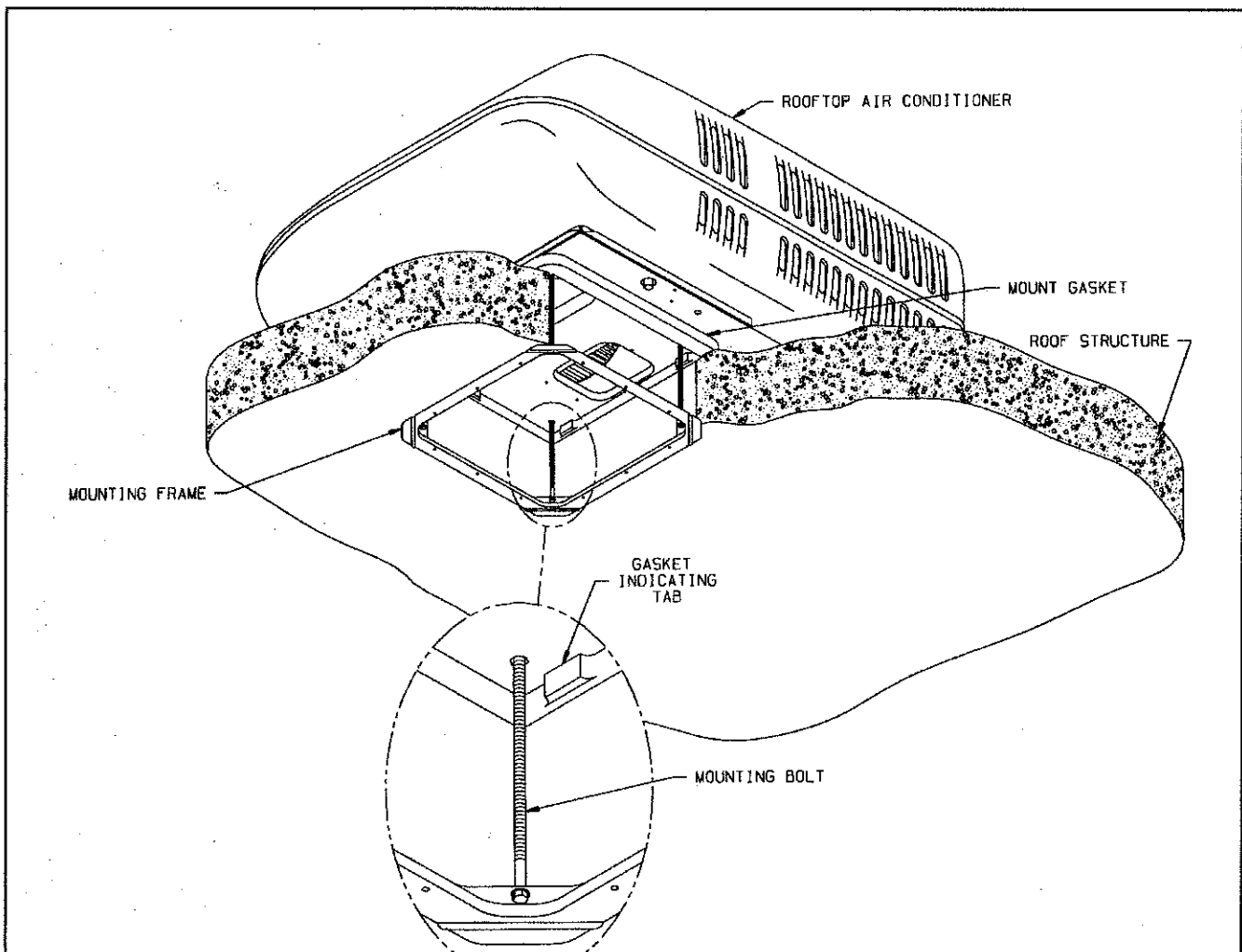




## SECURING THE A/C TO THE ROOF

A mounting frame is supplied with the ceiling assembly. Follow the steps below to secure the A/C to the roof. Refer to Figure 5.

- A. Locate the A/C mount gasket over the 14" to 15" square opening in the roof.
- B. Install the ceiling assembly mount frame using the four bolts found with the ceiling assembly
- C. Proper tension has been achieved for each gasket indicating tab has been pulled down even with the roof. See Figure 5. The upper unit has now been properly installed with optimum gasket compression.



**Figure 5**



## INSTALLING THE CELING ASSEMBLY

- A. Carefully remove the ceiling section from the box.
- B. Remove the shroud from the ceiling assembly plate.
- C. Before the ceiling section can be mounted to the mount frame, the duct collar must be fastened to the base pan of the A/C with three screws see Figure 6.
- D. Secure the ceiling plate to the mounting frame.
- E. Pull fabric duct material through ceiling assembly discharge duct opening. Slit the four corners of the fabric duct which extends below duct opening See Fig. 6
- F. Place metal flange in discharge duct opening trapping fabric between it and the ceiling assembly See Fig 6.
- G. Pull fabric tight. This will minimize material bunching.
- H. Fasten the material flange to the ceiling assembly with four screws.
- I. Route power wiring from Remote T-STAT to Connection on upper section.
- J. Run Main power from your power source. See electrical drawing for connections.

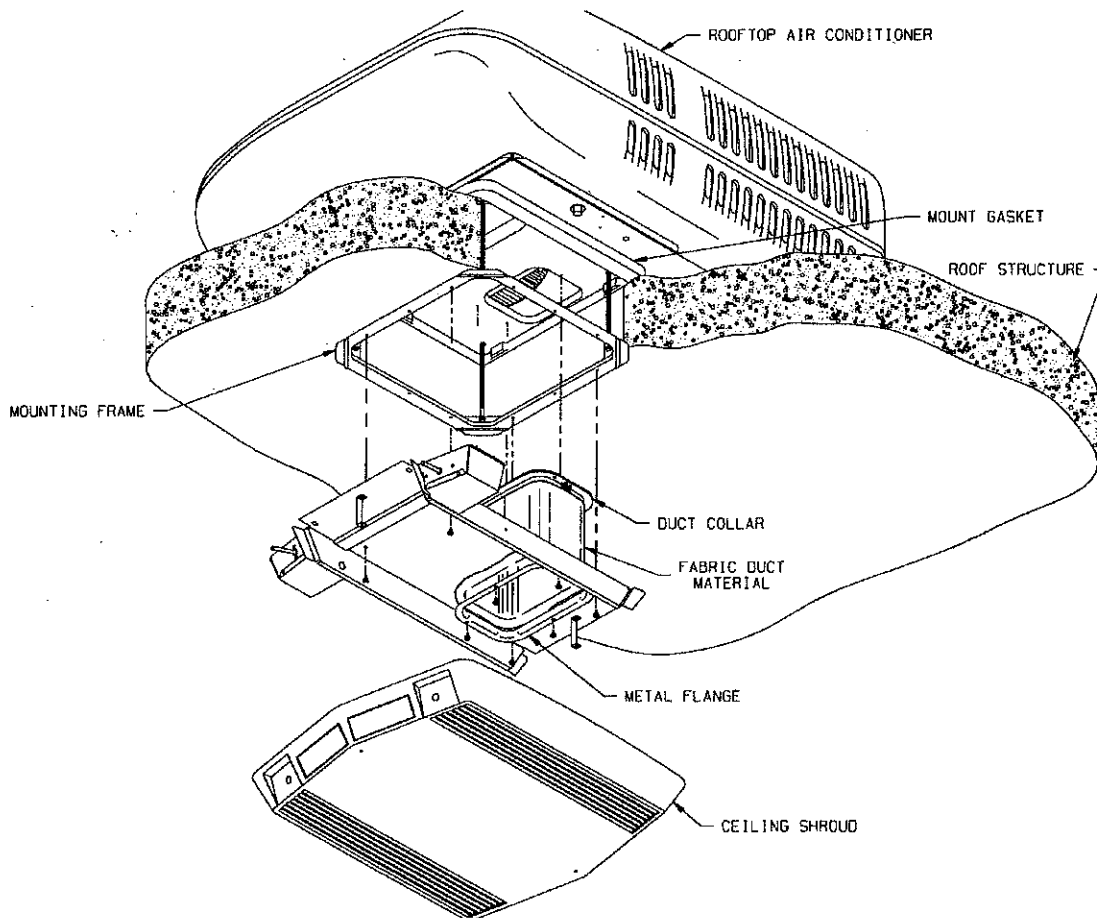
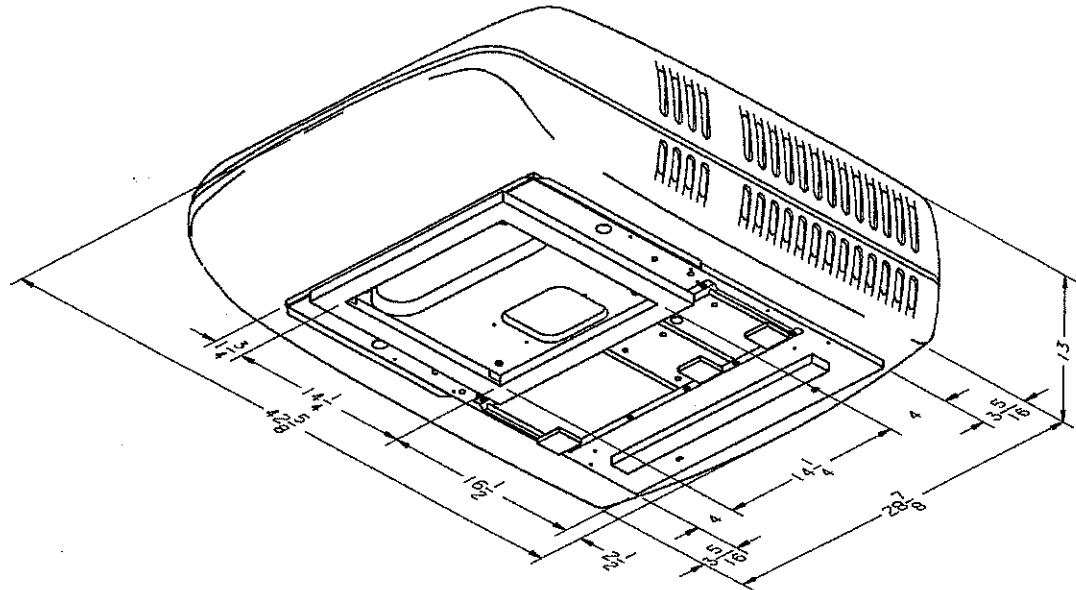


FIGURE 6



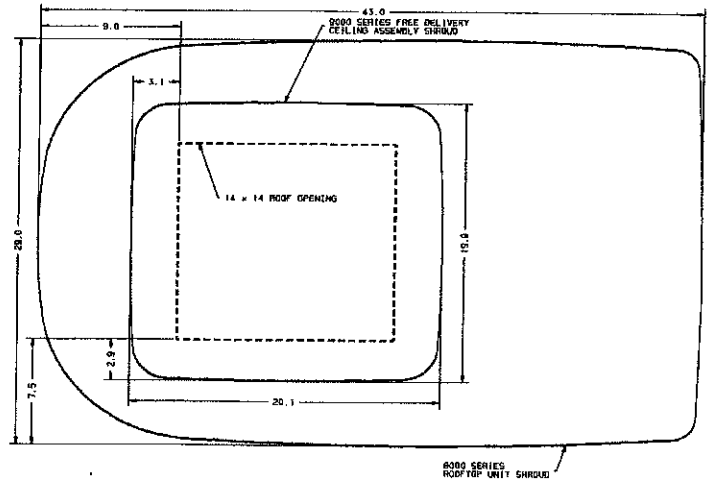
# ROOF TOP UNIT DIMENSIONS



## QUICK REFERENCE CHART

DIMENSIONS		
Exterior Shroud	Height	13 1/4"
	Width	29"
	Length	43"
Interior Shroud	Depth	2.1"
	Width	19.9"
	Length	20.1"

## CEILING SHROUD DIMENSIONS





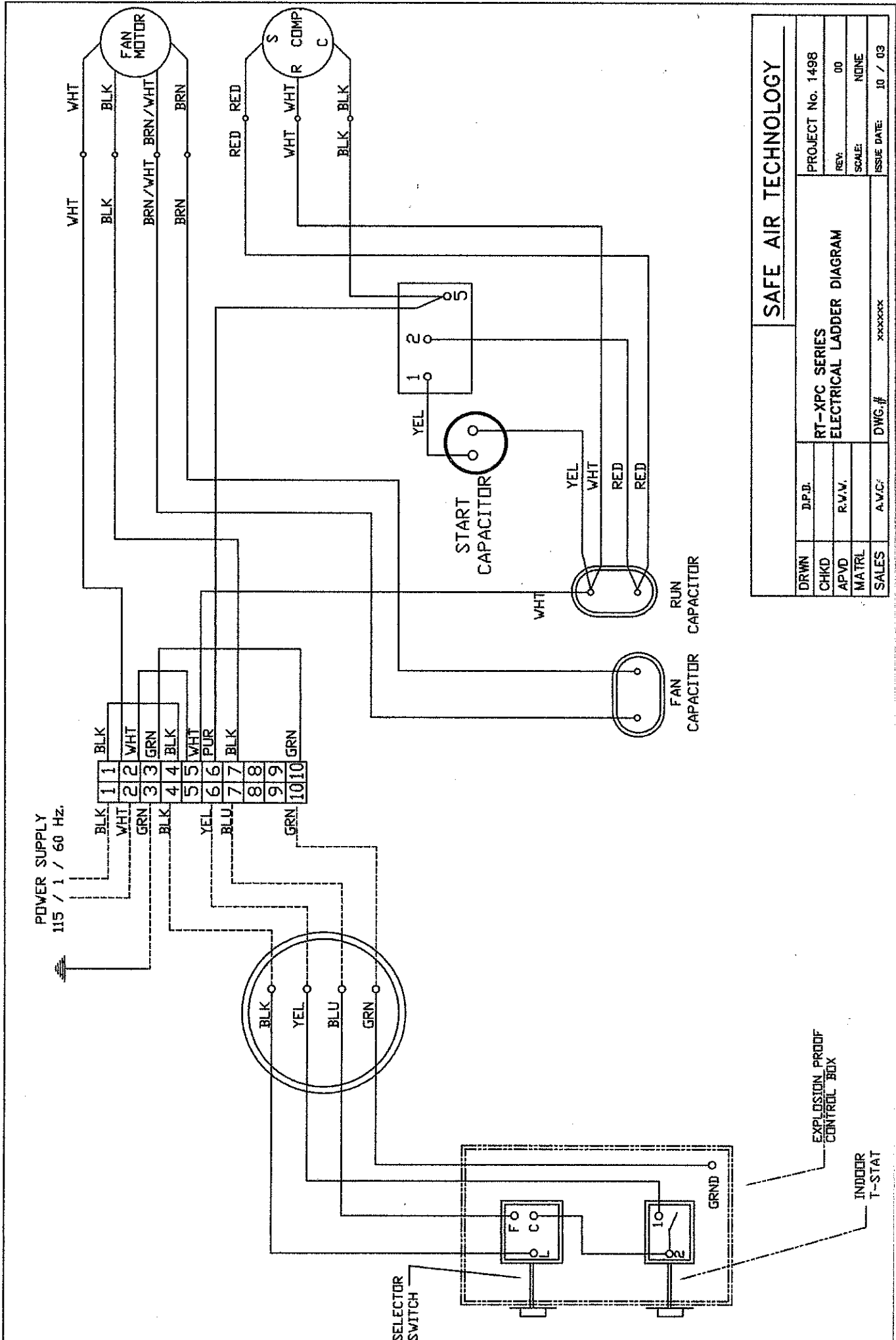
**Safe Air Technology Part List**  
**Job 1498**  
**Unit ID Number: RT-XPC-13500-1-ICD2-MG**

Item	Item Description	Part Number
A	Compressor	SAT/COMP-1498-120V-012345
B	Condenser Coil	SAT/COND-C-1498-R22-56932
C	Evaporator Coil	SAT/EVAP-C-1498-R22-56832
D	Fan Motor	SAT/FM-1498-120V-32791
E	Blower Wheel	SAT/BW-1498-B43811
F	Fan Blade	SAT/FB-1498-F43922
G	T-Stat	SAT/TS-1498-M3451
H	Selector Switch	SAT/SS-1498-M42114
I	Start Capacitor	SAT/CAP-SRT-1498-F8879223
J	Run Capacitor	SAT/CAP-RN-1498-JSD0577890E
K	Fan Capacitor	SAT/CAP-FN-1498-JGOSW35912
L	Relay	SAT/RELAY-1498-120V-F5766KD46









SAFE AIR TECHNOLOGY					
DRWN	D.P.D.	RT-XPC SERIES		PROJECT No. 1498	
CHKD	APVD	ELECTRICAL LADDER DIAGRAM		REV:	00
MATRL	SALES	DWG. #		SCALE:	NONE
				ISSUE DATE:	10 / 03





**\*\*\*\* WARRANTY STATEMENT \*\*\*\***

Safe Air Technology LLC warrants the equipment to be free from defects in workmanship and material for one (1) year. For international shipments, 18 months from date of shipment or 12 months from start up, SAT is obligated to the following; repair or replacement at SAT discretion, and at our production plant. Replacement parts shall be issued under the warranty period up on return and inspection of the part in question. All shipping charges are the responsibility of others.

SAT liability does not include the following: labor charges for the replacement of any part(s), repair services of any work done without our approval. SAT assumes no liability for services performed by out side sources other than that of SAT personal. Our obligation to replace or repair does not apply to any equipment that has been repaired or altered outside of our production plant with out SAT approval.



Safe Air Technology,

Providing Safe Solutions for your HVAC/R Projects on a Global Level



# CERTIFICATE OF CONFORMANCE

## NATIONAL ELECTRICAL CODE

### EXPLOSION PROOF HVAC/R & PRESSURIZATION EQUIPMENT

SAT certifies that to the best of our knowledge the equipment manufactured for and shipped under client Purchase Order number 4045147 and Safe Air Technology project number 1498 conforms to the requirements of the United States of America National Electrical Code for the following locations

CLASS I GROUPS C & D DIVISION 2

as applicable to equipment to be installed and operated in hazardous locations.

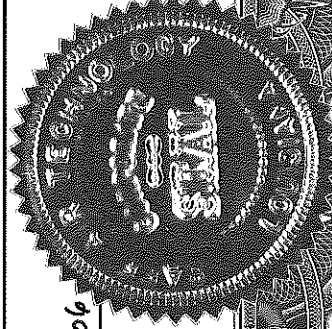
Unit Identification Number RT-XPC-13500-1-AU-ICD2-MG

Serial Number: SAT 0506-1498 Certification Date: MAY 23, 2006

CONFORMANCE I.D.: SAT-COC-0506-1498/NEC-2024

*Robert W. White 5/23/06*

Robert W. White  
Sr. Operations Manager



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**Safe Air Technology**









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PB-KU-H Platform**

## **Vendor Data Book**

P.O. # 1550-0268/05-01

Serial # 24005C

Volume: 1

### **Nautilus Crane Model 340LA-100**

#### **Section 5.0 Repair Manual**



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## Vendor Data Book

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 Volume: 1

### Nautilus Crane Model 340LA-100

#### Section 5.1 Hose Assembly List

ITEM	QTY	HOSE ID	TO	HOSE LOCATION	FROM
1	1	1-1/2"	Two-speed dump valve (in)		Pump #1
2	1	1-1/2"	Main control valve #2 (inlet tee)	Two-speed dump valve (out check)	
3	1	1/4"	Main pressure gauge #2	Main control valve #2 (inlet)	
4	1	1-1/2"	Return manifold	Main control valve (outlet)	
5	1	1-1/2"	Main hoist motor #2 (down)	Main control valve #2 (down)	
6	1	1-1/2"	Main dump valve (in)	Main control valve #2 (up)	
7	1	1-1/2"	Main hoist motor #2 (up)	Main dump valve (out)	
8	1	1-1/4"	Boom control valve #1 (inlet)	Pump #2 (flow divider port "B")	
9	1	1/4"	Boom pressure gauge #1	Boom control valve #1 (inlet)	
10	1	1-1/2"	Oil cooler (in)	Boom control valve #1 (outlet)	
11	1	1-1/2"	Hydraulic tank	Oil cooler (out)	
12	1	1-1/2"	Boom down dump valve #1 (in)	Boom control valve #1 (down)	



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Serial # 24005C

Volume: 1

### Nautilus Crane Model 340LA-100

ITEM	QTY	HOSE ID	TO	HOSE LOCATION	FROM
13	1	1-1/2"	Boom hoist motor (down tee)	Boom down dump valve #1 (out)	
14	1	1-1/2"	Boom up dump valve (in)	Boom control valve #1 (up)	
15	1	1-1/2"	Boom hoist motor (up tee)	Boom up dump valve (out)	
16	1	1-1/2"	Aux. / Main control valve (inlet)	Pump #3	
17	1	1/4"	Aux. / Main pressure gauge	Aux. / Main control valve (inlet)	
18	1	1-1/2"	Return manifold	Aux. / Main control valve (outlet)	
19	1	1-1/2"	Aux. hoist motor (down)	Aux. / Main control valve (down)	
20	1	1-1/2"	Aux. dump valve (in)	Aux. / Main control valve (up)	
21	1	1-1/2"	Aux. hoist motor (up)	Aux. dump valve (out)	
22	1	1-1/2"	Main hoist motor #1 (down)	Aux. / Main control valve (down)	
23	1	1-1/2"	Main dump valve #1 (in)	Aux. / Main control valve (up)	
24	1	1-1/2"	Main hoist motor #1 (up)	Main dump valve #1 (out)	
25	1	1-1/4"	Swing control valve (inlet)	Pump #4	



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 Serial # 24005C  
 Volume: 1

### Nautilus Crane Model 340LA-100

ITEM	QTY	HOSE ID	HOSE LOCATION	
			TO	FROM
26	1	1/4"	Swing pressure gauge	Swing control valve (inlet)
27	1	1-1/2"	Return manifold	Swing control valve (outlet)
28	2	3/4"	Swing drive #1	Swing control valve (working tee)
29	2	3/4"	Swing drive #2	Swing control valve (working tee)
30	1	1/4"	Park brake #1 (tee)	Swing control valve (inlet check tee)
31	1	1/4"	Park brake #2	Park brake #1 (tee)
32	1	1/4"	Park brake valve (in)	Swing control valve (inlet check tee)
33	1	1/4"	Hydraulic tank	Park brake valve (out)
34	1	1/4"	Dynamic brake #1 (tee)	Dynamic brake actuator
35	1	1/4"	Dynamic brake #2	Dynamic brake #1 (tee)
36	1	1-1/4"	Boom control valve #2 (inlet)	Pump #5
37	1	1/4"	Boom pressure gauge	Boom control valve #2 (inlet)
38	1	1-1/2"	Return manifold	Boom control valve #2 (outlet)



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P.O. # 1550-0268/05-01

Serial # 24005C

Volume: 1

### Nautilus Crane Model 340LA-100

ITEM	QTY	HOSE ID	HOSE LOCATION	
			TO	FROM
39	1	1-1/2"	Boom down dump valve #2 (in)	Boom control valve #2 (down)
40	1	1-1/2"	Boom hoist motor (down tee)	Boom down dump valve #2 (out)
41	1	1-1/2"	Boom up dump valve #2 (in)	Boom control valve #2 (up)
42	1	1-1/2"	Boom hoist motor (up tee)	Boom up dump valve #2 (out)
43	1	1/2"	Main dump valve #1 (1/2" check tee)	Aux. dump valve (1/2" check tee)
44	1	1/2"	Main dump valve #2 (1/2" check tee)	Main dump valve #1 (1/2" check tee)
45	1	1/2"	Boom dump valve #1 (after 1/2" check tee)	Main dump valve #2 (1/2" check tee)
46	1	1/2"	Anti-two block override valve (in)	Boom down dump valve #1 (after 1/2" check tee)
47	1	1/2"	Boom hose - union - pressure	Anti-two block override valve (out)
48	1	1/2"	Boom tip – tee – pressure	Boom base - union - pressure



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ITEM	QTY	HOSE ID	TO	HOSE LOCATION	FROM
49	1	1/2"	Main CBSD valve (in)	Boom tip - tee - pressure	
50	1	1/2"	Aux. CBSD valve (in)	Boom tip - tee - pressure	
51	1	1/2"	Boom tip - tee - return	Main CBSD valve (out)	
52	1	1/2"	Boom tip - tee - return	Aux. CBSD valve (out)	
53	1	1/2"	Boom base - union - return	Boom tip - tee return	
54	1	1/2"	Return manifold	Boom base - union - return	
55	1	1/2"	Two-speed dump valve (after 1/2" checks)	Aux. dump valve (1/2" check tee)	
56	1	3/8"	Manual high speed reset valve (port "A")	Two-speed dump valve (between 1/2" checks)	
57	1	3/8"	Pressure sensing valve (port "3" tee)	Manual high speed reset valve (port "B")	
58	1	3/8"	Hydraulic tank	Pressure sensing valve (port "3" tee)	
59	1	1/4"	Pressure sensing valve (port "2")	Manual high speed reset valve (pilot port)	



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ITEM	QTY	HOSE ID	HOSE LOCATION	
			TO	FROM
60	1	1/4"	Main dump valve #2 (gauge port)	Pressure sensing valve (port "1")
61	1	1/2"	Boom down dump valve #2 (1/2" check tee)	Boom down dump valve #1 (between 1/2" checks)
62	1	1/2"	Low boom angle override valve (port "C")	Boom down dump valve #2 (1/2" check tee)
63	1	1/2"	Low boom angle limit valve (port "B")	Low boom angle override valve (port "A")
64	1	1/2"	High boom angle limit valve (port "T" tee)	Low boom angle limit valve (port "T")
65	1	1/2"	Hydraulic tank	High boom angle limit valve (port "T" tee)
66	1	1/2"	Boom up dump valve #2 (1/2" check tee)	Boom up dump valve #1 (1/2" check)
67	1	1/2"	High boom angle limit valve (port "B")	Boom up dump valve #2 (1/2" check tee)
68	1	1/4"	Return pressure gauge	Return manifold
69	1	4"	Return filter	Return manifold



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HOSE LOCATION				
ITEM	QTY	HOSE ID	TO	FROM
70	1	1/4"	Swing brake cooler #1 (in tee)	Return manifold (1/4" flow control)
71	1	1/4"	Swing brake cooler #2 (in)	Swing brake cooler #1 (in tee)
72	1	1/4"	Swing brake cooler #2 (out tee)	Swing brake cooler #1 (out)
73	1	1/4"	Hydraulic tank	Swing brake cooler #2 (out tee)
74	1	1/4"	Hydraulic tank	Boom hoist case drain
75	1	1/4"	Main hoist case drain (tee)	Aux. hoist case drain
76	1	3/8"	Hydraulic tank	Main hoist case drain (tee)
77	1	3/8"	Unloading relief valve (port "P")	Pump #2 (flow divider port "R")
78	1	1/2"	Unloading relief valve (port "T" tee)	Unloading relief valve (port "T")
79	1	1/2"	Hydraulic tank	Unloading relief valve (port "T" tee)
80	1	3/8"	High pressure filter (in tee)	Unloading relief valve (port "2")



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ITEM	QTY	HOSE ID	TO	HOSE LOCATION	FROM
81	1	1/4"	Accumulator pressure gauge		High pressure filter (in tee)
82	1	3/8"	Accumulator (tee)		High pressure filter (out)
83	1	1/2"	Start valve (in)		Accumulator (tee)
84	1	1/2"	Start motor (in)		Start valve (out)
85	1	1/2"	Hydraulic tank		Start motor (out)
86	1	1/2"	Hand recharge pump (in)		Hydraulic tank
87	1	3/8"	High pressure filter (in tee)		Hand recharge pump (out)
88	1	2-1/2"	Pump #1		Hydraulic tank
89	1	2-1/2"	Pump #2		Hydraulic tank
90	1	2-1/2"	Pump #3		Hydraulic tank
91	1	2"	Pump #4		Hydraulic tank
92	1	2"	Pump #5		Hydraulic tank
93	1	1/4"	Engine oil pressure gauge		Engine block (pressure)
94	1	1/4"	Throttle cylinder		Throttle actuator
95	1	3/8"	Fuel filter ( in)		Fuel tank



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ITEM	QTY	HOSE ID	HOSE LOCATION	
			TO	FROM
96	1	3/8"	Sentinel valve (fuel in)	Fuel filter (out)
97	1	3/8"	Fuel pump (in)	Sentinel valve (fuel out)
98	1	1/4"	Sentinel valve (oil in orifice)	Engine block (pressure)
99	1	1/4"	Water temperature probe (in)	Sentinel valve (oil out)
100	1	1/4"	Engine block (vent)	Water temperature probe (out)
101	1	1"	Air swivel (bottom)	Pedestal wall
102	1	1"	Air tank	Air swivel (top check)
103	1	1/4"	Air horn button (in tee)	Air tank
104	1	1/4"	Air horn	Air horn button (out)
105	1	1/4"	Air pressure gauge (tee)	Air horn button (in tee)
106	1	1/4"	Windshield wiper button #1 (in tee)	Air pressure gauge (tee)
107	1	1/4"	Windshield wiper button #2 (in tee)	Windshield wiper button #1 (in tee)



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ITEM	QTY	HOSE ID	HOSE LOCATION	
			TO	FROM
108	1	1/4"	Windshield wiper button #3 (in)	Windshield wiper button #2 (in tee)
109	1	1/4"	Windshield wiper #1	Windshield wiper button #1 (out)
110	1	1/4"	Windshield wiper #2	Windshield wiper button #2 (out)
111	1	1/4"	Windshield wiper #3	Windshield wiper button #3 (out)
112	1	4"	Return manifold #1	Return manifold #2
113	1	1/4"	Hyd tank	Swing motor #2 case drain
114	1	1/4"	Swing motor #1	Swing motor #2
115	1	1/4"	MAIN load cell gauge	MAIN load cell (tip)
116	1	1/4"	Aux. load cell gauge	Aux. load cell (tip)
117	1	1-1/2"	Oil cooler (in tee)	Boom control valve #2 (out)
118	1	2"	Return manifold	Oil cooler (out)
119	-	-	-	-
120	-	-	-	-
121	-	-	-	-



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### Section 5.2 Bill of Materials

#### UPPERSTRUCTURE ASSEMBLY, N80666-501

<u>ITEM</u>	<u>QTY.</u>	<u>NUMBER</u>	<u>DESCRIPTION</u>
122	1.00	N46397-002	BALLRING, 340LA
*123	1.00	N47255-021	BOLT KIT, 340LA, BALLRING
*124	1.00	N47255-022	BOLT KIT, 340L, PEDESTAL
125	2.00	N61503-001	PINION, 340L
126	2.00	N60265-004	PINION KEEPER
127	2.00	N61196-004	PINION GUARD
128	2.00	N47103-001	GEARBOX, SWING DRIVE
129	2.00	N47199-002	BRAKE, SWING DRIVE
130	1.00	N61584-001	UPPERSTRUCTURE WELDMENT
131	1.00	N61591-001	BRIDLE

**\*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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### Section 5.2 Bill of Materials (cont'd)

#### UPPERSTRUCTURE ASSEMBLY, N80666-501(cont'd)

132	1.00	N61583-003	GANTRY
133	1.00	N61607-001	GANTRY LADDER SUPPORTS
134	1.00	N61608-001	GANTRY LADDER
135	1.00	N61627-015	RETURN MANIFOLD
136	-	-	-
137	-	-	-
138	-	-	-
139	-	-	-
140	-	-	-
141	-	-	-

#### BOOM SUSPENSION ASSEMBLY, N80666-502

142	840.00	N00034-012	WIRE ROPE, 3/4"
143	2.00	N60982-003	BOOM STOP



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### **Section 5.2** **Bill of Materials (cont'd)**

#### **BOOM SUSPENSION ASSEMBLY, N80666-502(cont'd)**

<b>144</b>	2.00	N15969-001	SPRING, BOOM STOP
<b>145</b>	2.00	N47008-001	BOOM BUMPER
<b>146</b>	1.00	N30602-007	SOCKET, OPEN WEDGE, 3/4"
<b>147</b>	1.00	N30606-012	CLAMP, CABLE, 3/4"
<b>148</b>	1.00	N45002-502	RATCHET & PAWL KIT
<b>149</b>	1.00	N47140	RATCHET & PAWL INSTALLATION
<b>150</b>	12.00	N45422-007	BEARING, SHEAVE
<b>151</b>	12.00	N45931-012	SHEAVE, NYLON, 20"
<b>152</b>	1.00	N46419-001	BOLT KIT, AUXILIARY HOIST
<b>153</b>	1.00	N46430-009	HOIST, CH230B
<b>154</b>	2.00	N46501-055	PENDANT LINE, 1-3/4" (55')
<b>155</b>	2.00	N61597-001	PENDANT LINK
<b>156</b>	2.00	N61594-001	PENDANT KEEPER
<b>157</b>	1.00	N46579-004	GATE, SAFETY, INTREPID



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#### Section 5.2 Bill of Materials (cont'd)

##### BOOM BASE ASSEMBLY, N80666-503

158	1.00	N45916-001	INDICATOR, BOOM ANGLE,
159	1.00	N60255-005	NEEDLE, INDICATOR BOOM ANGLE
160	1.00	N61586-001	BOOM BASE WELDMENT
161	8.00	N62596-002	BOOM ROLLER, MID
162	1.00	N62596-003	BOOM ROLLER, TIP
163	1.00	N62596-001	BOOM ROLLER, BASE
164	6.00	N00186-012	BOARD, OAK
165	-	-	-
166	-	-	-
167	-	-	-
168	-	-	-
169	-	-	-
170	-	-	-
171	-	-	-
172	-	-	-



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#### Section 5.2 Bill of Materials (cont'd)

##### BOOM INSERT ASSEMBLY, N80666-504

173	2.00	N61587-030	BOOM MID WELDMENT
174	1.00	N95SK1-104	FLEET ANGLE IDLER
175	-	-	-
176	-	-	-
177	-	-	-

##### BOOM POINT ASSEMBLY, N80666-505

178	1.00	N61588-001	BOOM POINT WELDMENT
179	1.00	N99SK1-093	BRIDLE REST
180	-	-	-
181	-	-	-

##### POWER UNIT ASSEMBLY, N80666-506

182	1.00	N47787-002	ENGINE, CATERPILLAR 3126 DIT
183	1.00	N47907-005	CABLE, CHALMATIC, 35'
184	1.00	N47907-006	CABLE, CHALMATIC, 40'



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### **Section 5.2 Bill of Materials (cont'd)**

#### **POWER UNIT ASSEMBLY, N80666-506(cont'd)**

<b>185</b>	1.00	N45272-004	SILENCER, MUFFLER
<b>186</b>	1.00	N45358-003	ACTUATOR, REMOTE, HYDRAULIC
<b>187</b>	2.00	N45125-001	FILLER, BREATHER, RESERVOIR
<b>188</b>	1.00	N47243-001	INSULATION, EXHAUST, BLANKET
<b>189</b>	1.00	N47233-002	SHUTDOWN, CAT. ENGINE
<b>190</b>	2.00	N45690-030	GAUGE, LEVEL, 0-25PSI
<b>191</b>	1.00	N47232-020	VALVE, CHALMATIC
<b>192</b>	1.00	N47232-501	LEVER HANDLE, CHALMATIC VALVE
<b>193</b>	5.00	N45921-028	STRAINER, SUCTION, 2"
<b>194</b>	1.00	N46133-003	PICKUP, MAGNETIC, TACHOMETER
<b>195</b>	1.00	N47445-018	GAUGE, PRESSURE, 0-200PSI
<b>196</b>	1.00	N61590-026	POWER UNIT WELDMENT
<b>197</b>	2.00	N46748-030	GAUGE, TEMPERATURE 13-250 DEG.
<b>198</b>	2.00	N45679-014	VALVE, BALL, 3/4"
<b>199</b>	1.00	N46101-015	RAIN CAP



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### Section 5.2 Bill of Materials (cont'd)

#### POWER UNIT ASSEMBLY, N80666-506(cont'd)

<b>200</b>	1.00	N45998-001	VALVE, SHUTOFF, 3/4"
<b>201</b>	1.00	N45358-003	ACTUATOR, HYDRAULIC REMOTE
<b>202</b>	2.00	N45358-200	CYLINDER, THROTTLE
<b>203</b>	1.00	N00174-001	COATING, EPOXY
<b>204</b>	8.00	N13581-004	PAD, FABREEKA
<b>205</b>	2.00	N45813-008	RESERVOIR, SWING BRAKE
<b>206</b>	-	-	-

#### CONTROL STATION ASSEMBLY, N80666-507

<b>207</b>	1.00	N80279-044	CAB WELDMENT
<b>208</b>	1.00	N46638-001	SEAT, TRIMLINE
<b>209</b>	1.00	N46638-501	PEDESTAL, SEAT SWIVEL
<b>210</b>	4.00	N45130-004	KNOB, CONTROL LEVER
<b>211</b>	1.00	N47445-024	GAUGE, PRESSURE, 0-3000
<b>212</b>	1.00	N47445-016	GAUGE, PRESSURE, 0-100



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#### CONTROL STATION ASSEMBLY, N80666-507(cont'd)

213	5.00	N47445-026	GAUGE, PRESSURE, 0-5000
214	1.00	N45358-001	THROTTLE KIT, HYD. FOOT
215	1.00	N45813-003	SWING, BRAKE, CYLINDER
216	1.00	N80278-044-GLASS-TINTED	GLASS, TINTED, CAB
217	1.00	N80278-213	LATCH, CAB DOOR
218	1.00	N80278-214	HANDLE, CAB DOOR
219	35.00'	N80278-220	GASKET, DOOR END SEAL
220	10.00'	N80278-222	CAB, GLASS, RUBBER GASKET
221	1.00	N61644-002	SWING LOCK
222	1.00	N61117-037	CAB TRAY
223	1.00	N46017-003	TACHOMETER, DIGITAL
224	1.00	N45924-002	ENCLOSURE, TACHOMETER
225	1.00	N80344-240	LINKAGES
226	1.00	N61322-026	CONSOLE, CAB GAUGE



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#### CONTROL STATION ASSEMBLY, N80666-507(cont'd)

<b>227</b>	1.00	N61322-027	CONSOLE, CAB GAUGE
<b>228</b>	1.00	N45880-013	FIRE EXTINGUISHER, DRY CHEMICAL
<b>229</b>	1.00	N45880-513	BRACKET, FIRE EXTINGUISHER
<b>230</b>	1.00	N46649-002	TOOLBOX, PLASTIC
<b>231</b>	1.00	N89SK1-403	DYNAMIC SWING BRAKE
<b>232</b>	1.00	N45727-108	INDICATOR, LOAD, DIAPHRAGM
<b>233</b>	1.00	N45729-086	INDICATOR, LOAD, PISTON
<b>234</b>	1.00	N46529-002	SUN VISOR
<b>235</b>	1.00	N45358-200	CYLINDER, THROTTLE
<b>236</b>	-	-	-
<b>237</b>	-	-	-
<b>238</b>	-	-	-
<b>239</b>	-	-	-
<b>240</b>	-	-	-



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### Section 5.2 Bill of Materials (cont'd)

#### PIN KIT, N80666-508

241	2.00	N61604-001	MAIN IDLER PIN
242	2.00	N61596-001	GANTRY UPPERSTRUCTURE PIN
243	2.00	N61595-001	BOOM FOOT PIN
244	2.00	N60646-004	LOAD CELL PIN
245	1.00	N61605-001	LOWER AUXILIARY EXTENSION PIN
246	8.00	N60986-004	BOOM CONNECTION PIN
247	4.00	N60986-005	BOOM LIFTING PADEYE PIN
248	2.00	N61603-001	BRIDLE / GANTRY PIN
249	1.00	N60645-001	MAIN EXT.WEDGE SOCKET PIN
250	-	-	-
251	-	-	-
252	-	-	-
253	-	-	-



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### Section 5.2 Bill of Materials (cont'd)

#### WALKWAY ASSEMBLY, N80666-509

254	1.00	N61589-027	WALKWAYS & SUPPORTS
255	1.00	N2006SK1-141	LADDER, ACCESS
256	1.00	N46579-004	GATE, SAFETY, INTREPID
257	-	-	-
258	-	-	-
259	-	-	-
260	-	-	-
261	-	-	-

#### PEDESTAL ASSEMBLY, N80666-510

262	1.00	N2005SK1-171	PEDESTAL WELDMENT
263	4.00	N2003SK1-296	JACK PAD PLUG
264	-	-	-
265	-	-	-
266	-	-	-



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### Section 5.2 Bill of Materials (cont'd)

#### BRACKETS, N80666-511

267	1.00	N60863-001	RETURN FILTER BRACKET
268	1.00	N61609-001	AUX LOAD CELL BRACKET
269	2.00	N60989-010	ANTI-TWO BLOCK HANGERS
270	1.00	N60756-007	HI / LO BOOM KICKOUT
271	2.00	N61109-040	FLOODLIGHT BRACKET
272	1.00	N61638-001	ELECTRIC SWIVEL BRACKET
273	1.00	N62223-001	SPEAKER BRACKET
274	2.00	N99SK1-110	BOOM LIFTING BRACKET
275	1.00	N80402-006	BOOM TIP BEACON BRACKET
276	1.00	N80402-007	GANTRY BEACON MOUNTING
277	-	-	-
278	-	-	-
279	-	-	-
280	-	-	-



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### Section 5.2 Bill of Materials (cont'd)

#### RIGGING ASSEMBLY, N80666-512

281	1.00	N46487-009	HOIST, CH330A (MAIN)
282	443.00'	N00031-012	WIRE ROPE, DYFORM (3/4")
283	1.00	N45002-007	HOIST, CH150A (AUX.)
284	1913.00'	N00031-014	WIRE ROPE, DYFORM (7/8")
285	4.00	N45315-048	CABLES, ANTI-TWO BLOCK
286	2.00	N46419-001	BOLT KIT, AUXILIARY HOIST
287	1.00	N45421-033	SHEAVE, NYLON, 14"
288	1.00	N45421-039	SHEAVE, NYLON, 14"
289	2.00	N45422-006	BEARING, SHEAVE
290	1.00	N30602-008	SOCKET, OPEN WEDGE, 7/8"
291	1.00	N30611-004	SOCKET, OPEN WEDGE, 3/4"
292	1.00	N30606-012	CLAMP, CABLE, 3/4"
293	1.00	N30606-014	CLAMP, CABLE, 7/8"
294	8.00	N30601-006	SHACKLE, ANCHOR
295	8.00	N45422-007	BEARING, SHEAVE



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#### Section 5.2 Bill of Materials (cont'd)

##### RIGGING ASSEMBLY, N80666-512(cont'd)

296	1.00	N46831-230	LOAD BLOCK, 80 TON
297	1.00	N46832-014	OVERHAUL BALL, 10 TON
298	1.00	N80196-003	KIT, EMERGENCY LOAD LOWERING
299	3.00	N45931-012	SHEAVE, NYLON, 20"
300	4.00	N45931-014	SHEAVE, NYLON, 20"
301	1.00	N45421-050	SHEAVE, NYLON, 16"
302	1.00	N80196-005	KIT, EMERGENCY LOAD LOWERING
303	1.00	N46500-001	BOLT, KIT, GANTRY
304	-	-	-
305	-	-	-
306	-	-	-
307	-	-	-
308	-	-	-
309	-	-	-
310	-	-	-



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#### Section 5.2 Bill of Materials (cont'd)

##### HYDRAULIC SYSTEM, N80666-513(cont'd)

311	2.00	N45375-003	MOTOR, 120
312	1.00	N45758-004	VALVE, SHUTTLE, HYD
313	3.00	N45025-001	VALVE, DIRECTIONAL, HYD, 3/4"
314	3.00	N45025-501	SPRING KIT, DIRECTIONAL VALVE
315	3.00	N45025-502	KIT, HANDLE, DIRECTIONAL VALVE
316	2.00	N45401-001	VALVE, HYD1
317	7.00	N60780-001	BODY, DUMP VALVE
318	7.00	N45854-002	CARTRIDGE, HYD DUMP VALVE
319	7.00	N45855-002	COVER, HYD DUMP VALVE w/BOLTS
320	1.00	N45419-004	VALVE, FLOW CONTROL
321	1.00	N45674-005	VALVE, CHECK, HYD, INLINE, 1-1/2"
322	1.00	N45674-009	VALVE, CHECK, HYD, INLINE, 1/4"
323	7.00	N45674-011	VALVE, CHECK, HYD, INLINE, 1/2"
324	1.00	N45683-001	VALVE, START, HYD, SOFT ENGAGE



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### **Section 5.2** **Bill of Materials (cont'd)**

#### **HYDRAULIC SYSTEM, N80666-513(cont'd)**

<b>325</b>	1.00	N83SK1-043	FILTER, HIGH PRESSURE
<b>326</b>	1.00	N83SK1-044	PUMP, HYD HAND
<b>327</b>	2.00	N46912-001	ACCUMULATOR
<b>328</b>	2.00	N45460-001	FILTER, RETURN, HYDRAULIC
<b>329</b>	4.00	N45460-501	FILTER, ELEMENT, HYDRAULIC
<b>330</b>	2.00	N45943-001	VALVE, CBSD, HYDRAULIC
<b>331</b>	1.00	N46094-019	MOTOR, START, HYDRAULIC
<b>332</b>	1.00	N46740-001	VALVE, START, HYD
<b>333</b>	1.00	N46897-001	VALVE, ACCUMULATOR
<b>334</b>	2.00	N83SK1-045	BRACKET, ACCUMULATOR
<b>335</b>	1.00	N46785-453	PUMP, HYD, GEAR
<b>336</b>	1.00	N46785-454	PUMP, HYD, GEAR
<b>337</b>	1.00	N47010-003	VALVE, CONTROL, V90 ASSY
<b>338</b>	1.00	N47010-004	VALVE, CONTROL, V90 ASSY



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### Section 5.2 Bill of Materials (cont'd)

#### HYDRAULIC SYSTEM, N80666-513(cont'd)

339	3.00	N47010-001	VALVE, CONTROL, HYD, V90 ASSY
340	1.00	N46488-001	VALVE, FLOW DIVIDER
341	1.00	N47445-013	GAUGE, PRESSURE, 0-5000 PSI
342	1.00	N46074-001	VALVE, SENSING, PRESSURE
343	1.00	N46096-001	VALVE, RESET
344	1.00	N46639-001	OIL COOLER
345	-	-	-
346	-	-	-

#### ELECTRICAL SYSTEM, N80666-514

347	2.00	N45037-007	BREAKER, CIRCUIT
348	2.00	N45038-001	COVER, CIRCUIT BREAKER
349	1.00	N45039-005	BOX, ELECTRIC SERVICE
350	2.00	N45042-002	RECEPTACLE, PLUG, DEAD END
351	2.00	N45042-013	RECEPTACLE, PLUG
352	200.00'	N45044-008	CABLE, ELECTRIC



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### **Section 5.2 Bill of Materials (cont'd)**

#### **ELECTRICAL SYSTEM, N80666-514(cont'd)**

<b>353</b>	180.00'	N45044-013	CABLE, ELECTRIC
<b>354</b>	50.00'	N45044-032	CABLE, ELECTRIC
<b>355</b>	2.00	N47582-502	BULB, FLOODLIGHT
<b>356</b>	2.00	N46405-006	BOX, JUNCTION
<b>357</b>	2.00	N46405-003	BOX, JUNCTION
<b>358</b>	2.00	N46238-005	LIGHT, BEACON, RED
<b>359</b>	2.00	N46534-002	ENCLOSURE, ONE, 3/4"
<b>360</b>	3.00	N46537-001	SWITCH, SELECTOR, 2 POSITION
<b>361</b>	1.00	N46540-002	LIGHT, PILOT, GREEN
<b>362</b>	2.00	N46868-005	LIGHT, CAB, 100W
<b>363</b>	1.00	N46868-010	LIGHT, CAB, 150W
<b>364</b>	2.00	N46868-517	BULB, LIGHT, 100W
<b>365</b>	1.00	N46868-521	BULB, LIGHT, 100W
<b>366</b>	1.00	N46878-001	PAGING SYSTEM ASSY.
<b>367</b>	1.00	N46878-504	HEADSET, W/MIC ASSY.



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#### Section 5.2 Bill of Materials (cont'd)

##### ELECTRICAL SYSTEM, N80666-514(cont'd)

368	1.00	N46878-505	CABLE, 30' EXT.
369	1.00	N46878-506	HORN/SPEAKER
370	1.00	N46878-507	SPEAKER DRIVER
371	1.00	N47021-071	SWIVEL, ELECTRIC
372	1.00	N47367-002	POTENTIOMETER, KILLARK
373	1.00	N47367-507	SWITCH, DIMMER, OFF-ON
374	2.00	N46731-017	LIGHT, FLOOD, YOKE MOUNT
375	1.00	N47514-001	AIR CONDITIONER, CAB-MOUNTED
376	-	-	-
377	-	-	-
378	-	-	-
379	-	-	-
380	-	-	-
381	-	-	-
382	-	-	-



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### Section 5.2 Bill of Materials (cont'd)

#### PNEUMATIC SYSTEM., N80666-515

383	1.00	N45445-003	VALVE, POPOFF, AIR, 100PSI
384	1.00	N45674-004	VALVE, CHECK, HYD
385	1.00	N45678-003	HORN, AIR
386	1.00	N45693-005	RECEIVER, AIR
387	1.00	N45844-015	GAUGE, PRESSURE
388	1.00	N46003-001	VALVE, PUSH BUTTON, AIR
389	3.00	N46051-001	WIPER, ASSEMBLY
390	1.00	N46178-008	VALVE, BALL
391	-	-	-
392	-	-	-
393	-	-	-
394	-	-	-
395	-	-	-
396	-	-	-
397	-	-	-



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#### LOAD CHART & API TAG, N80666-522

398	1.00	N2006SK3-034	CHART, LOAD
399	1.00	24005 INFO	CHART, INFORMATION
400	1.00	24005 API	TAG, API
401	-	-	-

#### MANUFACTURER ENGINE SPARE PARTS

402	1.00	N47787-503	RADIATOR GROUP
403	1.00	N47787-504	RADIATOR CAP
404	1.00	N47787-505	RADIATOR FAN GUARD
405	1.00	N47787-506	RADIATOR FAN GUARD
406	1.00	N47787-507	RADIATOR SHROUD
407	1.00	N47787-508	FUEL TRANSFER PUMP
408	1.00	N47787-538	FUEL PRIMING PUMP
409	1.00	N47787-510	SECONDARY FUEL FILTER
410	1.00	N47787-511	OIL FILTER
411	1.00	N47787-529	AIR CLEANER ASSEMBLY
412	1.00	N47787-513	AIR CLEANER ELEMENT – PRIMARY



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## Section 5.2 Bill of Materials (cont'd)

### MANUFACTURER ENGINE SPARE PARTS(cont'd)

413	1.00	N47787-514	AIR CLEANER ELEMENT - SECONDARY
414	2.00	N47787-515	ENGINE FAN BELTS
415	1.00	N47787-516	FAN PULLEY SYSTEM
416	1.00	N47787-517	BELT TENSIONER
417	1.00	N47787-518	FLYWHEEL
418	1.00	N47787-519	WATER PUMP
419	1.00	N47787-520	FAN SPIDER ASSEMBLY
420	1.00	N47787-521	UPPER RADIATOR HOSE
421	1.00	N47787-522	LOWER RADIATOR HOSE
422	1.00	N47787-533	OIL PRESSURE GAUGE
423	3.00	N47787-531	EXHAUST MANIFOLD GASKETS
424	1.00	N47787-532	WATER TEMPERATURE GAUGE
425	1.00	N47787-537	FUEL PRESSURE GAUGE
426	-	-	-



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### **Section 5.3 Identified Parts – Pictures**



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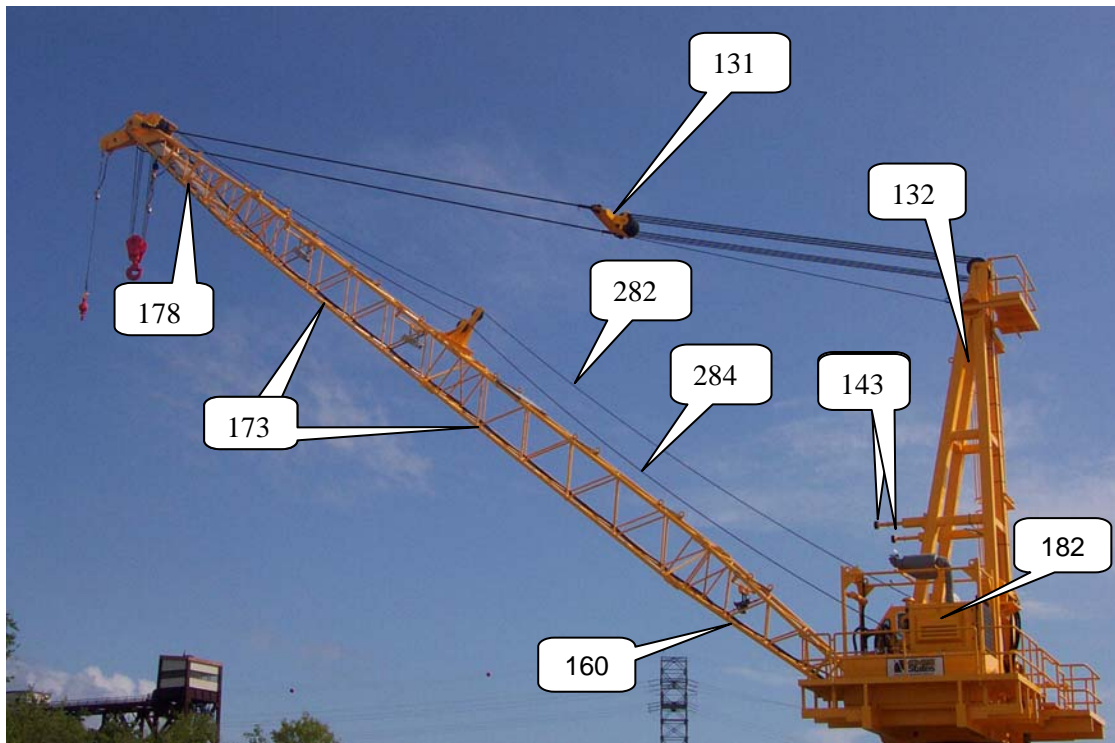




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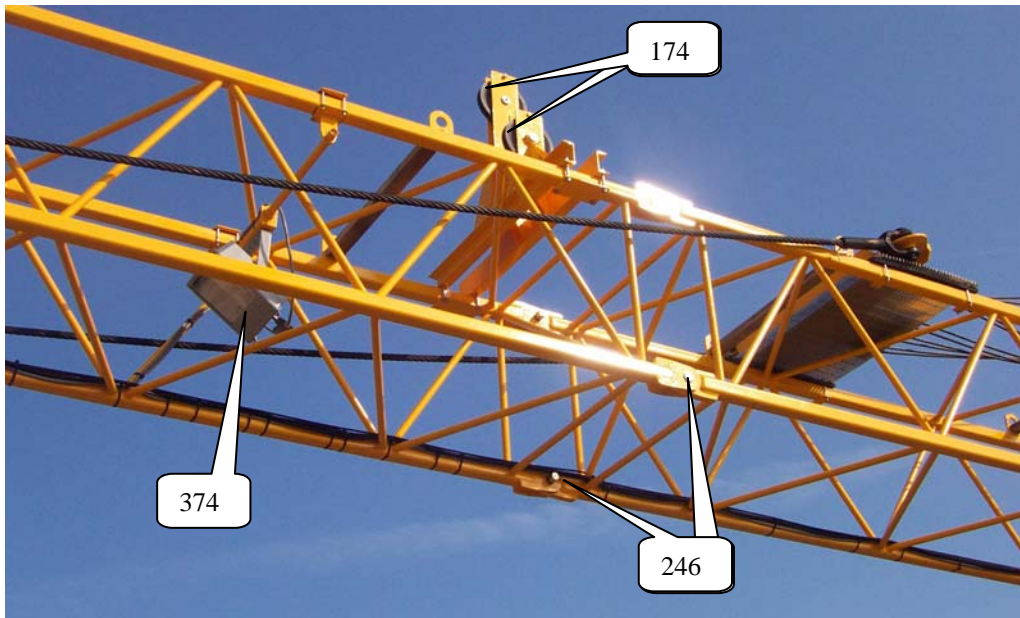


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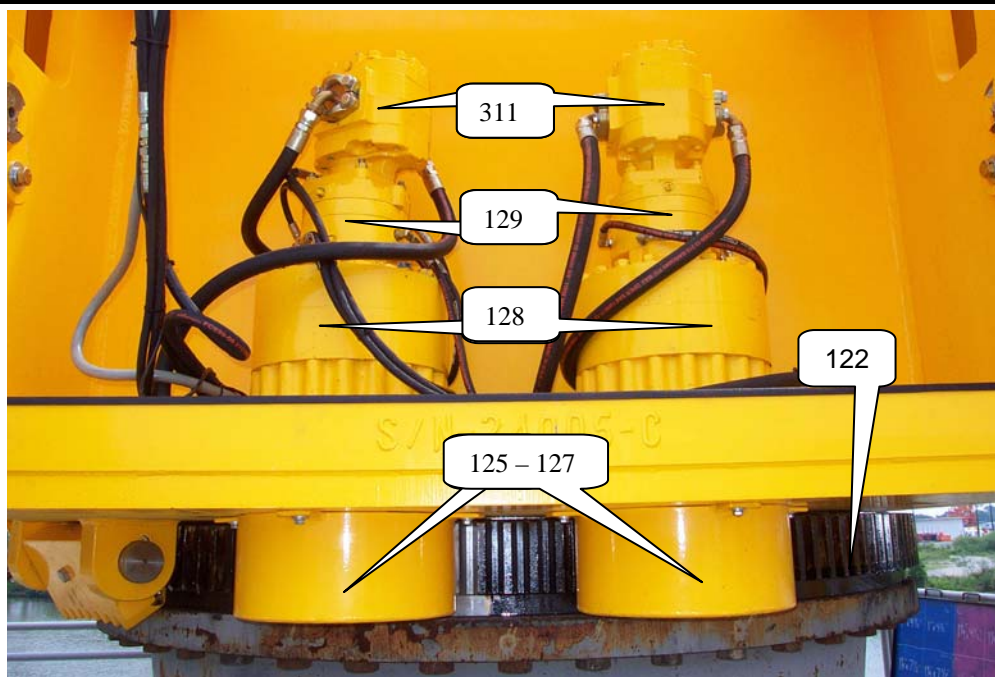
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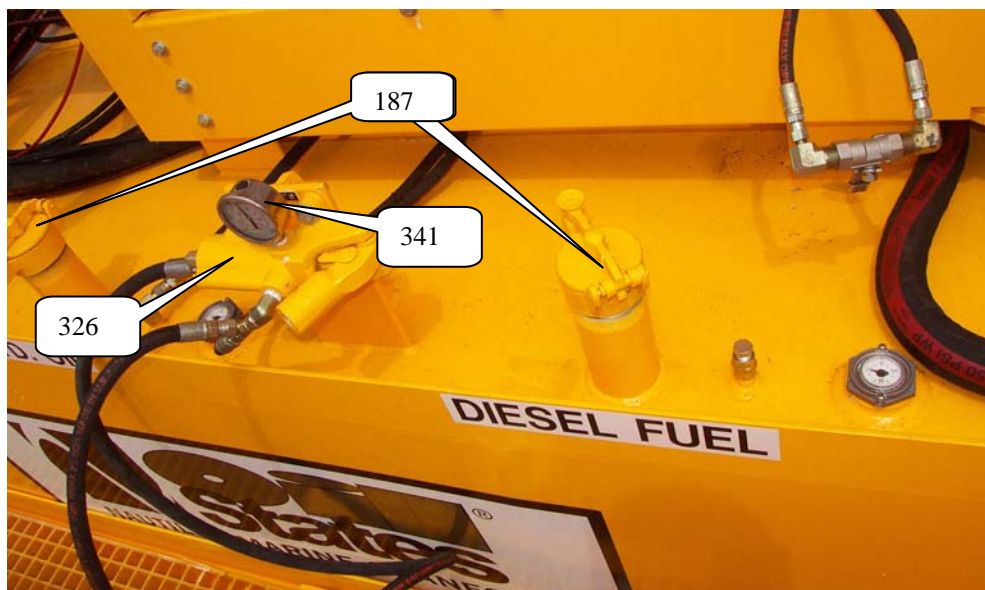
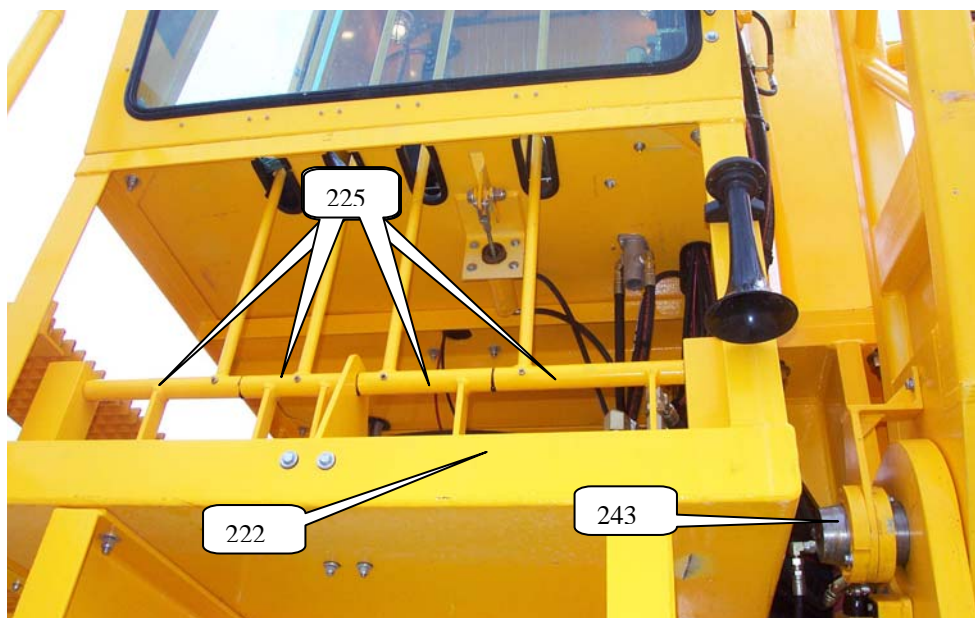
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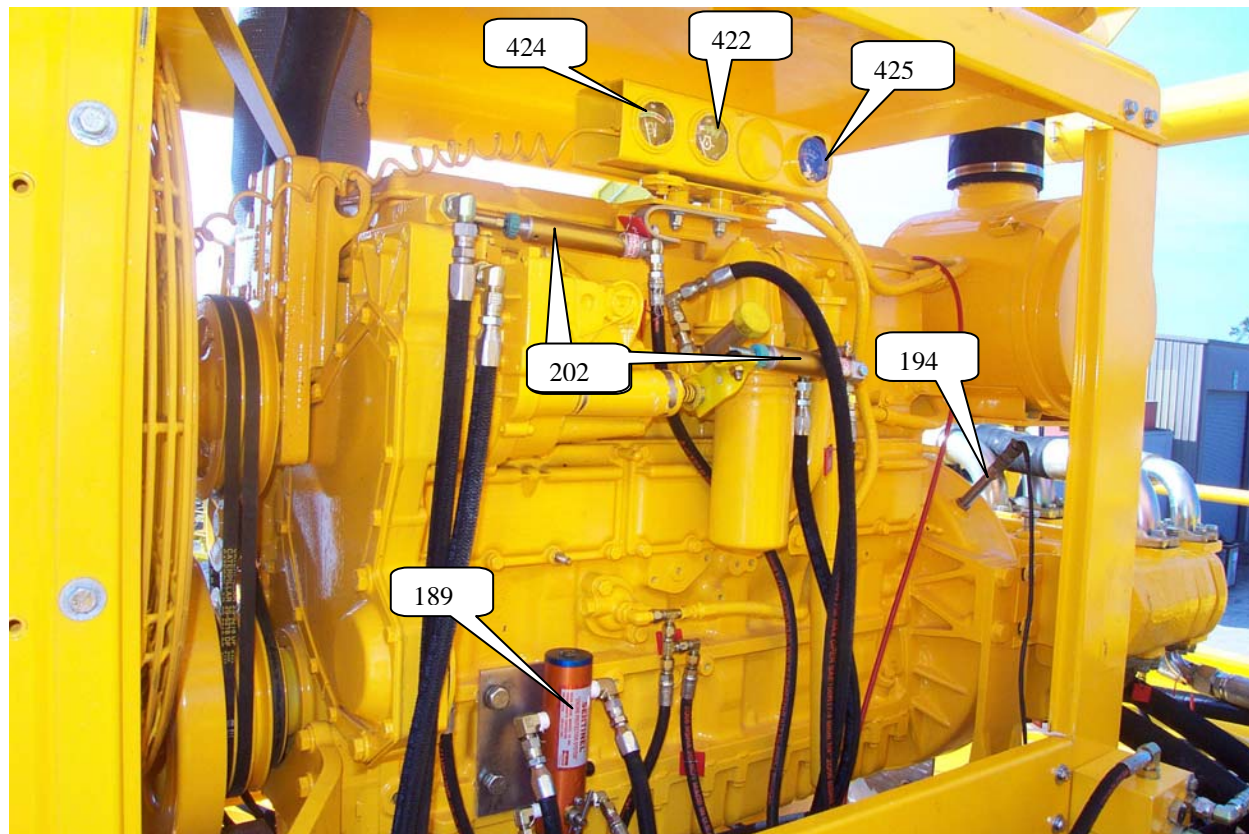


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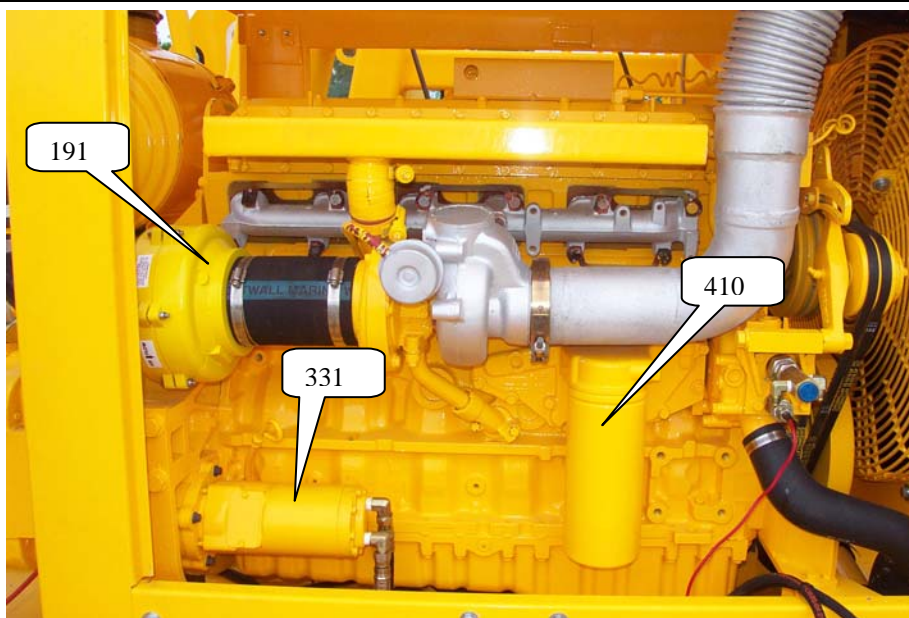
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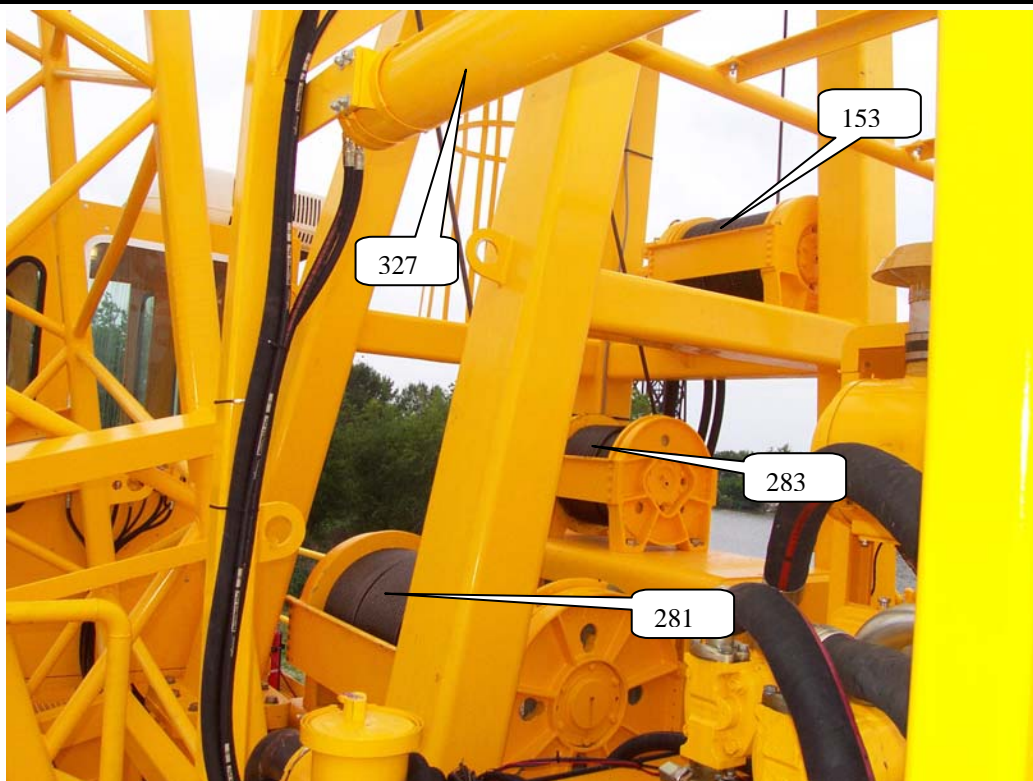
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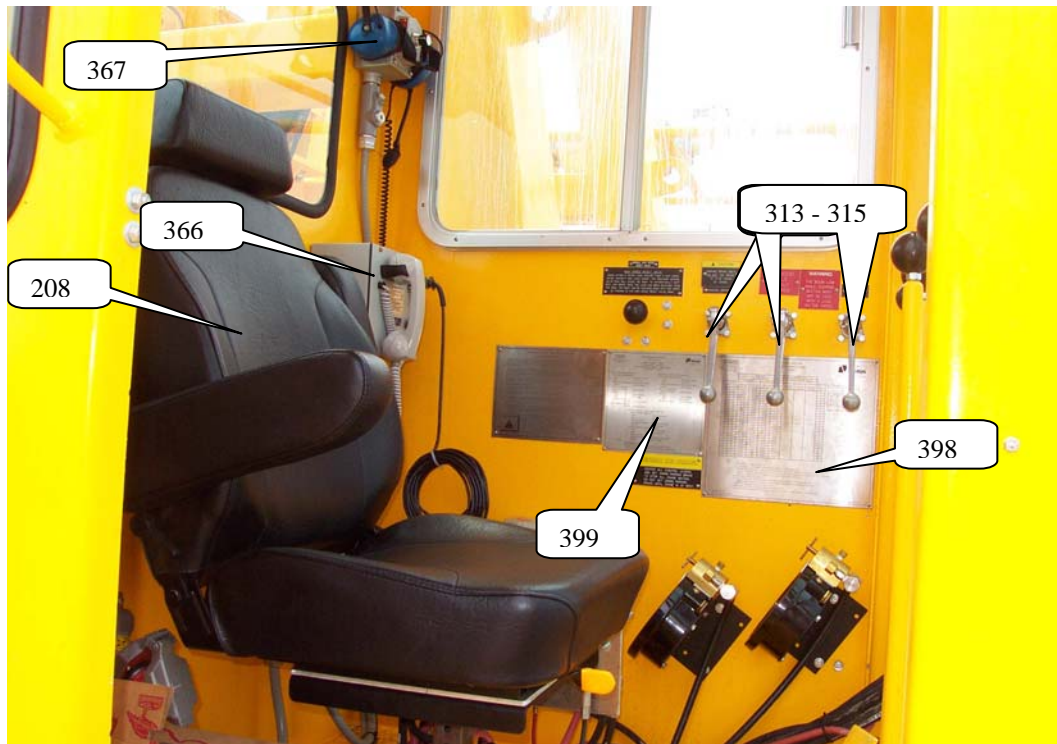
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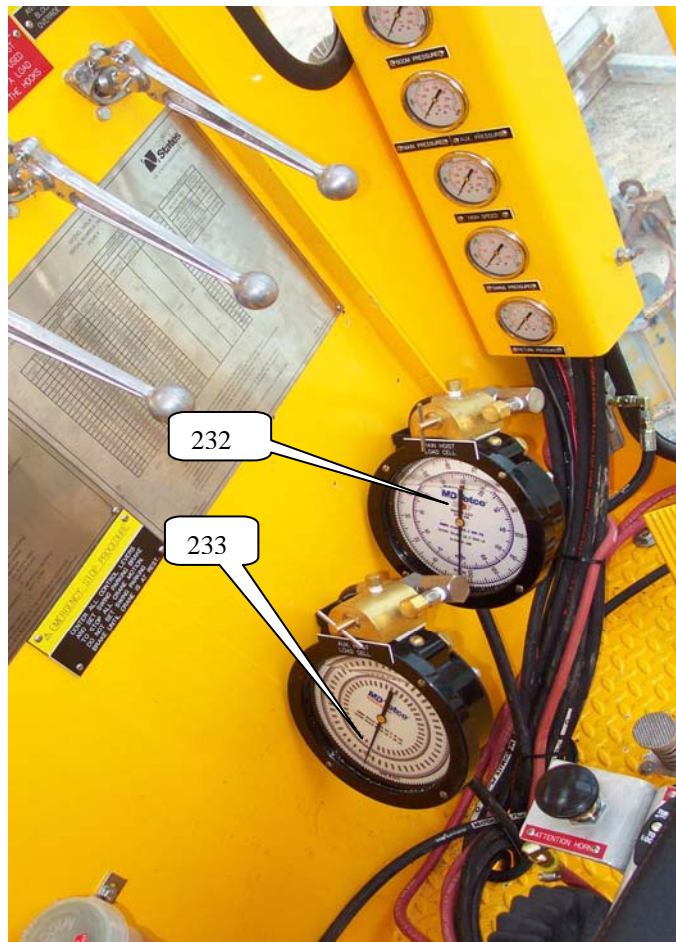




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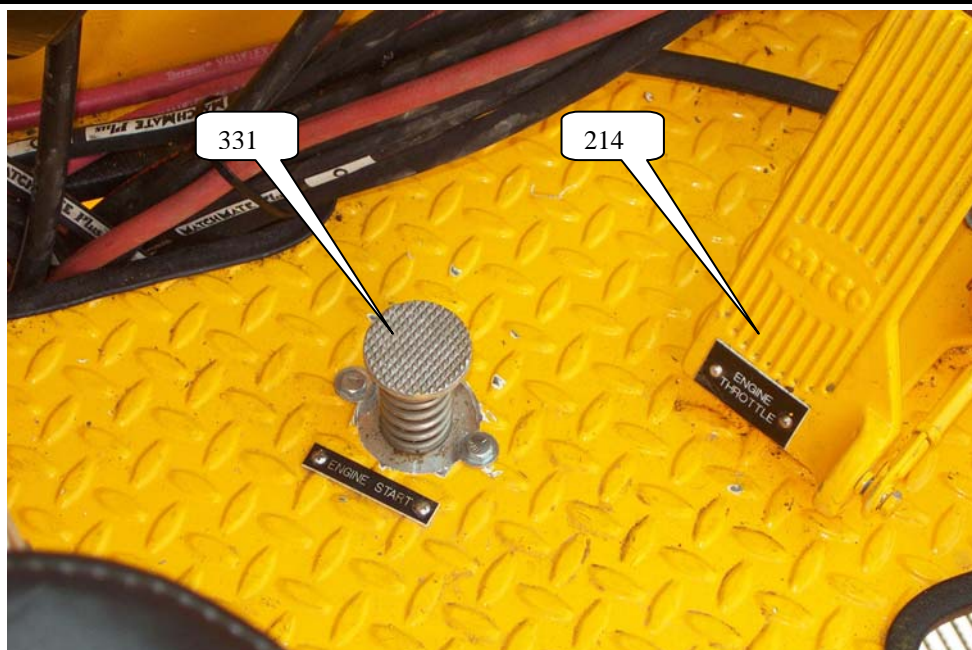


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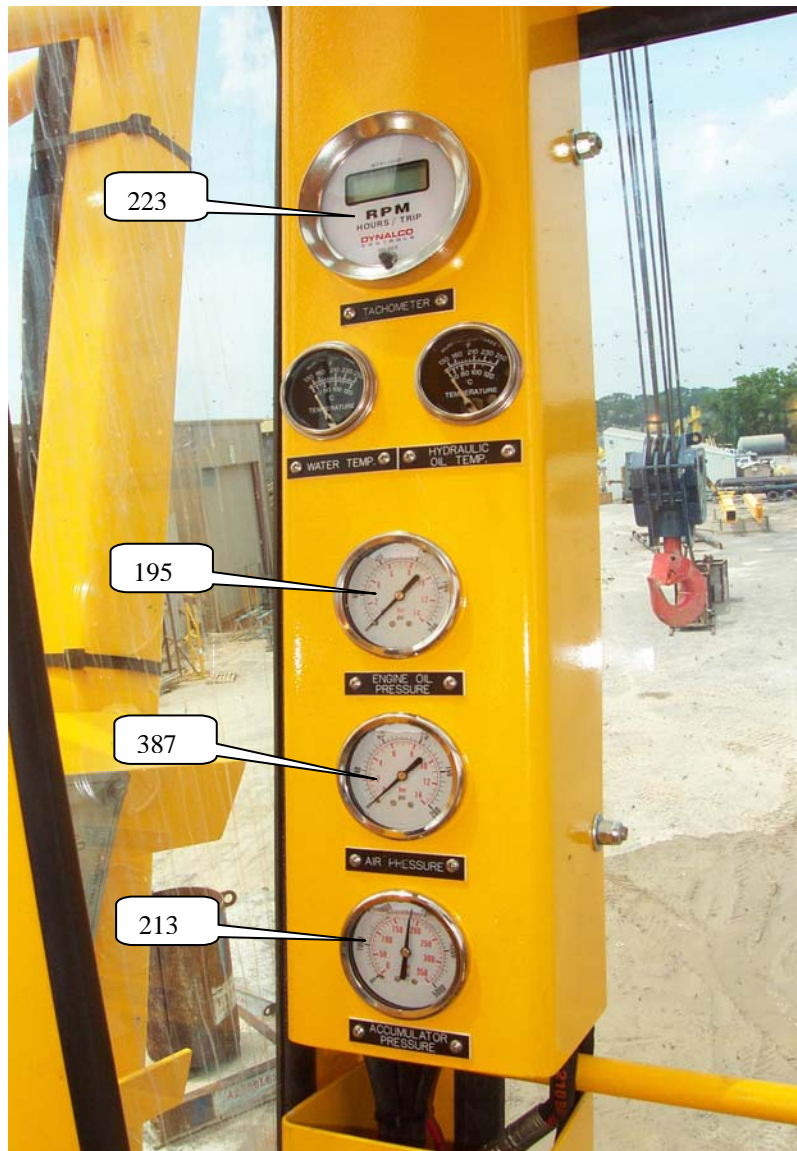




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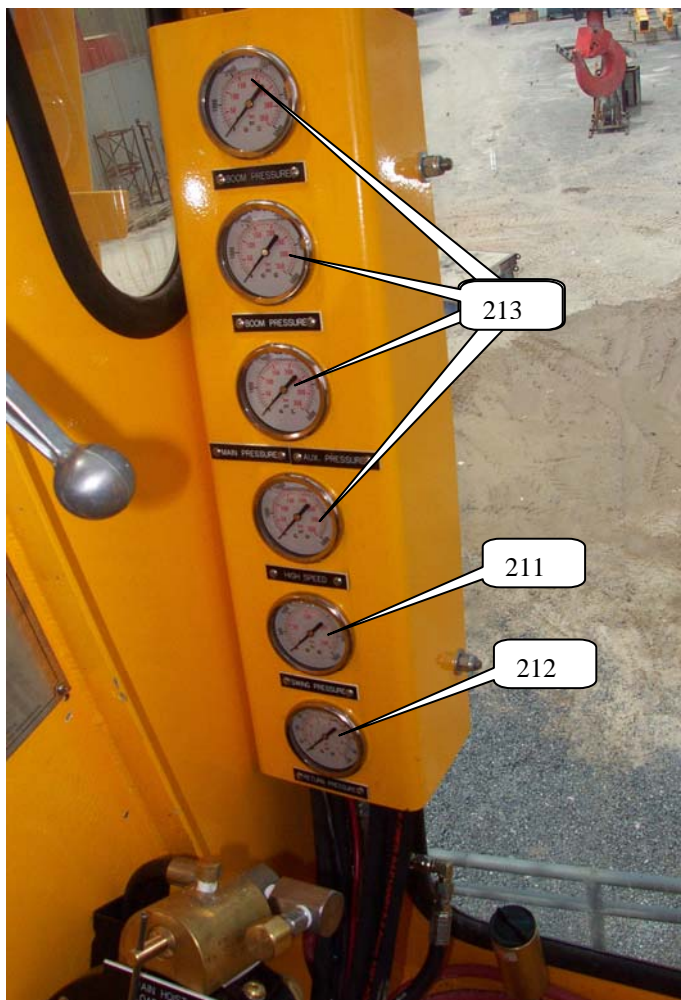
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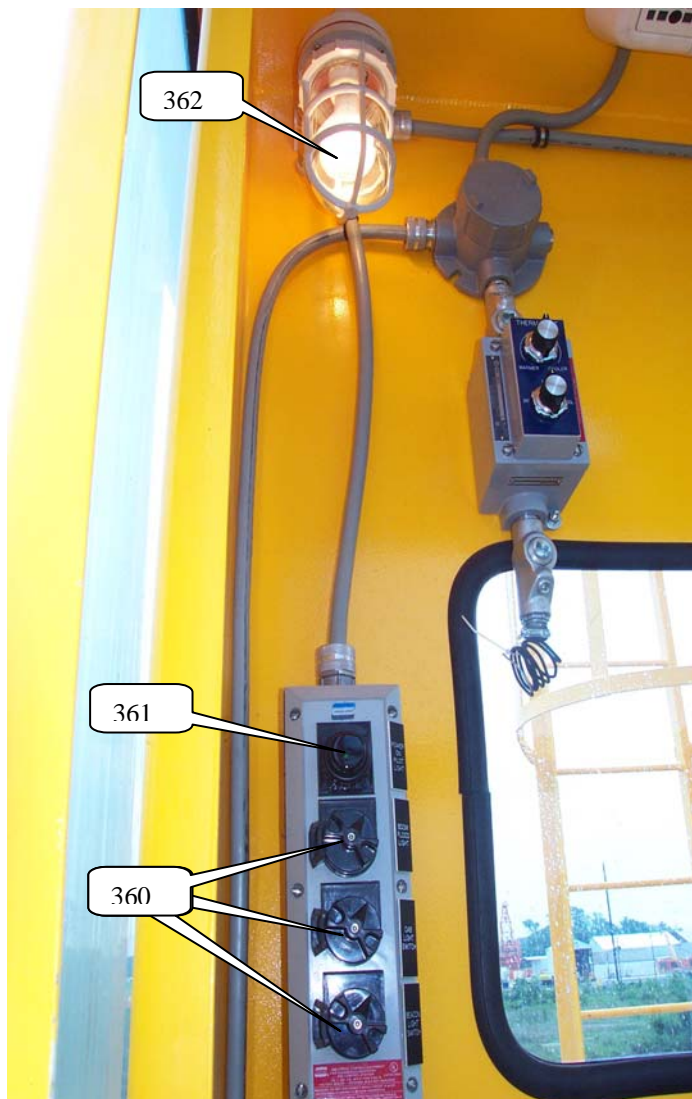


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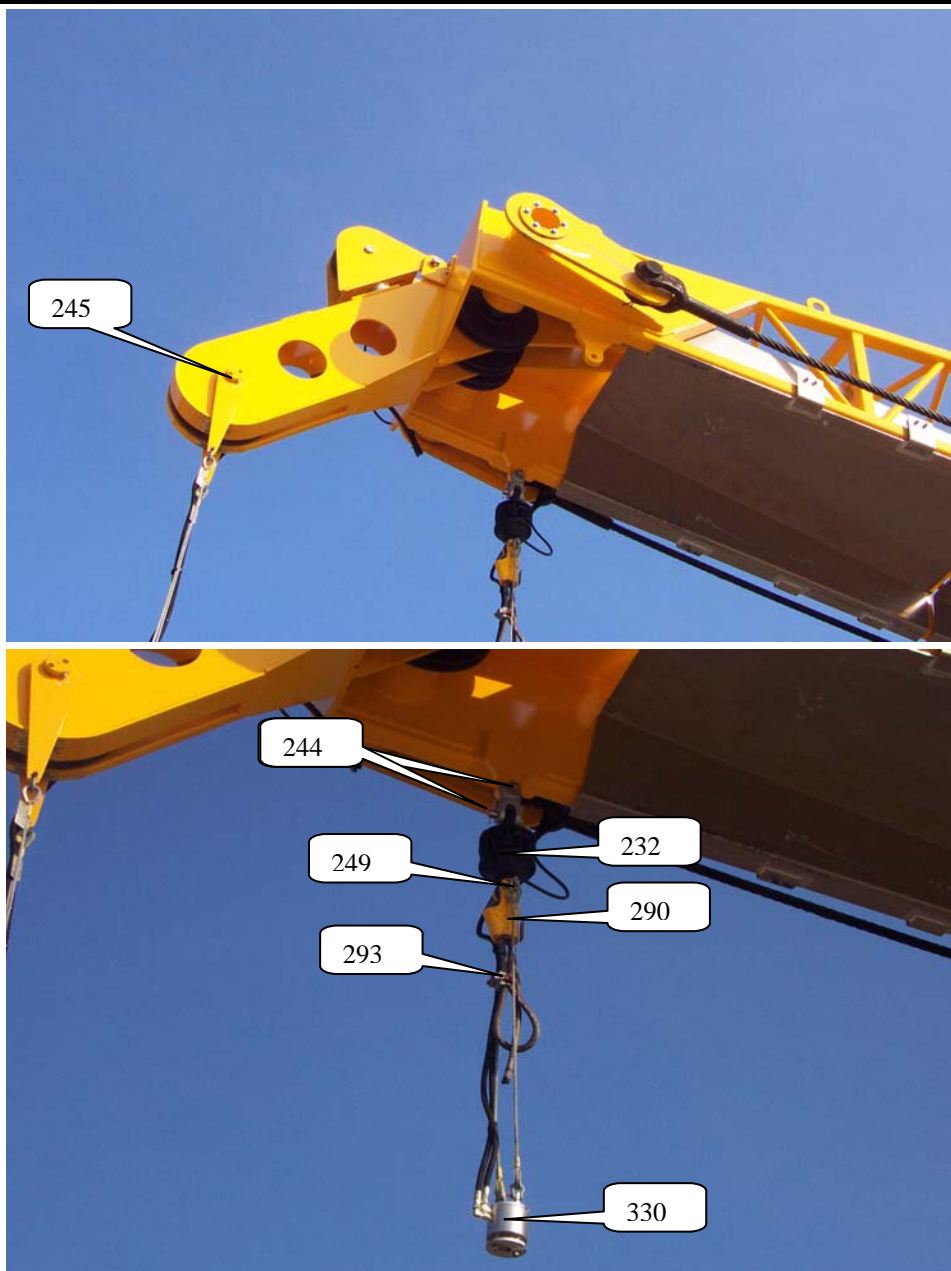
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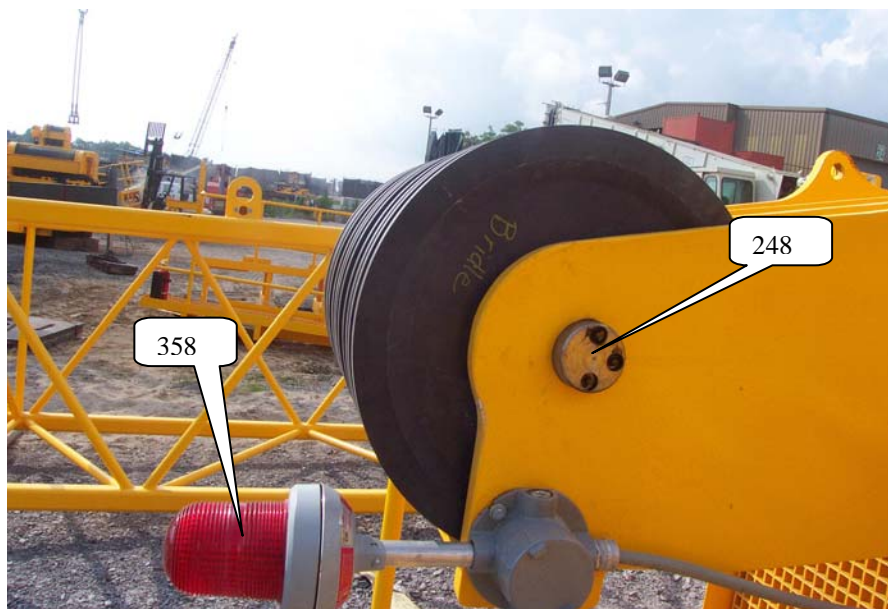
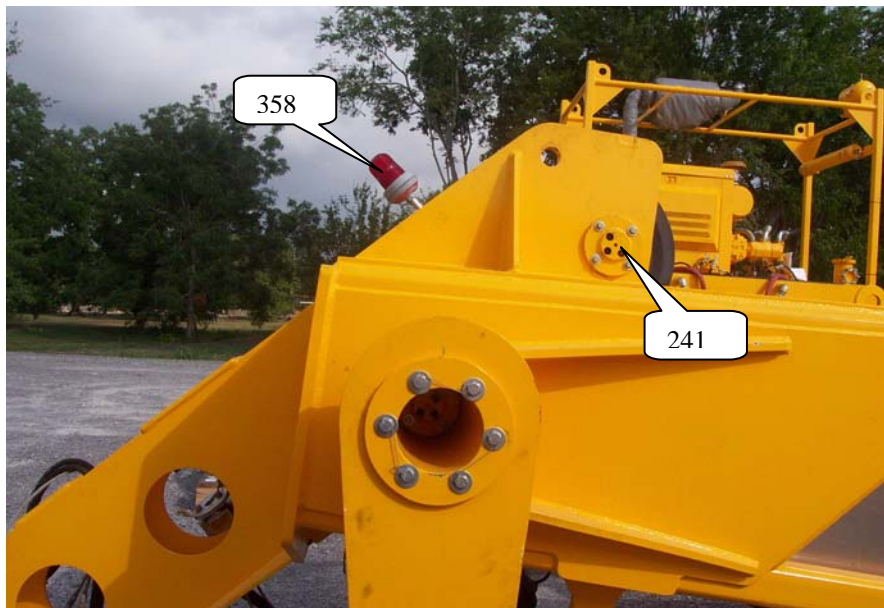
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Volume: 1

### Nautilus Crane Model 340LA-100



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA







Bosnor S. A. DE  
C. V. / Pemex  
PB-KU-H Platform

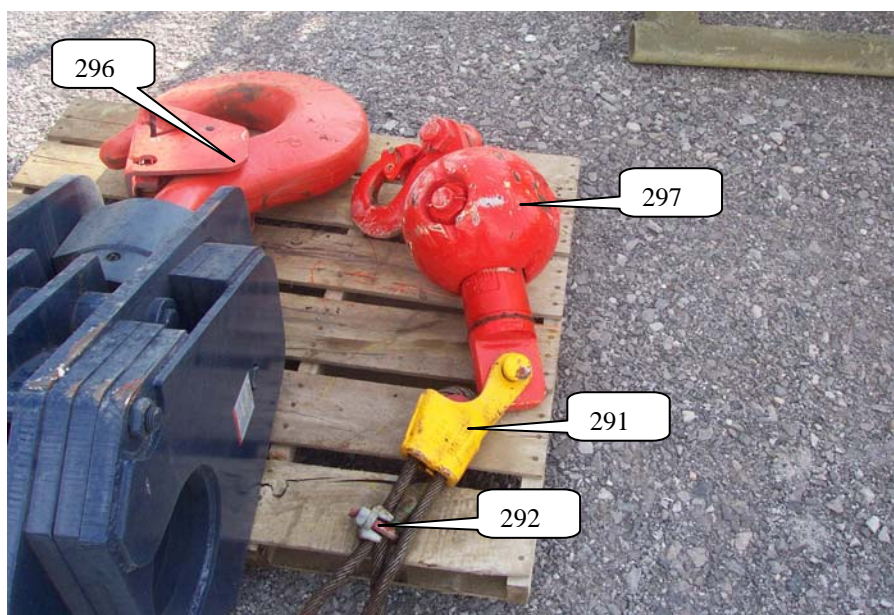
## Vendor Data Book

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### Nautilus Crane Model 340LA-100



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Serial # 24005C  
Volume: 1

## **Nautilus Crane Model 340LA-100**

### **Section 5.4 Power Unit General Arrangement N2005SK4-059**



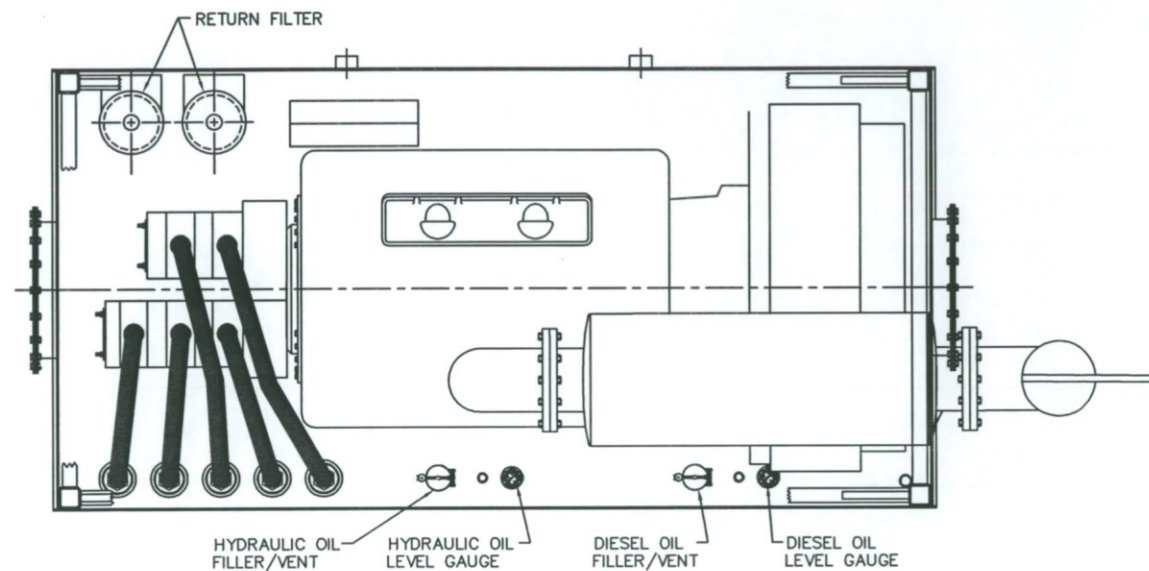
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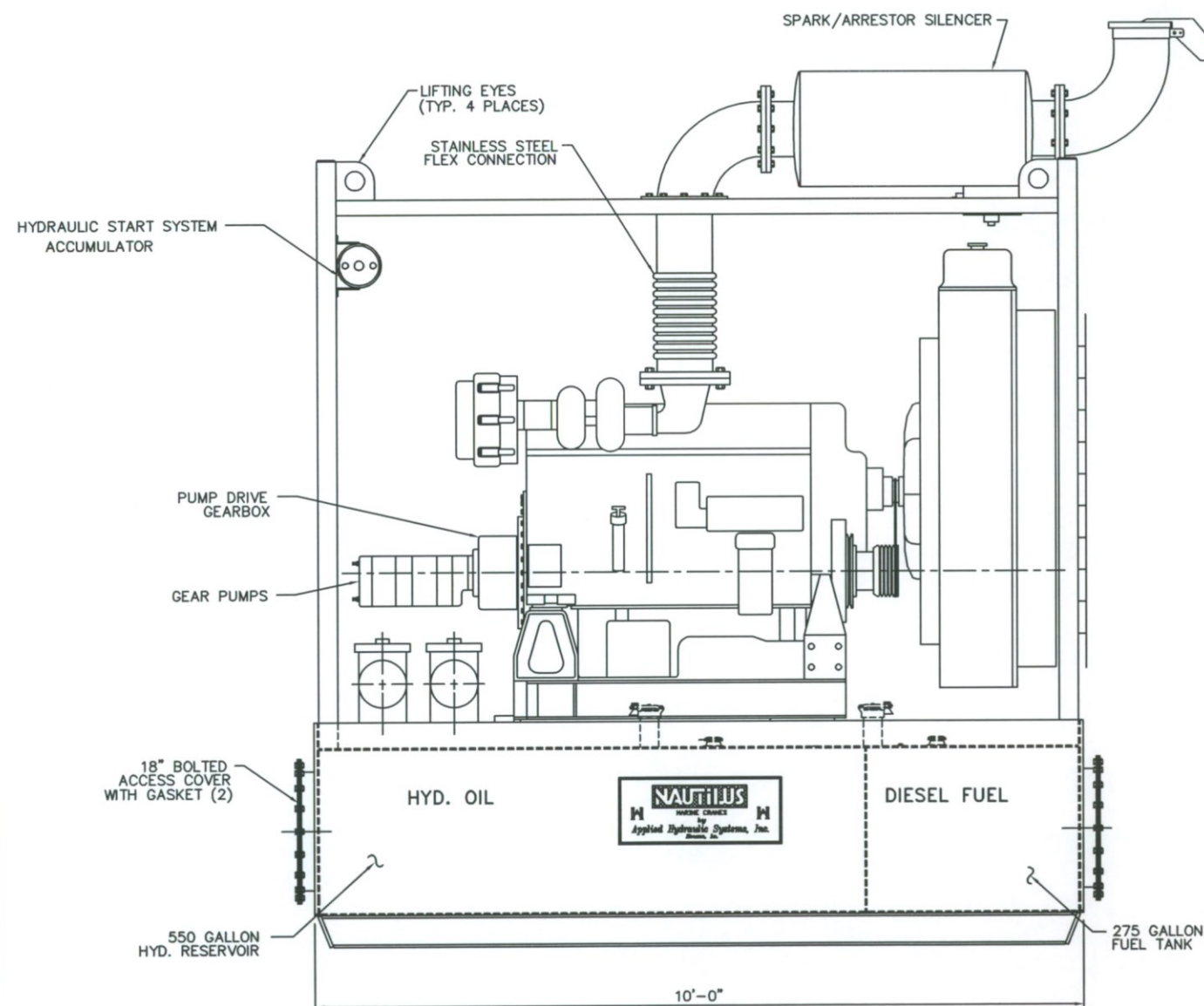




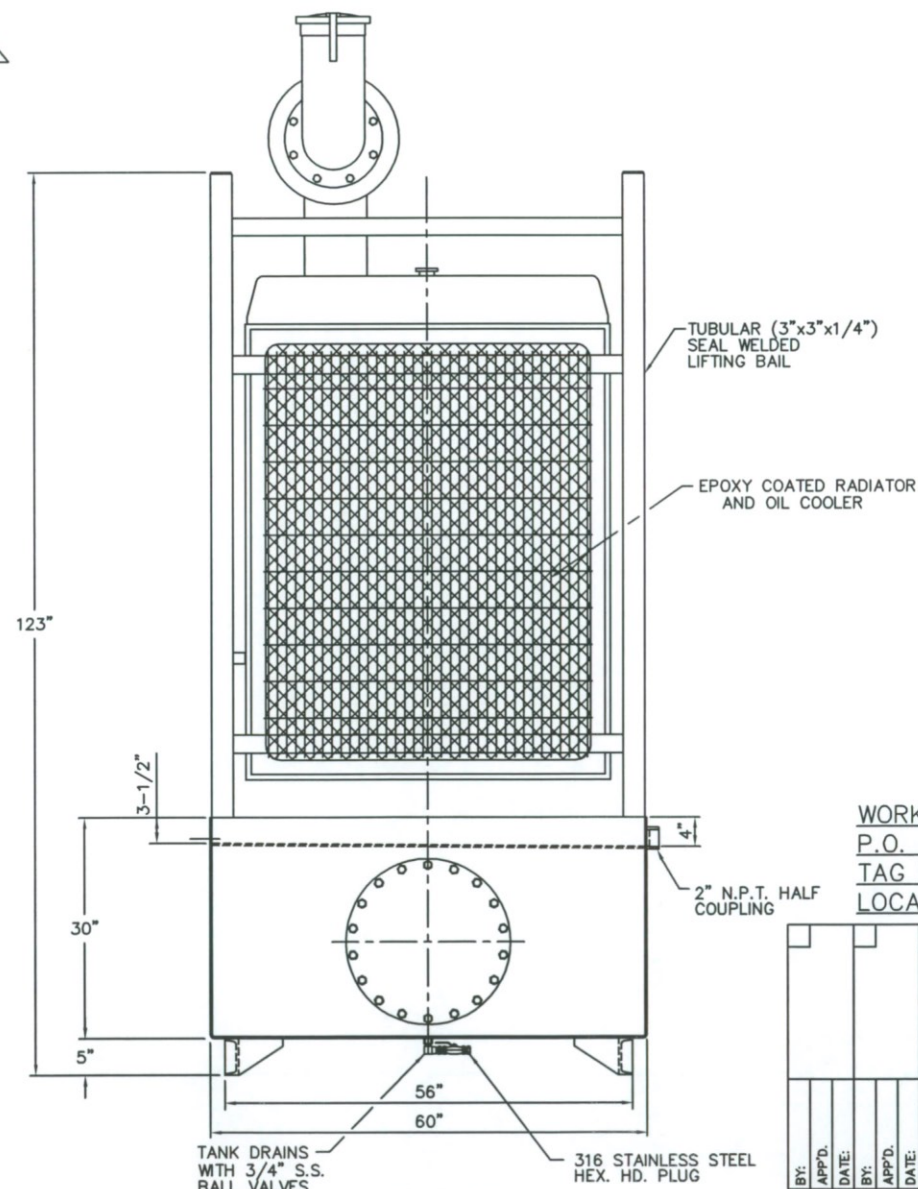




PLAN VIEW



SIDE VIEW





END VIEW

NOTE:

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.
7. WATER COOLED EXHAUST MANIFOLD AND TURBOCHARGER.
8. ENGINE EQUIPPED WITH A HDRAULIC START SYSTEM.

WORK ORDER NUMBER: 24005 & 24105  
P.O. NUMBER: 1550-0268/05-01  
TAG NUMBER: ZZZ-7550 & ZZZ-7555  
LOCATION: PB-KU-H PLATFORM

OIL STATES INDUSTRIES INC. APPLIED HYDRAULIC SYSTEMS DIVISION											
 											
Sales & Service (985) 868-0630 Fax No. (985) 851-0754											
Manufacturing Plant 1180 Mulberry Rd. Houma, LA 70363											
GENERAL ARRANGEMENT CATERPILLER 3126 PEMEX											
DWG. NO. N2005SK4-059 DRFT -1 SCALE: 12:1 DATE: 10/28/05											
CHK'D BY: RLB APP'D BY: RLB											
DWN BY: RLB SHT. 1 OF 1											

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**Vendor Data Book**  
P.O. # 1550-0268/05-01  
Serial # 24005C  
Volume: 1

## **Nautilus Crane Model 340LA-100**

### **Section 5.5 Hydraulic Schematic N2005SK1-179**



SKAGIT SMATCO  
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USA

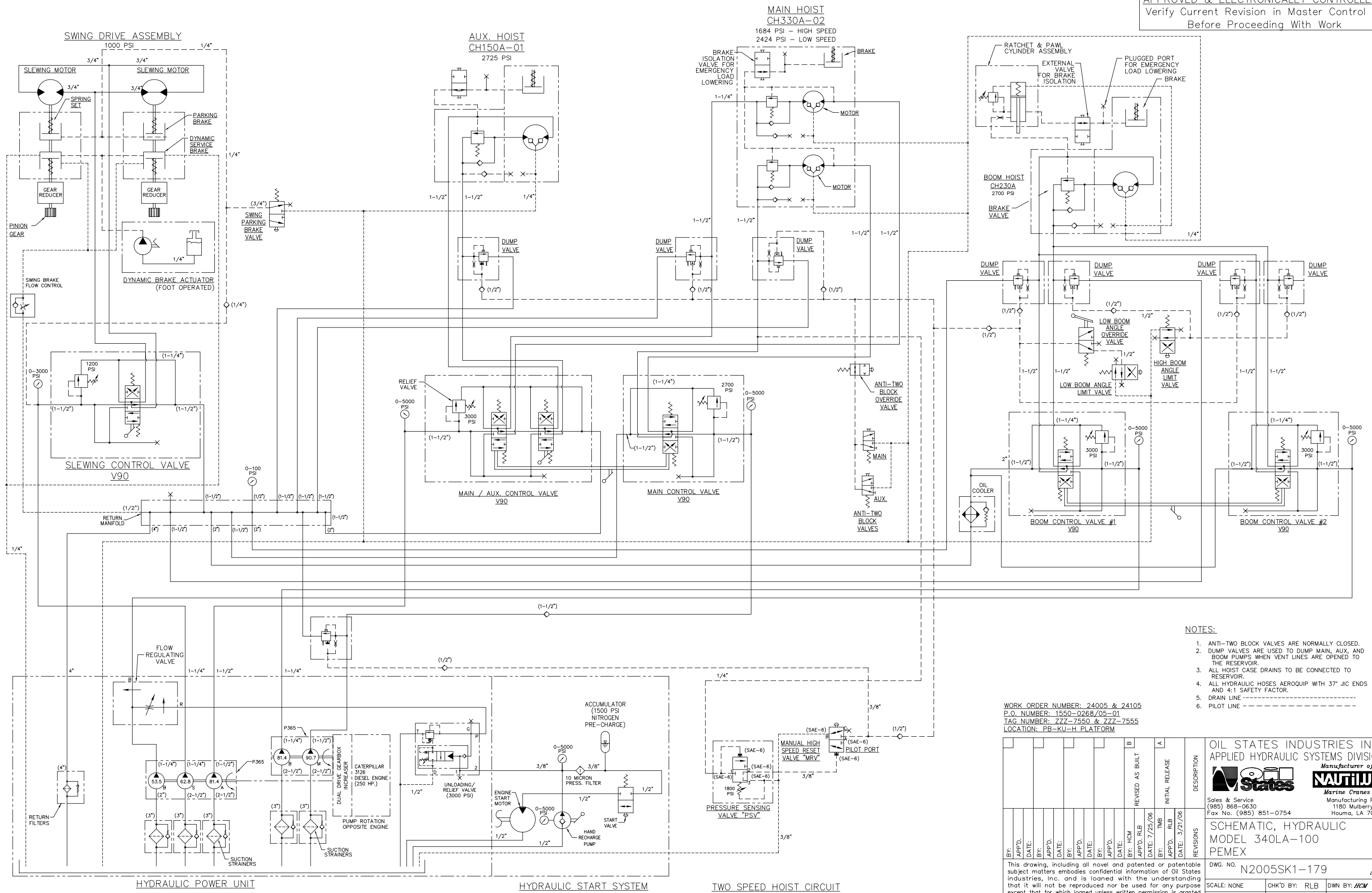










APPROVED & ELECTRONICALLY CONTROLLED  
Verify Current Revision in Master Control  
Before Proceeding With Work



- 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 AEROQUIP WITH 37" JIC ENDS AND 4:1 SAFETY FACTOR.
  5. DRAIN LINE -----
  6. PILOT LINE -----

WORK ORDER NUMBER: 24005 & 24105  
P.O. NUMBER: 1550-0268/05-01  
TAG NUMBER: ZZZ-7550 & ZZZ-7555  
LOCATION: PB-KU-H PLATFORM

BY: _____		B		DESCRIPTION	OIL STATES INDUSTRIES INC. APPLIED HYDRAULIC SYSTEMS DIVISION  <i>Manufacturer of</i> <b>NAUTILUS</b> <i>Marine Cranes</i> Sales & Service (985) 868-0630 Fax No. (985) 851-0754 Manufacturing Plant 1180 Mulberry Rd. Houma, LA 70363
APPD: _____		REVISED AS BUILT			
BY: _____		A			
APPD: _____		INITIAL RELEASE			
DATE: _____					
BY: _____		REVISED AS BUILT		REVISIONS	SCHEMATIC, HYDRAULIC MODEL 340LA-100 PEMEX
APPD: _____		BY: HCM			
BY: _____		APPD: RLB			
APPD: _____		DATE: 7/25/06			
DATE: _____		BY: TMB			
BY: _____		APPD: RLB		DWG. NO. N2005SK1-179	
APPD: _____		DATE: 3/21/06			
BY: _____					
APPD: _____					
DATE: _____					
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PB-KU-H Platform**

**Vendor Data Book**  
P.O. # 1550-0268/05-01  
Serial # 24005C  
Volume: 1

## **Nautilus Crane Model 340LA-100**

### **Section 5.6 Engine Operations and Maintenance Manual**



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA









# Operation and Maintenance Manual

---

## **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

i01171460

### Safety Signs and Labels

**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.



g00640926

Do not spray starting aids such as ether into the air inlet. Such use could result in an explosion and personal injury.



## Clutch

i01377208

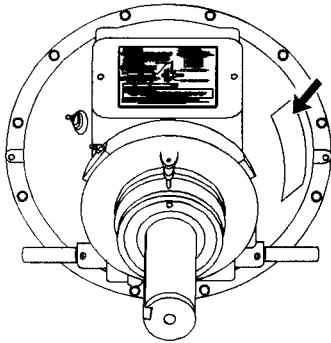
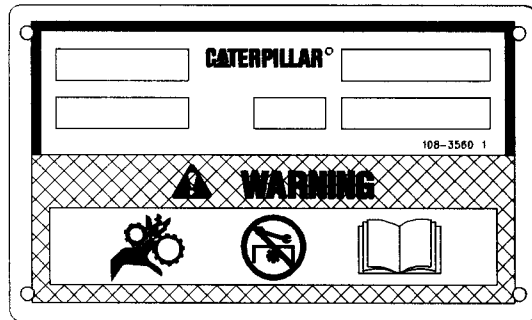


Illustration 1

g00107406

The warning label for the clutch is located on the clutch housing (if equipped).



g00107407

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

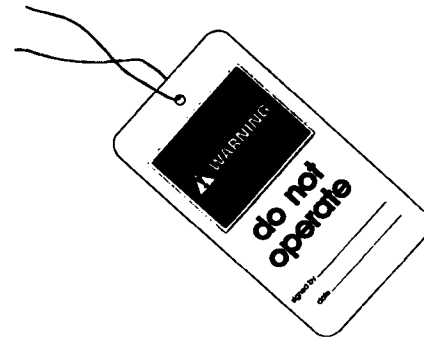


Illustration 2

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.



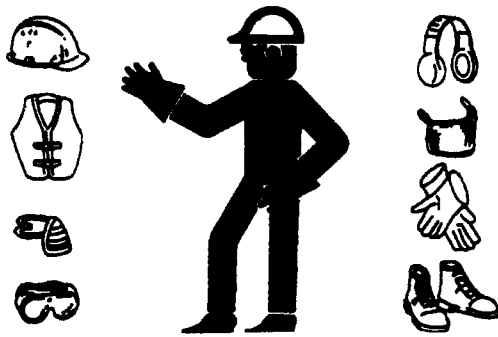


Illustration 3

g00702020

- 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

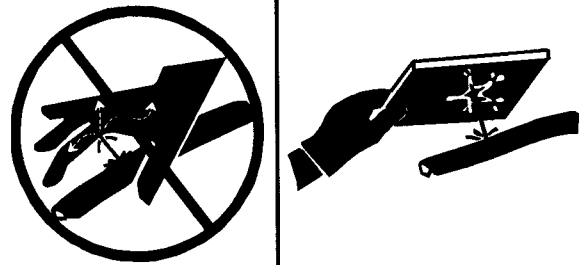


Illustration 4

g00687600

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

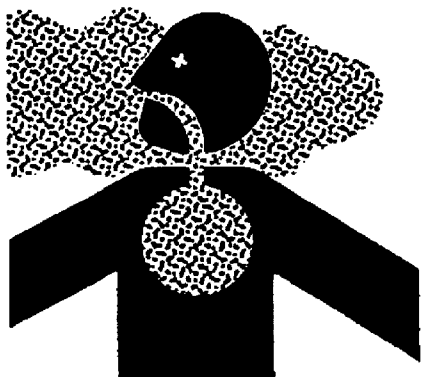


Illustration 5

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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

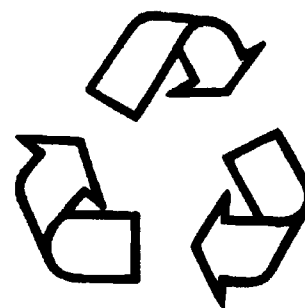


Illustration 6

g00706404

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.

i01480768

## 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

g00704000

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.

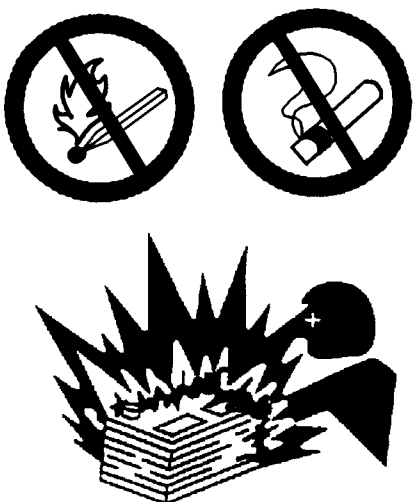


Illustration 9

g00704135

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.

i01372247

## 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

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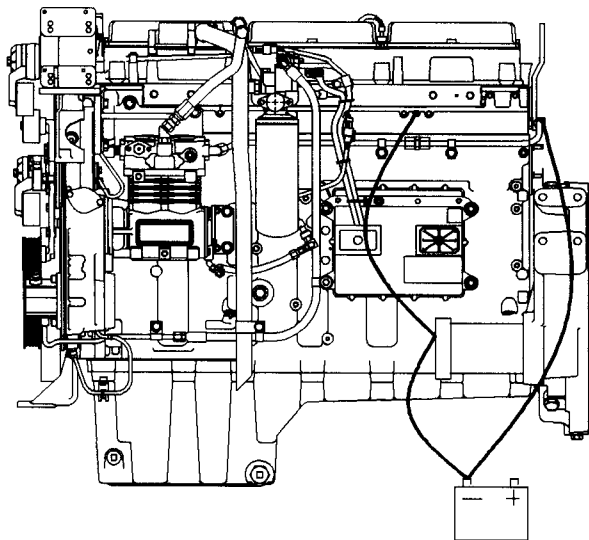


Illustration 10  
Typical example  
Grounding Stud To Battery Ground

g00771448

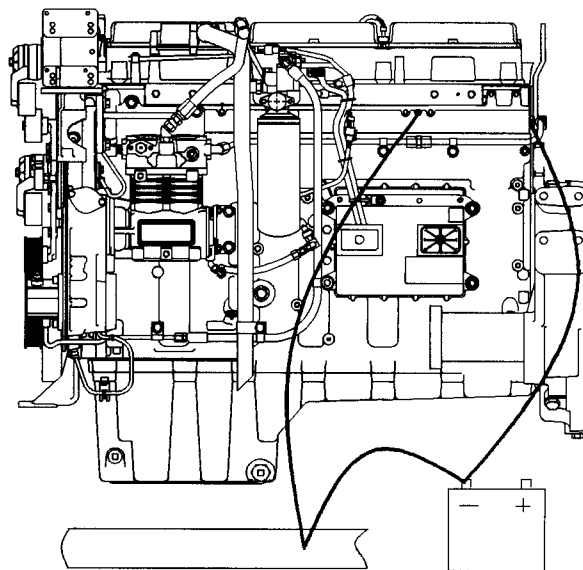


Illustration 11  
Typical example  
Alternate Grounding Stud To Battery Ground

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



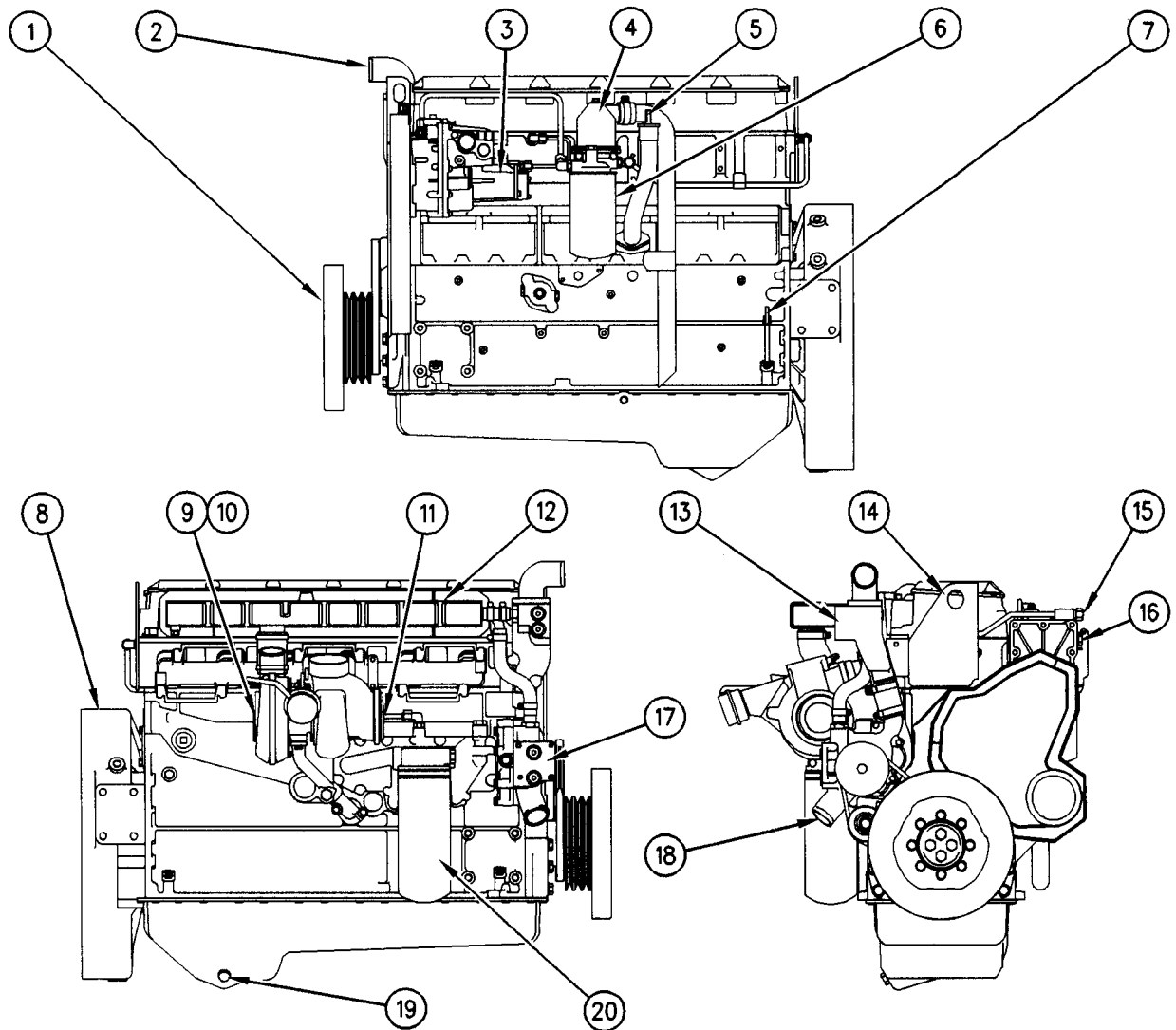


Illustration 12

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                         |                         |



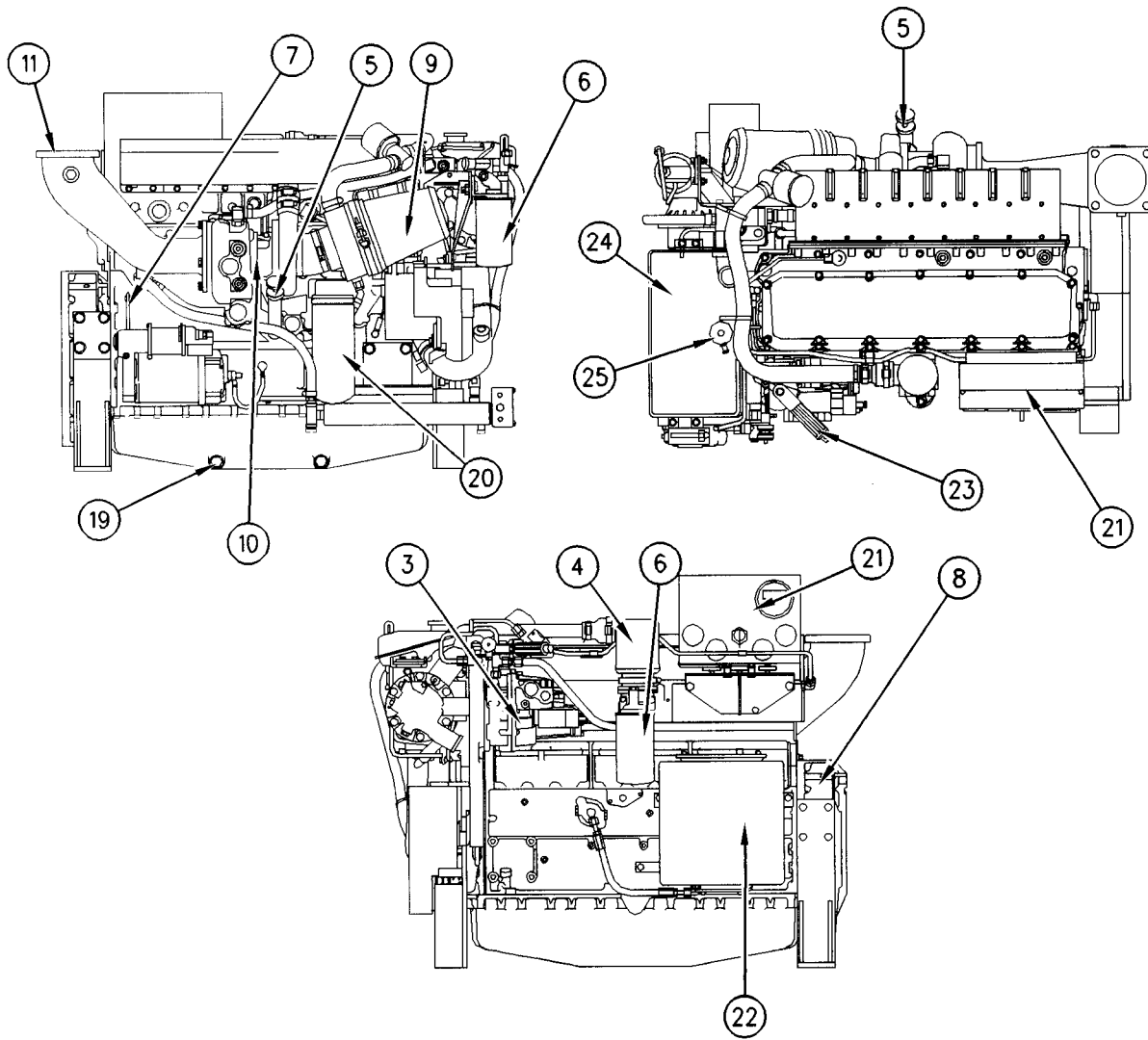


Illustration 13

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.

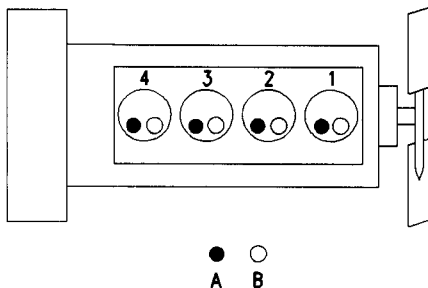


Illustration 14  
Cylinder and valve location for the 3114 Engine  
(A) Exhaust valves  
(B) Inlet valves

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)

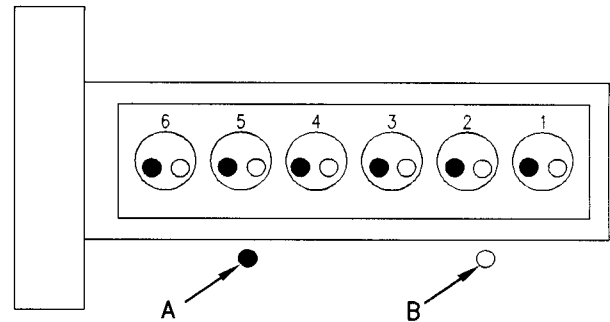


Illustration 15  
3116 and 3126 Engines  
Cylinder and valve locations  
(A) Exhaust valve  
(B) Inlet valve

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. \_\_\_\_\_



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 COMMERCIALLY AVAILABLE DIESEL FUEL.								
DATE OF MANUFACTURE MONTH : 08								
7E-8090 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

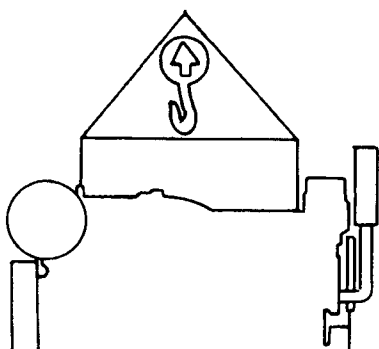


Illustration 19

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.**

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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

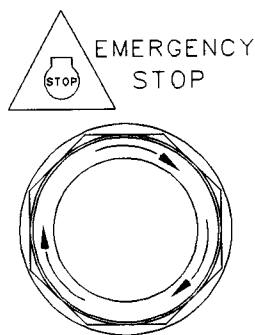


Illustration 20

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.

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- 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.

i01190421

### 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".



i01594340

## 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.

i01250450

## 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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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.

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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)



i00621350

## 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

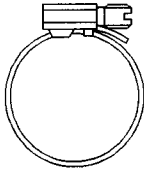


Illustration 21

g00280501

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.



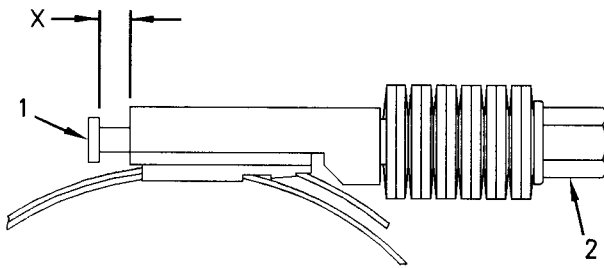


Illustration 22

g00735086

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.

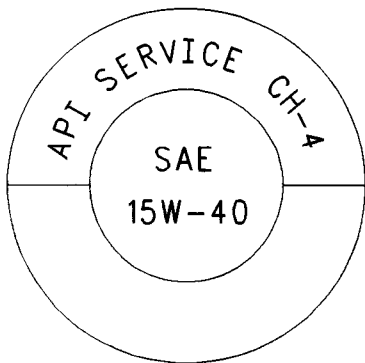


Illustration 23

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.

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).

i01539915

## 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.

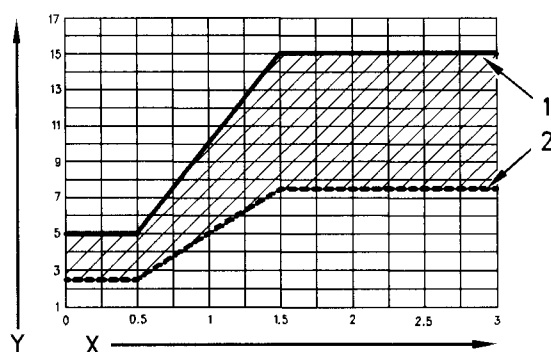


Illustration 24

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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)

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## 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.

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## 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.



## 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 °C (-65 °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 °C (100 °F), use the fuel only in temperatures below 0 °C (32 °F). Do not use any fuels with a viscosity of less than 1.2 cSt at 38 °C (100 °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.

i00259474

## 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.

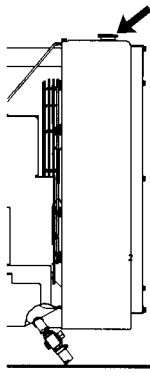


Illustration 25

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.

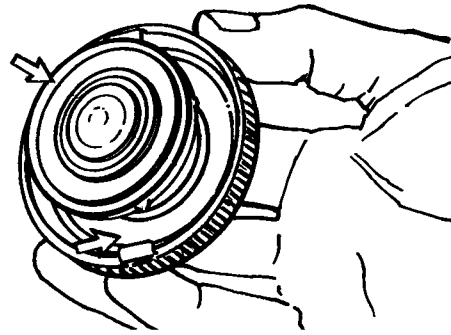


Illustration 26

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.



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## 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.**

---

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.

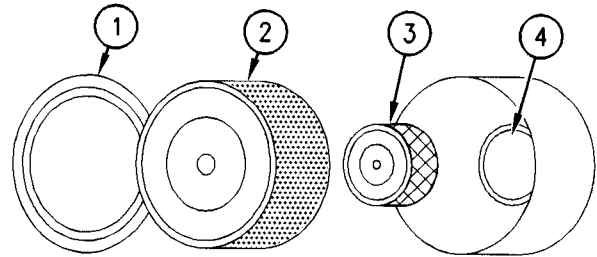


Illustration 27

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).

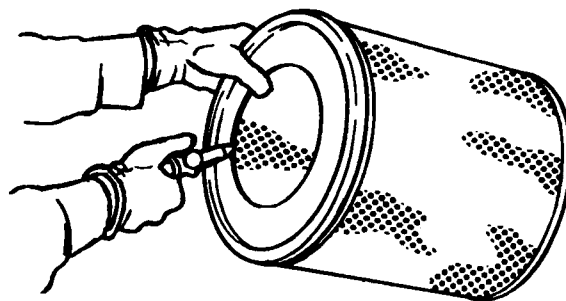


Illustration 28

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

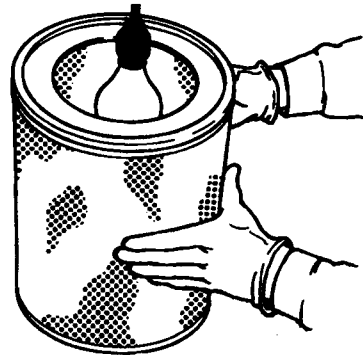


Illustration 29

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.

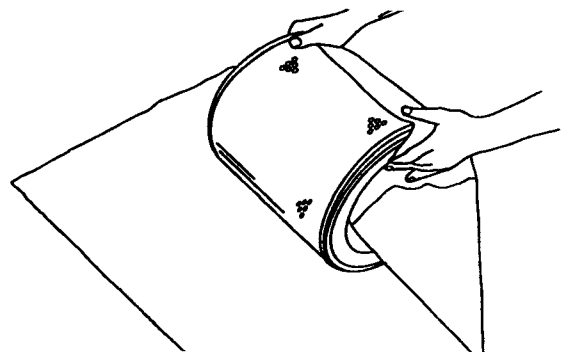


Illustration 30

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.

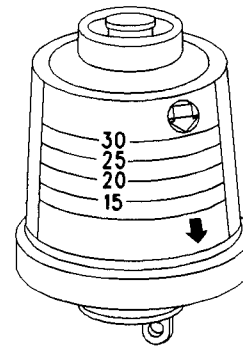


Illustration 31

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

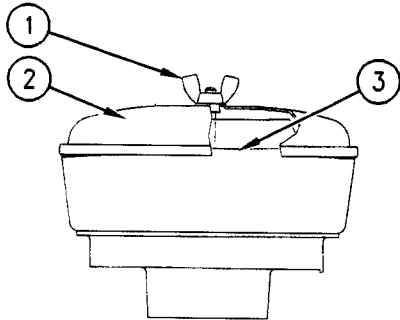


Illustration 32

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.

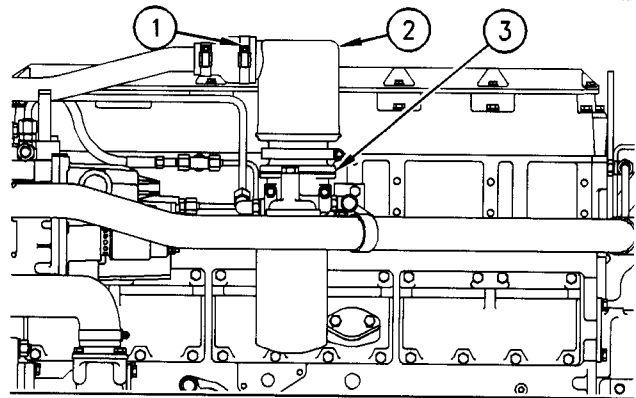


Illustration 33

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.**

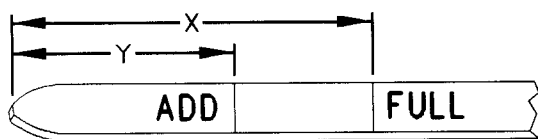


Illustration 34

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.

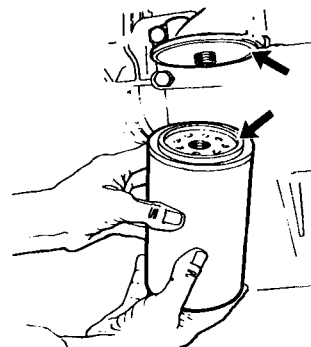


Illustration 35

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.



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**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.

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**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.

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**NOTICE**

During testing, abnormal operating conditions must be simulated.

The tests must be performed correctly in order to prevent possible damage to the engine.

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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

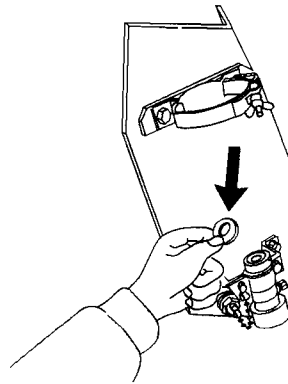


Illustration 36

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

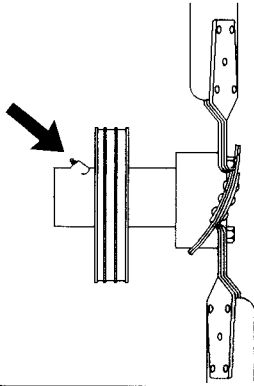


Illustration 37

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.

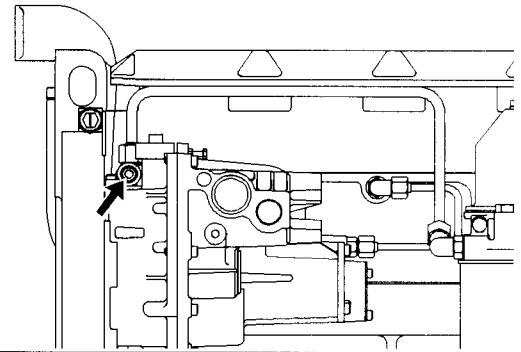


Illustration 38

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

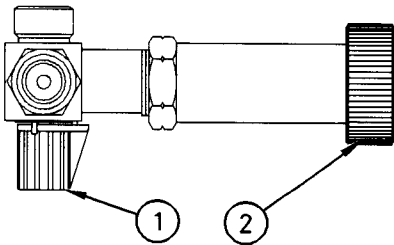


Illustration 39

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.

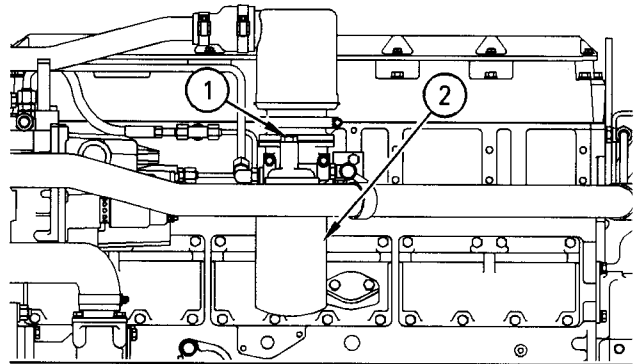


Illustration 40

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.

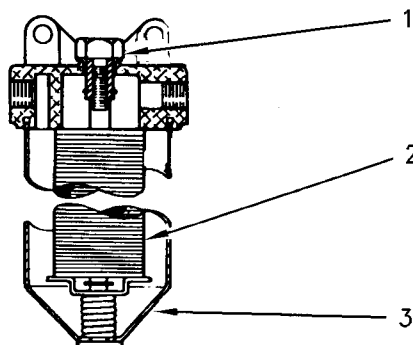


Illustration 41

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.**



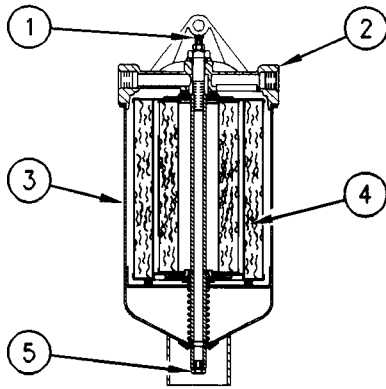


Illustration 42

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.

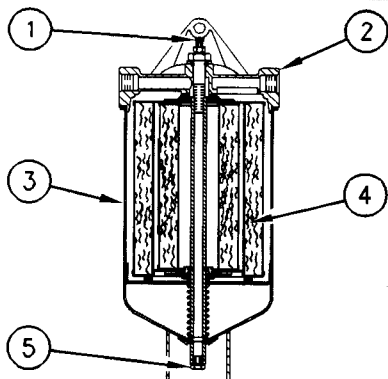


Illustration 43

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.

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".

i00151038

## 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.

i01411756

## 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.

i00632301

## 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.

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- 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

i00727327

### 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:	_____	_____	_____









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**Vendor Data Book**

P.O. # 1550-0268/05-01

Serial # 24005C

Volume: 1

## **Nautilus Crane Model 340LA-100**

### **Section 5.7 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.



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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.
7. Start prime mover and allow it to run at low (idle, 1,000 rpm).
8. Operate system at least of a few minutes at zero pressure.
9. Operate repaired system without a load on the hood, 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 # 24005C

Volume: 1

### **Nautilus Crane Model 340LA-100**

#### **Section 5.8 Hydraulic Load Indicator Systems SD & SW Series**



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USA









**Part Number TW522**

**Revision A**

# **MD Totco™**

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**A Varco Company**

**INSTALLATION, OPERATION, AND MAINTENANCE**

## **SD AND SW SERIES LOAD CELL SYSTEMS**

**Manufacturers of Precision Instruments**



Manual TW522 contains 22 pages, divided as follows:

Cover . . . . .	April 1998
i through iii . . . . .	April 1998
Introduction/Description . . . . .	April 1998
Installation/Operation . . . . .	April 1998
Maintenance/Troubleshooting . . . . .	April 1998
Repair . . . . .	April 1998

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## **IMPORTANT SAFETY NOTICE**

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Proper service and repair is important to the safe, reliable operation of all **M/D TOTCO** equipment. The service procedures recommended by **M/D TOTCO** and described in the technical manuals are recommended methods of performing service operations. When these service operations require the use of tools specially designed for the purpose, those special tools should be used as recommended. Warnings against the use of specific service methods that can damage equipment or render it unsafe are stated in the manuals. These warnings are not exclusive, as **M/D TOTCO** could not possibly know, evaluate and advise service people of all conceivable ways in which service might be done or of all possible associated hazardous consequences. Accordingly, anyone who uses service procedures or tools which are not recommended by **M/D TOTCO** must first satisfy themselves thoroughly that neither personnel safety nor equipment safety will be jeopardized by the method selected.



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# LIMITED PRODUCT WARRANTY

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THE FOLLOWING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER EXPRESS, IMPLIED OR STATUTORY, INCLUDING, BUT NOT BY WAY OF LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

Martin-Decker TOTCO ("Company") warrants to Buyer ("Purchaser") of new products manufactured or supplied by the Company that such products are, at the time of delivery to the Purchaser, free of material and workmanship defects, subject to the following exceptions:

- A. Any product which has been repaired or altered in such a way, in the Company's judgement, as to affect the product adversely, including any repairs, rebuilding, welding or heat treating outside of Company authorized facility.
- B. Any product which has, in the Company's judgement, been subject to negligence, accident, or improper storage.
- C. Any product which has not been installed, operated and maintained in accordance with normal practice and within the recommendations of the Company.
- D. For all items of special order by Buyer which are not manufactured by Company, Buyer should submit warranty claims directly to the manufacturer thereof.

The Company's obligation under this warranty is limited to repairing, or at its option, replacing any products which in its judgement proved not to be as warranted within the applicable warranty period. All costs of transportation of products claimed not to be as warranted to authorized Company service facility shall be borne by Buyer. Costs of return transportation to Buyer of products accepted for repair or replacement by Company under the warranty provisions of the Sales Agreement shall be borne by the Company. Company may, at its sole option elect to refund the purchase price of the products, and Company shall have no further obligation under the Sales Agreement.

The cost of labor for installing a repaired or replacement part shall be borne by Buyer. Replacement parts provided under the terms of this warranty are warranted for the remainder of the warranty period of the product upon which installed to the same extent as if such parts were original components thereof.

The warranty periods for various products are:

- A. Hydraulic, Mechanical, Electronic Equipment: one (1) year from date of installation or fifteen (15) months from date of shipment from Company, whichever occurs first.
- B. All Elastomer Diaphragms: six (6) months from date of shipment from Company.

No deviations from the Company's standard warranty terms or period as stated herein will be honored unless agreed to in writing by an authorized Company representative prior to acceptance of the order.

**EXCLUSIVITY OF REMEDY AND LIMITATION OF LIABILITY.** THE REMEDIES PROVIDED FOR IN THIS WARRANTY SHALL CONSTITUTE THE SOLE RECOURSE OF BUYER AGAINST COMPANY FOR BREACH OF ANY OF COMPANY'S OBLIGATIONS UNDER THE SALES AGREEMENT WITH BUYER, WHETHER THE CLAIM IS MADE IN TORT OR IN CONTRACT, INCLUDING CLAIMS BASED ON WARRANTY, NEGLIGENCE, OR OTHERWISE.

IN NO EVENT SHALL COMPANY BE LIABLE FOR DIRECT, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, REGARDLESS OF THE FORM OF ACTION, WHETHER IN CONTRACT, STRICT LIABILITY OR IN TORT (INCLUDING NEGLIGENCE), NOR FOR LOST PROFITS.



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## SECTION I

### INTRODUCTION AND DESCRIPTION

#### 1-1. INTRODUCTION

1-2. This manual contains installation, operation and maintenance instructions for the MARTIN-DECKER SD Series (Tension) and SW Series (Compression) Load Cell Systems.

1-3. Read the appropriate section of this manual before performing the indicated installation, operation or maintenance procedures. Insure that all personnel who will be performing these procedures have read the Important Safety Notice located on the inside front cover of this book.

#### 1-4. DESCRIPTION

1-5. **TENSION AND COMPRESSION LOAD CELL SYSTEMS.** (See figure 1-1) Both the tension and compression load cell systems are hydraulically operated, require no external power source, are assembled and fully loaded with MARTIN-DECKER hydraulic fluid prior to shipment. They are designed to operate within the ambient temperature range of -29° to 49°C (-20° to 120°F). Accuracy of the systems, when shipped from the factory, is  $\pm 0.2\%$  of full scale capacity at an ambient range of 16° to 27°C (60° to 80°F). Hose lengths should be limited to values compatible with the load cell effective area, consult MARTIN-DECKER for these limits and methods to add tubing where required.

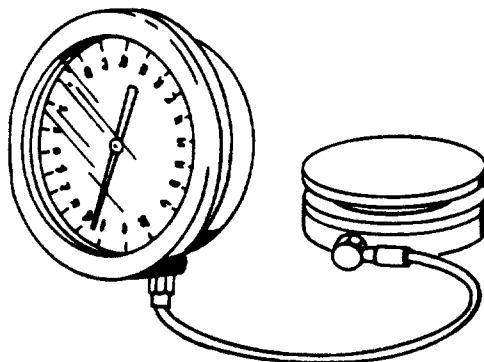
1-6. **SYSTEM COMPONENTS.** The system consists of the following basic components and attaching hardware:

- a. Indicator
- b. Sensater Load Cell (hereinafter referred to as load cell)
- c. Hydraulic Hose
- d. Disconnect Coupling(s) (Optional)
- e. Tubing (Optional)

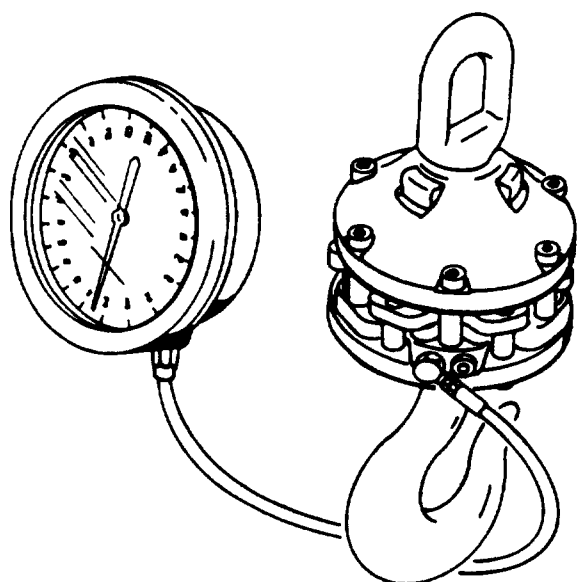
1-7. **Indicator.** The indicator provides a dial faceplate, calibrated in pounds, tons or kilograms, as specified. The indicator has a damper to smooth pointer sensitivity and adjust pointer response to the operators preference. Also included on each indicator is a dial adjust gear, which rotates the dial to make necessary tare adjustments.

1-8. **Load Cell.** The load cell transmits a hydraulic pressure signal to the indicator by transforming the applied load into the respective pressure. This is accomplished by a diaphragm sensing element held in place by a load cell housing. All load cells are compression measurement devices. With the addition of auxiliary hardware it has the additional capability of measuring tension loads with extreme accuracy. (Refer to figure 1-1).





TYPICAL SW SERIES COMPRESSION LOAD CELL SYSTEM



TYPICAL SD SERIES TENSION LOAD CELL SYSTEM

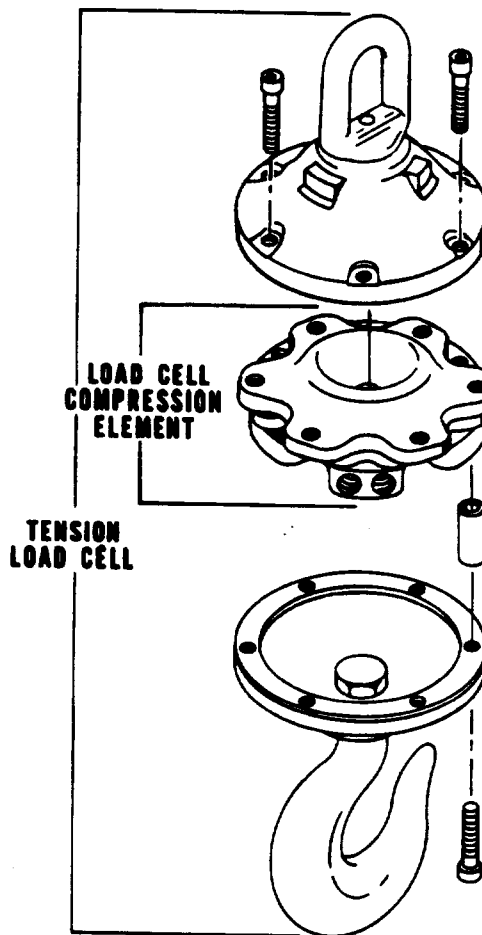


Figure 1-1. Compression and Tension Load Cell Systems



- 1-9. Hydraulic Hose. Two types of hydraulic hose are used, depending upon the capacity of the system. The hydraulic hose with 1/4 NPT hose connections is standard. Disconnect couplings are available for most capacities where installation or frequent disconnecting of the hose from the load cell or indicator is required. The hydraulic hose will come in maximum lengths of 50 feet in a single unit and couplings (P/N J103) will be used where extended lengths are needed to meet job requirements.
- The 3/16 inch diameter hose is of single wire braid construction and rubber covered. MARTIN-DECKER recommends use of this hose with all systems, using 4.0 to 16.1 square inch load cells.
  - The 1/4 inch diameter hose is of double wire braid construction and rubber covered. MARTIN-DECKER recommends use of this hose with all systems, using 25.0 to 100.0 square inch load cells.
- 1-10. J10900A Series Disconnects. Disconnects are available for most capacities where disconnection of the hose from the load cell or indicator is required. The female half of the disconnect is usually installed on the hose while the male half is installed on the damping chamber to facilitate connection. Additionally, disconnects may be used in-line to separate two hoses. Disconnect halves are supplied with protective covers to preclude entry of contaminants into system when components are disconnected.
- 1-11. Tubing. Copper or stainless steel tubing may be used to supplement the hydraulic hose for fixed applications or where the indicator is mounted at extreme distances from the load cell. It can also be used for rigidity and transmission line protection.
- 1-12. Attaching and Support Hardware. The system is furnished with all necessary attaching and support hardware to facilitate installation and maintenance:
- Check Valve - Usually installed on the load cell and is used to replenish the hydraulic fluid in the system. In some cases, the check valve may be located elsewhere in the system.
  - YA2 Hand Pump - Used for field loading the system with hydraulic fluid. Connects to the check valve.
  - Hydraulic Fluid - Supplied in quart and gallon containers. W15 (quart) W16 (gallon) hydraulic fluid is to be used in the event it becomes necessary to charge the system in the field.
  - Indicator Bracket - Used for mounting the indicator.



## SECTION II

## INSTALLATION AND OPERATION

2-1. INSTALLATION

## 2-2. PRE-INSTALLATION

- 2-3. The pre-installation procedure consists primarily of insuring that either the Tension or Compression System is the correct system to be installed. The following is to be checked:

- a. Determine that indicator dial is calibrated in the units of measurement (pounds, tons, or kilograms) compatible with what will be measured.
- b. Determine that disconnect O-rings (if supplied with system) are not damaged (Refer to paragraph 4-4 for replacement).
- c. Determine that load cell capacity is suitable for the intended application.
- d. Determine that the load cell and hydraulic hose is located in a position to move freely, taking into account any obstructions that may interfere with the load to be measured. Also, determine that hydraulic hose is of sufficient length for routing from the indicator to the load cell.
- e. Verify condition of hose disconnects and fittings to insure that they will not leak hydraulic fluid when mated.

## 2-4. SYSTEM INSTALLATION

- 2-5. **LOAD CELL INSTALLATION.** The load cell may be mounted in any attitude, depending on application requirement. The SD Series Tension Cell should be installed in such a manner that when a load is applied, the components mating with the eye nuts, hooks, pad-eyes, etc. bear at the center of these attachments. The SW Series Compression Cells should be installed in such a manner that the mating surfaces are within  $1^{\circ}$  to  $2^{\circ}$  of parallel. The load plate (piston) and retainer ring (cylinder) should not be eccentric greater than 1/16 inch. Eccentricity or excessive out of parallel loading may produce an indication error and induce premature failure of the diaphragm.

**CAUTION**

The load cell does not support torsional loading of any significance. Torsional loads will cause the diaphragm to rotate over the pressure plate, resulting in premature failure. In applications where twisting is encountered, a swiveling device must be used to relieve the load cell from torsional loads. Some versions of the SD tension load cell are available with anti-rotation configuration.

- 2-6. **Compression Load Cell in Lever Applications.** When an SW Compression System has been ordered to be used with a lever (i.e. specified as 3:1, 2:1 or other lever ratio), the lever length and position of the weight must be precisely measured to maintain accuracy. If, for example, a 2:1 ratio system has been ordered, the weight must be applied to the lever at the midpoint between the load cell and the lever pivot point (fulcrum). Any deviation from this arrangement will result in faulty weight indication (figure 2-1). Figure 2-1 shows a 2:1 ratio lever arrangement; note that while the load cell receives half of the applied weight, the indicator shows all of it. Changing the position of the weight along the



2-6. cont.

lever will change the indication; closer to the load cell will increase the error in a plus direction (reads fast) while farther from the load cell will increase the error in a minus direction (reads slow). For final span adjustment, change the length of the lever slightly by moving the load cell closer to, or farther from, the pivot point. When the span has been adjusted, bolt the lever to the load cell to prevent accidental shifting.

2-7. Requirements for a successful lever installation include:

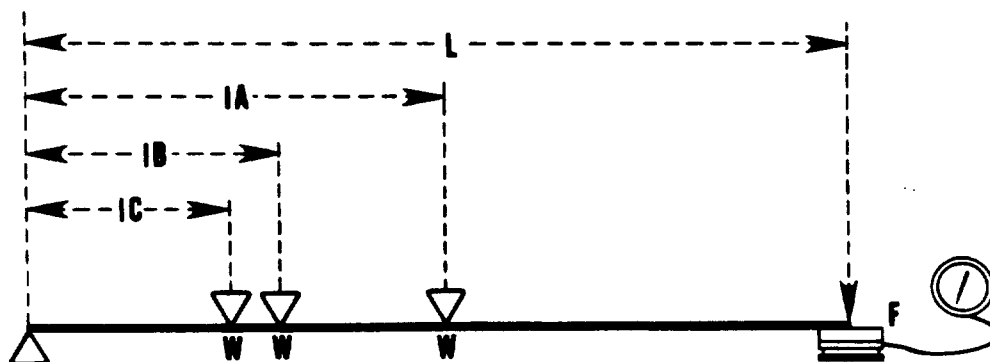
- Lever secured to pivot point (free to rotate vertically) and load cell to prevent accidental shifting. Distance (L, figure 2-1) to be precisely measured.
- Load center of gravity positioned directly over predetermined location on lever to maintain ratio of system.
- Lever must be sufficiently sturdy to prevent introduction of a bending moment with attendant indication error.
- System must be level within 1/4 bubble on a carpenters level, or equivalent.

2-8. **INDICATOR INSTALLATION.** Select location for the indicator that provides convenient visual access to the operator.

**CAUTION**

The indicator is a precision instrument and must be handled with extreme care.

- Locate indicator mounting bracket. Figures 2-2, 2-3 and 2-4 give mounting dimensions for the 6, 8-1/2, 12, 18 and 24 inch indicators.
- After locating bracket, refer to the proper figure for mounting dimensions.
- Drill holes.
- Install bracket on indicator.
- Install indicator/bracket using screws and washers.



2:1 RATIO     $IA = 1/2L$ ,  $F = 1/2W$

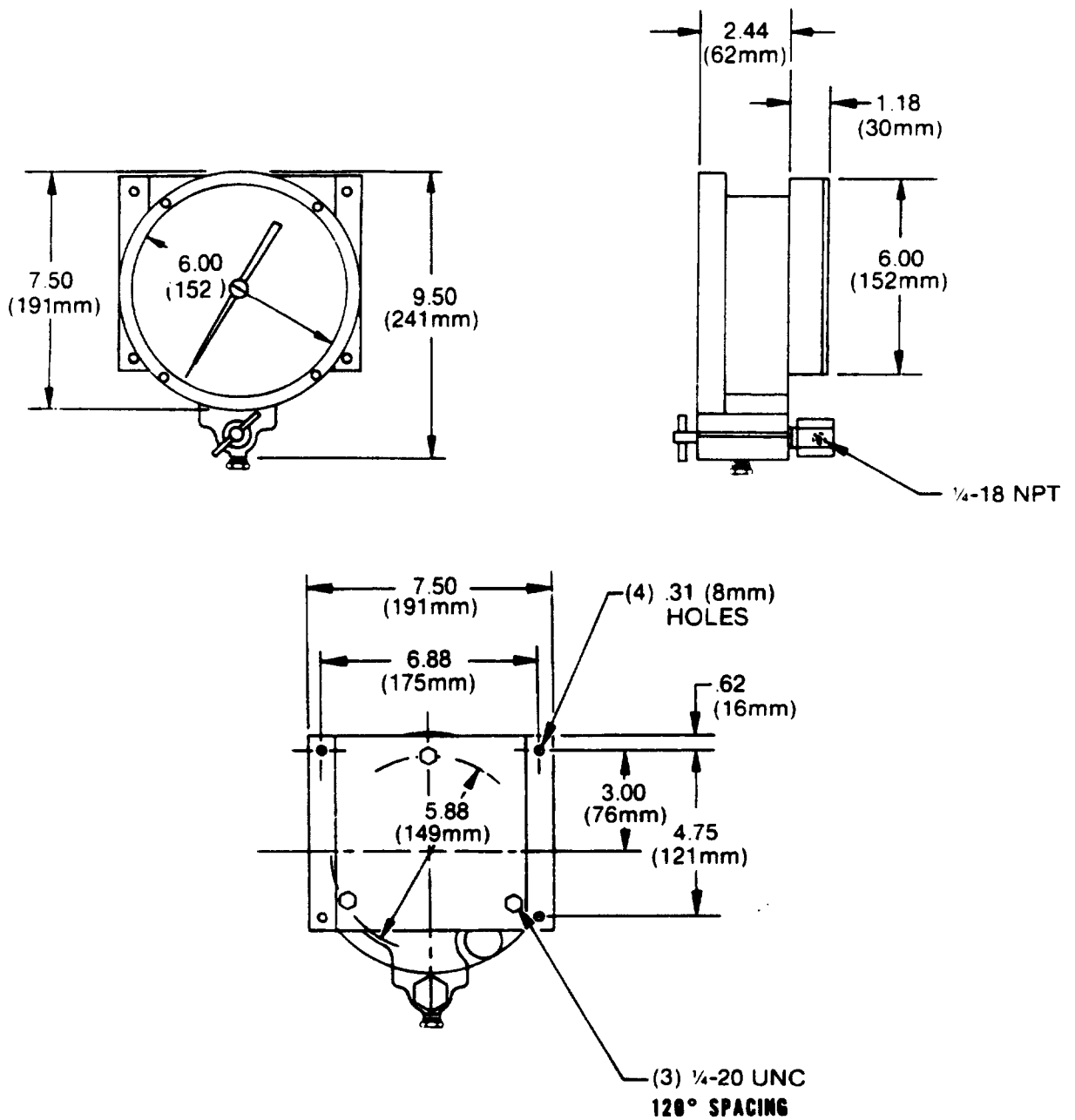
3:1 RATIO     $IB = 1/3L$ ,  $F = 1/3W$

4:1 RATIO     $IC = 1/4L$ ,  $F = 1/4W$

**VARIATION IN  $IA$ ,  $IB$  OR  $IC$  WILL CAUSE INCORRECT WEIGHT INDICATION IN DIRECT PROPORTION TO VARIANCE.**

Figure 2-1. Application of Lever Ratio





NOTE: Indicator furnished with damper at bottom unless otherwise specified.

Figure 2-2. Dimensions for 6-Inch Indicator and A1232 Bracket



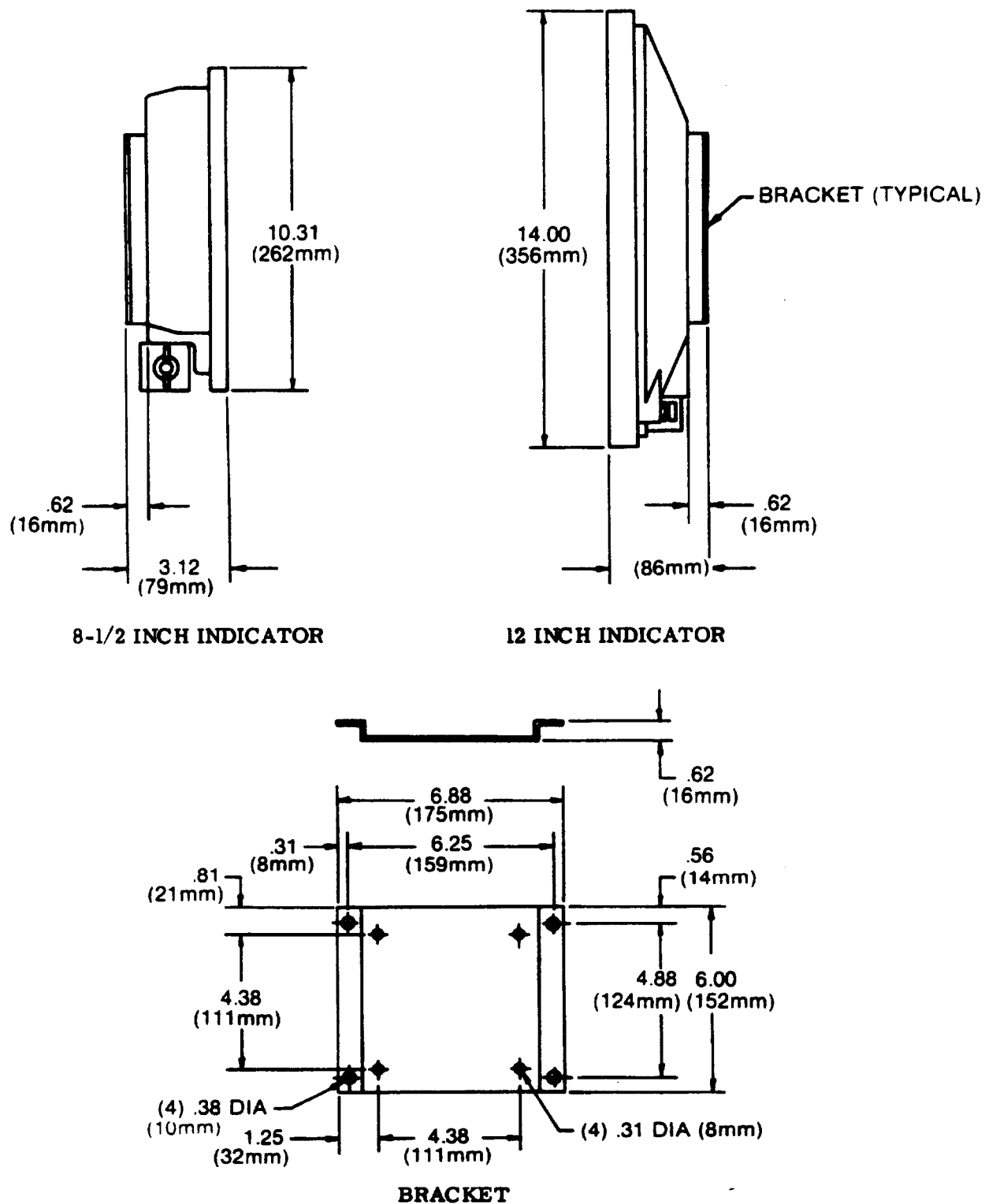


Figure 2-3. Overall Dimensions for 8-1/2 and 12 Inch Indicator and A1063A Bracket Installation



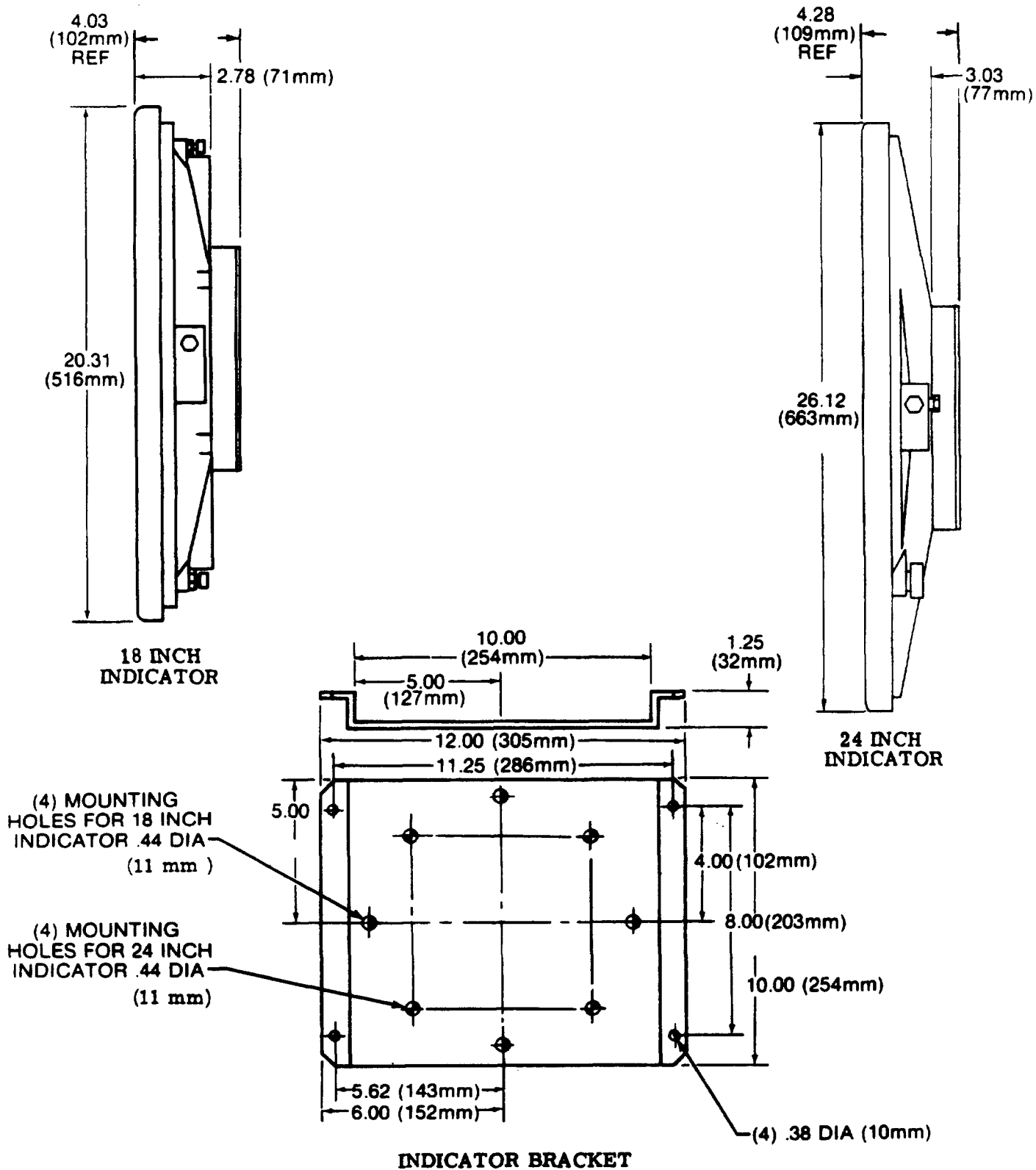


Figure 2-4. Overall Dimensions for 18 and 24 Inch Indicator and A1049 Bracket Installation



**2-9. HYDRAULIC HOSE INSTALLATION**

- a. Route hose so that it will not be crushed, cut or otherwise damaged.
- b. Tie hose to structures where permitted.

**CAUTION**

Allow sufficient slack in the hose to avoid pulling hose taut. Excess tension could cause fitting or connector failure.

- c. Connect disconnects.

**2-10. POST-INSTALLATION CHECKOUT****2-11. After system installation check to insure that it is operating properly.**

- a. Exercise the system several times, using a known weight of at least 25 percent of full scale capacity. This is to flex the Sensater diaphragm in the load cell.
- b. Remove weight from Sensater load cell.
- c. Turn tare adjust knob to rotate dial indicator to zero.
- d. Check load cell to see that it is free of all encumbrances.

**2-12. SYSTEM OPERATION****2-13. The load indicating system is automatic, but two adjustments of the load cell system indicator are necessary prior to initial use of the system.****2-14. LOAD POINTER ZERO ADJUSTMENT.**

- a. Apply a load not exceeding 75% of full scale capacity.
- b. Remove load.

**NOTE**

When reading the indicator, maintain a direct and perpendicular line of sight between the eye and pointer in order to eliminate the possibility of parallax error.

- c. Adjust zero adjust knob until indicator pointer reads zero with all tare loads acting on load cell.

**2-15. POINTER DAMPING ADJUSTMENT. The damper is located on the top, bottom or side of the indicator case and has a tee handle or slotted stem projecting from the damper block.**

- a. Fully engage damper, push stem in and turn clockwise to closed position.
- b. Open damper by turning stem counterclockwise two complete revolutions.
- c. If pointer is too sensitive, turn stem clockwise 1/4 to 1/2 revolution.
- d. If pointer is sluggish, turn damper stem counterclockwise 1/4 to 1/2 revolution.
- e. Recheck sensitivity and repeat step c or d, as applicable, until desired sensitivity is reached.

**2-16. SYSTEM ACCURACY CHECK**

- 2-17. System accuracy is such that the indicated load should not differ from actual load more than  $\pm 0.2\%$  of full scale over an ambient temperature range of 16° to 27°C (60° to 80°F). Adjustments to the system fluid volume may be required for ambient temperatures outside of the quoted range. Extra hose should not be added to systems as they are received from MARTIN-DECKER. See paragraphs 1-9 & 1-11. Use a series of known loads to check the systems accuracy. (Refer to paragraph 2-18).**



## 2-18. SYSTEM WEIGHT TEST

2-19. To insure accuracy of the load indicator system, a load test should be performed at 6-month intervals and at initial test or system installation. A sample load test data worksheet is provided in figure 2-6 and the weight test procedure is contained in paragraph 2-20.

## 2-20. WEIGHT TEST

NOTE

Test weights should have a minimum accuracy of  $\pm 0.01\%$ .

- a. Assemble necessary equipment to perform test:
  1. Test weights on the order of 15, 35 and 75 percent of the total capacity of the system, accurate to  $\pm 0.01\%$ .
  2. Rigging or equipment required to hoist test weights. If weight of rigging or lift equipment is to be included in test, its weight must also be known to  $\pm 0.01\%$ .
- b. Apply test weights and write indicator reading in the space provided on the worksheet.
- c. Repeat step b to ensure repeatability.
- d. If system does not meet specified tolerances refer to paragraph 3-3.

## 2-21. VOLUME CHAMBER

2-22. Some models of the SW and SD series Load Cell systems include a calibration volume chamber. On systems so equipped the following procedures should be followed to make minor corrections to the fluid load for system accuracy correction (figure 2-5).

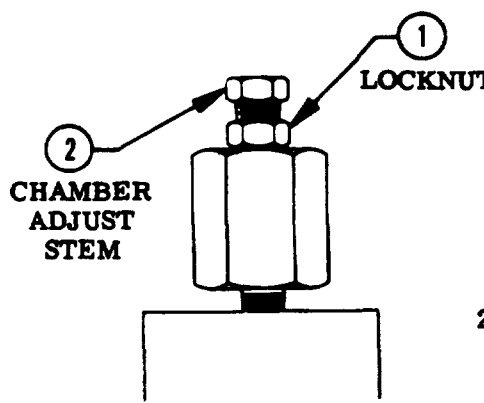
- 
1. If scale reading is too high:
    - a. Loosen lock nut (1).
    - b. Apply a full scale capacity load or as near full scale capacity load as is available.
    - c. Turn volume chamber adjust stem (2) counterclockwise until scale reads correct weight being applied to scale.
    - d. Remove test weight being applied to scale.
    - e. Re-zero scale at tare load.
    - f. Apply test weight to scale.
    - g. If the scale still reads high, repeat step b thru e until scale checks at zero and the test weight being used.
    - h. Tighten lock nut.
  2. If scale reading is too low:
    - a. Loosen lock nut (1).
    - b. Apply a full scale capacity load or as near full scale capacity load as is available.
    - c. Turn volume chamber adjust stem (2) clockwise until scale reads correct weight being applied to scale.
    - d. Remove test weight being applied to scale.
    - e. Re-zero scale at tare load.
    - f. Apply test weight to scale.
    - g. If the scale still reads low, repeat step b thru e until scale checks at zero and the test weight being used.
    - h. Tighten lock nut.

Figure 2-5.  
Volume Chamber Adjustment



OWNER		DATE	
MFG. MARTIN-DECKER SANTA ANA, CALIFORNIA		MODEL	SERIAL
		SYSTEM CAPACITY	
CONFIGURATION AT TIME OF TEST			
LOCATION OF LOAD SENSOR			
TEST LOAD DATA: PERCENT OF TOTAL SYSTEM CAPACITY WEIGHT OF TEST LOAD TO INCLUDE ALL EQUIPMENT (To $\pm$ 0.1%)			
15%	35%		75%
	15% TEST WEIGHT	35% TEST WEIGHT	75% TEST WEIGHT
1st INDICATOR READING			
ERROR *			
2nd INDICATOR READING			
ERROR *			
CONDITION OF LOAD INDICATING DEVICE:			
INSPECTOR		ORGANIZATION	DATE

\* A plus error denotes an indicated load greater than actual load.  
A minus error denotes an indicated load less than actual load.

Figure 2-6. Sample Load Data Worksheet



## SECTION III - MAINTENANCE AND TROUBLESHOOTING

3-1. MAINTENANCE

3-2. GENERAL. The system, as described in this manual, requires no maintenance. However, general operating practices should include:

- a. Cleaning indicator glass on an "as necessary" basis. This can be accomplished by using any commercially available glass cleaning solution and a clean, soft, lint-free cloth.
- b. Visual inspection of the system prior to use. Pay particular attention to the integrity of fittings and connections (no fluid leakage). Check load cell gap and ascertain that the load cell is free of obstructions. Should any leakage and/or malfunction be observed, refer to paragraph 4-2.

NOTE

The maintenance/repair procedures contained in this section and Section IV are the only procedures practical to be performed in the field. In situations involving a faulty component, the faulty component should be returned to MARTIN-DECKER, 1928 South Grand, Santa Ana, California, or authorized service facility for repair and recalibration.

3-3. TROUBLESHOOTING

3-4. If during operation an indication of system malfunction is observed (no load indication and/or sluggish, erratic or erroneous indication), see Figure 4-1 and check load cell gap (paragraph 3-5) in conjunction with Table 3-1 for tabulation of probable causes and their corrective actions.

3-5. LOAD CELL GAP. (Figure 4-1). The load cell gap is the distance measured between the load plate and the load cell retaining ring. The gap will vary from one load cell to another due to configurational makeup. The nominal gap is stamped on the load cell pipe plug at the completion of system calibration at MARTIN-DECKER. This information can be used as a quick reference when a malfunction is suspected in the system, or when hydraulic fluid is added or reduced (Paragraphs 4-4 and 4-5), and as a comparative check against actual weight calibration. The load cell must be exercised several times before this measurement is made. (Paragraph 2-17).

## SECTION IV - REPAIR

4-1. SYSTEM REPAIR

4-2. System repair is limited to removing a faulty component and replacing it with one in serviceable condition. This section of the manual covers repairs that may be readily performed in the field and does not include detailed disassembly/assembly procedures of the indicator and load cell. Field repairs consist of charging or bleeding the hydraulic system, removing and replacing the indicator, load cell and/or hydraulic hose or replacing the O-Ring (Part No. 100796-113AO) in the J900 or J901 series Hydraulic hose disconnects.

4-3. COMPONENT REPAIR - HYDRAULIC HOSE DISCONNECT. The J10900A series hydraulic hose quick disconnect half couplings. (Part Nos. J10900A-02 and J10900A-20) have replaced the J900 and J901 series disconnects. The J10900A series disconnects do not contain an O-Ring; however, the J900 and J901 Series disconnect contains an O-Ring which if damaged must be replaced, as follows, to preserve the integrity of the system.

- a. Be sure that system is not under load.
- b. Remove damaged O-Ring from the female-half of the disconnect.
- c. Clean O-ring groove.
- d. Lubricate (using silicon, or equivalent) and install new O-Ring (Part No. 100796-113AO).

CAUTION

Be careful not to damage O-Ring during mating. A damaged O-Ring could result in hydraulic fluid leaking during operation.

- e. Carefully align male and female coupling halves and push firmly together. Thread nut onto male half of coupling and tighten.



TABLE 3-1. MALFUNCTION ISOLATION

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
Load Indication Too High	Improper zero (tare) setting	Adjust zero set (tare) (para 2-14)
	System charge overload	Reduce (bleed system) hydraulic charge (para 4-6)
Load Indication Too Low	Improper zero (tare) setting	Adjust zero set (tare) (para 2-14)
	Insufficient system charge	Charge system (para 4-5)
	Loose and leaking hose connection	Tighten hose connection
	Obstruction in hydraulic hose	Replace or clean hose
	Hydraulic hose crimped	Straighten hydraulic hose and eliminate tight bends, etc.
Erratic or Sluggish Indication	Insufficient system charge	Charge system (para 4-5)
	Incorrect damper setting	Correct damper setting (para 2-15)
	Obstruction in hose	Replace or clean hose
	Hydraulic hose crimped	Straighten hydraulic hose, eliminate tight bends, etc.
No Indication	Dampers closed	Correct damper setting (Para 2-15)
	Load cell/cells dry (No hydraulic fluid)	Check load cell gap and charge system (para 4-5)
	Hydraulic hose crimped	Straighten hydraulic hose, eliminate tight bends
	Obstruction in hose	Replace or clean hose



**4-4. CHARGING AND BLEEDING SYSTEM**

- 4-5. HYDRAULIC FLUID ADDITION, LOAD SYSTEM.** The system must be kept full of hydraulic fluid at all times to accurately indicated hoisted weight or load. A quick check for adequate fluid in system is the gap between the load cell load plate and retainer ring. Refer to figure 4-1 for gap location, proper gap will be stamped on load cell plug or nameplate.

- a. Remove all weight from load cell.
- b. Insure that weight hose is free of kinks and sharp bends.
- c. Remove cap from F350-1 check valve.
- d. Close damper.
- e. Attach YA2 hand pump to check valve. Do not tighten.
- f. Fill hand pump reservoir with W/15/ W16 (red) hydraulic fluid.
- g. Operate hand pump plunger slowly to bleed air from pump at check valve.

**NOTE**

Keep hand pump reservoir at least half full at all times to avoid introducing air into system.

- h. When air bubbles cease (step g) tighten hand pump to check valve connection.
- i. Raise load cell to a position slightly higher than indicator.
- j. Loosen load cell plug (figure 4-1).
- k. Pump fluid into system and bleed at load cell plug until air bubbles cease to appear.
- l. Tighten load cell plug.
- m. Pump enough fluid into system to slightly overcharge system, loosen pipe plug and bleed to proper gap (figure 4-1). Tighten pipe plug.
- n. Disengage hand pump from check valve.
- o. Replace and tighten check valve cap.
- p. Adjust LOAD damper as necessary (paragraph 2-15).

- 4-6. HYDRAULIC FLUID REDUCTION.** Occasionally it may be necessary to reduce the quantity of hydraulic fluid in the system to achieve accuracy.

- a. Remove all weight from load cell.

**NOTE**

Use rag or other type of container to trap escaping fluid.

- b. Loosen plug on damper until fluid begins to escape from fitting. Bleed fluid until cell gap is at required dimension. Tighten pipe plug.

- 4-7. INDICATOR DAMPER SEAL REPLACEMENT.** If the O - ring in the damper block should become scarred and hydraulic fluid leaks from around damper stem:

- a. Remove damper stem by turning stem nut counterclockwise.
- b. Remove damaged O - ring.
- c. Lubricate new O - ring with silicone grease or equivalent.
- d. Install new O - ring by slipping over end of stem working it up over shoulder into recessed groove.

**CAUTION**

Use extreme care when inserting the damper stem into the damper body to prevent damaging O - ring.

- e. Insert damper stem into damper block.
- f. Install damper stem nut by turning clockwise.
- g. Recharge of system will be necessary, refer to paragraph 4-5.



**SD - SERIES (TENSION) LOAD CELL SYSTEM  
REPLACEMENT DIAPHRAGM**

**PARTS LIST**

CAPACITY (LBS)	LOAD CELL PART NO.	EFFECTIVE AREA (SQ. INS)	DIAPHRAGM PART NO.
500	E403-1xx	4.02	E401A-2
1,000 2,000	E137A-1xx	6.44	E97-21
3,000 4,000	E137A-2xx	6.44	E97-22
5,000 6,000 10,000 15,000	E135B-2xx	16.10	E83-20
16,000 20,000	E135B-3xx	16.10	E83-30
16,000 20,000 25,000	E135B-4xx		
50,000 60,000	E286-1xx E286-2xx	36.767	E257-36
80,000 120,000 150,000	E282-1xx E282-3xx E282-4xx	50.00	E273-40
200,000 300,000	E250-2xx E421-2xx	60.00 100.00	E251A-50 E390-45

**SD - SERIES PADEYE (TENSION) LOAD CELL SYSTEM  
REPLACEMENT DIAPHRAGM**

**PARTS LIST**

CAPACITY (LBS)	LOAD CELL PART NO.	EFFECTIVE AREA (SQ. INS)	DIAPHRAGM PART NO.
5,000/25,000 5,000/30,000	E235-4xx E235-5xx	16.1	E230-1
30,000/40,000 30,000/60,000	E288N-1xx E288N-2xx	36.767	E257-36
80,000/100,000 80,000/150,000	E293N-1xx E293N-2xx	50.00	E273-40
160,000 160,000/200,000	E250N-1xx E250N-2xx	60.00	E251A-50
200,000/250,000 200,000/300,000	E421-111 E421-222	100.00	E390-45



**SW - SERIES (COMPRESSION) LOAD CELL SYSTEM  
REPLACEMENT DIAPHRAGM**

**PARTS LIST**

<b>CAPACITY (LBS)</b>	<b>LOAD CELL PART NO.</b>	<b>EFFECTIVE AREA (SQ. INS)</b>	<b>DIAPHRAGM PART NO.</b>
500 1,000	E354-21/22	4.02	E324-15
1,000 2,000	E136-11/12	6.44	E97-21/22
3,000 4,000	E136-21/22	6.44	E97-22
3,000 4,000 5,000 6,000	E360-2/4	8.00	E358-20
5,000 6,000 10,000	E373-1/3	12.00	E323-24
5,000 6,000 10,000 15,000	E92-11/12	16.10	E83-20
16,000 20,000 25,000	E92-21/22	16.10	E83-30
25,000 30,000 40,000	E369-1/2	25.00	E325-30
30,000 40,000 50,000 60,000	E266-2/6	36.767	E257-36
60,000 80,000 100,000 125,000 150,000	E328-1/2	50.00	E273-40
100,000 125,000 160,000 200,000	E384-1/2	60.00	E251A-50
200,000 250,000 300,000	E523-1/2	100.00	E390-45
400,000 500,000	E523-3/4		









**Bosnor S. A. DE  
C. V. / Pemex  
PB-KU-H Platform**

**Vendor Data Book**  
P.O. # 1550-0268/05-01  
Serial # 24005C  
Volume: 1

## **Nautilus Crane Model 340LA-100**

### **Section 5.9 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

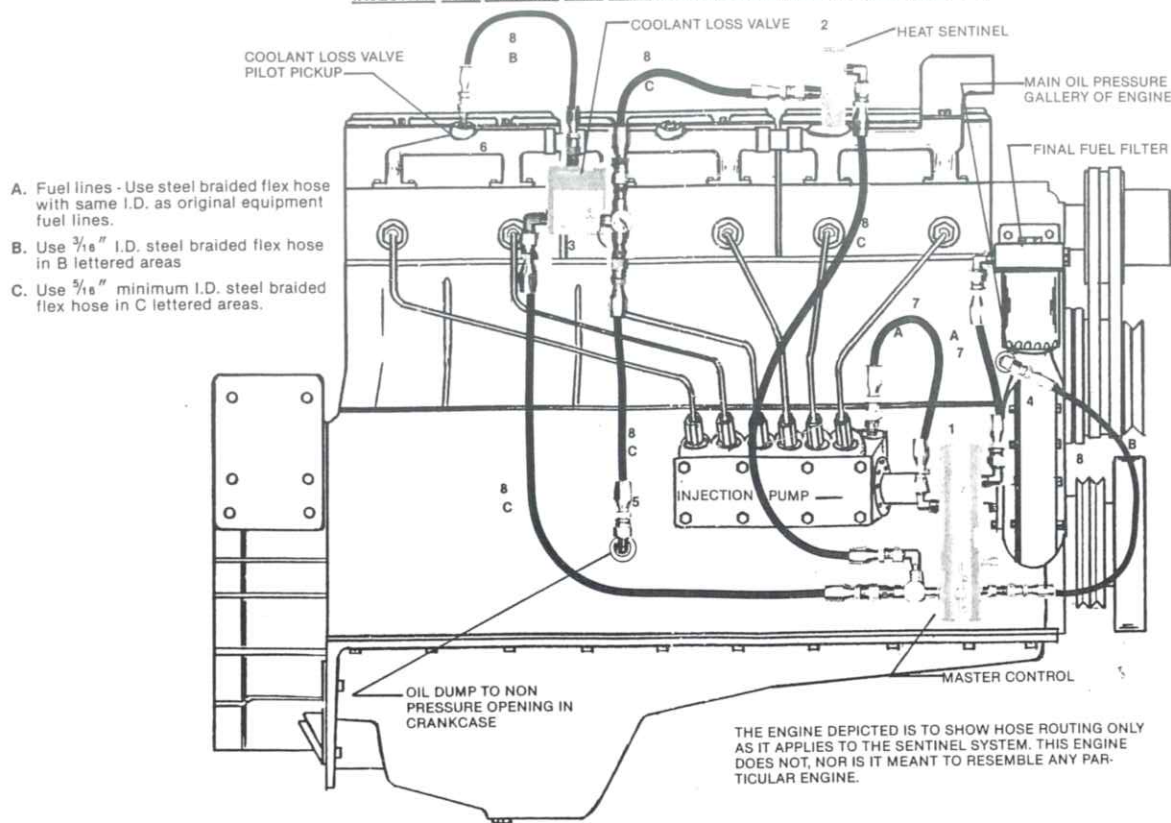
Parker Hannifin N.M.F. GmbH  
Racor Division Europe  
Geestemunder Strasse 42  
D5 Koln 60, West Germany  
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Telex 8885219



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 1/2" N.P.T.F. or 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 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.





Purchase Order No.: 1550-0268/05-01					OSI Doc. No.: 24005	
Rev. No.	Submittal Date	Revision	Prep By	OSI Checked	OSI Approved	Client Approval
A	23 March 06	Official Release	K. Cunningham	M. Niette		





**Bosnor**  
S. A. DE C. V. / Pemex

# Vendor Data Book

P.O. # 1550-0268/05-01

Serial # 24005C

Volume: 1

## Nautilus Crane Model 340LA-100

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- 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 Ball Certificates
- 9.0 Backlash Reports
- 10.0 Miscellaneous



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA







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## Vendor Data Book

P.O. # 1550-0268/05-01

Serial # 24005C

Volume: 1

### Nautilus Crane Model 340LA-100

#### Section 1.0

#### Material Certificates and NDE Reports

- Pedestal Weldment
- Upperstructure Weldment
- Boom Base Weldment
- Boom Insert Weldment (Mid #1)
- Boom Insert Weldment (Mid #2)
- Boom Point Weldment
- Bridle Weldment



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA





# Material Traceability Log

CRANE WO. NO.: 24005  
CUSTOMER: PEMEX  
WELDMENT PART NO.: N2005SK1-171  
WELDMENT S/N: 05334-03  
DESCRIPTION: Pedestal Weldment  
MODEL: 340LA-100  
CHECKED BY: Mike Niette  
DATE: 1-16-06

[illegible]



ISG BURNS HARBOR Plate, Inc.  
QUALITY ASSURANCE  
REPORT OF TEST AND ANALYSIS

API 11

SHIPMENT NO 803-11369		DATE SHIPPED 07-16-05		CAR OR VEHICLE NO IHB-DOLTN-UP		BN 621440		PAGE 5				
LONGHORN STEEL & FLAMECUTTING INC 11921 FM 529 RD HOUSTON TX 77041				LONGHORN STEEL & FLAMECUTTING INC C/O A&L TRUCKING PTRA SPUR 23 HOUSTON TX								
NOTE	SERIAL NUMBER	PAT NO.	HEAT NUMBER	NO PCS	SIZE AND QUANTITY				YIELD POINT	TENSILE STRENGTH	ELONG	RED
					THICKNESS	WIDTH OR DIA	LENGTH	WEIGHT				
					INCHES	INCHES	INCHES	POUNDS	PSI	PSI	IN %	%

QUALITY STEEL MELTED & MANUFACTURED IN THE U. S. A.  
PLATES - API -2H GR 50 INTEGRA 1999 EDITION  
S1,S3,S4,S5,S12 CE=.43X PER IIW  
FORMULA, ASTM A633-95 GR C, ABS GRD  
DH/EH36 REV 2001, ASTM A537-95 PVQ  
MOD CB.04 MAX CLASS 1, CH-V A20S5  
PLT T 30/25 FTLBS AT -40F, THRU THK  
PER API-2H S4, NDT API-2H PLT NO  
BRK AT -30F, UT A578 LEVEL 2 100%  
--- PLT NORMALIZED & COOLED IN COOLED IN STILL AIR  
NO WELD REPAIR WAS PERFORMED ON BELOW PLATE(S)  
---PLATE PASSED NDT API-2H NO BREAK AT -30F----

CO# 320958 GH 841-3565B  
PLATES HEAT TREATED - TEST SPECIMENS ATTACHED & YIELD STRENGTH @ .5% EUL  
PLATES ULTRASONICALLY TESTED PER ATTACHMENT  
OUTSIDE INSPECTION BY AMERICAN BUREAU OF SHIPPING  
L032841 812L40870 1 1 120 480 16335 55600 74300 8 26

62  
59

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  
ISG BURNS HBR PLATE. 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	CHARPY IMPACT			SHEAR(%)			LAT. EXP MILS		
										ENERGY FT LBS								
L032841		812L40870			1.000	V	FULL T	-40	140	280	270							

SUBSCRIBED AND SWORN TO BEFORE ME  
THIS 18 DAY OF 20 05  
NOTARY PUBLIC DONNA J. POMEROY  
PORTER COUNTY INDIANA  
MY COMMISSION EXPIRES MAY 17, 2007  
COUNTY OF PORTER

HEAT NUMBER	CHEMICAL ANALYSIS																LIQUID GRAIN SIZE
	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Ti	Al	B	Co	N	Sn	
812L40870	.13	1.45	.014	.002	.317	.013	.01	.07	.052	.005	.003	.026	.0005	.033	.007		
	IIW PCM																
	.40 .22																

25616  
Daniel W. Elwood  
12-2-0

I certify that the above results are a true and correct copy of actual results contained in records maintained by ISG 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 #00477

D. W. ELWOOD

ISG BURNS QUALITY ASSURANCE



**FRISA FORJADOS, S. A. DE C. V.**

Valentin G. Rivero No. 127 Col. Los Treviño  
C.P. 66350 Tels. 52(8) 153-0321, 153-0302  
Fax: 52(8) 336-3560  
Sta. Catarina, N. L., México

CERTIFIED COMPANY

**ISO 9001 : 2000**

Material Test Report No. 235374

Customer: OIL STATES SKAGIT SMATCO

Spec: ASTM A694 F50 R-03

Pag. 1 / 1

Qty	Date	P.O. Number	Part No.	Job Order
2	20/06/2005	4038262	N47073-008 RH	207950
Description	ROLLED RING 90.000" X 76.000" X 3.000" MELTING PRACTICE: E. F. V. D.			

**HEAT: P2339 (2/2) PCS****CHEMICAL ANALYSIS**

Heat No.	Ladle	C %	Mn %	P %	S %	Si %	Ni %	Cr %	Mo %
P2339		0.1400	1.3600	0.0140	0.0100	0.2700	0.0500	0.0600	0.0300
		Cu %	V %	CE %					
	Ladle	0.1500	0.0510	0.4100					

**MECHANICAL PROPERTIES**

Heat Treat Lot No.	Yield Strength (PSI)	Tensile Strength (PSI)	Elong. % (2")	A.R. (%)	Hardness HBW QTC	Hardness HBW PCS	CVN (ft/lb)	Lat. Exp. (IN)	Shear %	Test. Temp. (°F)
105028	60400	77900	34	77	156		145	0.077	70	-4
					156		185	0.082	100	
							145	0.079	85	

**HEAT TREATMENT**

Quantity	Heat Treat Lot No.	Heat Treatment	Temperature (°F)	Time at Temp (Hrs)	Cooling Medium	Quench. M. Temp. (°F)
2 PCS	105027	AUSTENITIZED	1652	4.00	WATER	
2 PCS	105028	TEMPERED	1200	4.00	AIR	

**OBSERVATIONS**

- . QTC SIZE (4" X 4" X 10")
- . IF IMPACT TEST WAS PERFORMED: 0.39" X .39" X 2.16" CVN SPECIMEN
- . IF TENSILE TEST WAS PERFORMED: 0.500" DIAMETER SPECIMEN
- . ULTRASONIC EXAMINATION PER: ASTM A 388M-03
- . FURNACE CALIBRATED PER: API 6A APPENDIX H
- . HARDNESS ON TEST SPECIMEN IS REPRESENTED BY TWO VALUES.
- . FURNACE TEMP. MONITORING METHOD: AIR THERMOCOUPLE
- . FULLY KILLED MATERIAL
- . TESTING ACCORDING TO ASTM A370

*[Signature]*  
6-27-05





## ULTRASONIC TEST REPORT

**Customer** OIL STATES SKAGIT SMATCO

**Certificate** 6027

### IDENTIFICATION PART

Test Date : JUN/20/2005

**Job Order :** 207950

**Purchase Order :** 4038262

**Part Number :** N47073-008 RH

**Material :** ASTM A694 F50 R-03

**Dimensions :** 90.00 " x 76.00 " x 3.00 "

**Heat :** P2339 **Qty :** 2 **PCS**

**Specification :** ASTM A 388M-03

**Description :** ROLLED RING

### EQUIPMENT

Brand	Model	Serial No	Calibration Due
KrautKramer	USN-50D	604113	APR/26/2006

### LONGITUDINAL WAVE (STRAIGHT BEAM)

**Transducer Size :** 1 "

**Transducer Frequency :** 2.25 Mhz

**Transducer Serial No :** 325189

**Reference Gain dB :** 33 dB

**Scanning Gain dB :** +10

**Couplant :** OIL SAE 30

**Surface Condition :** 250 rms

**Calibration Block:** ASTM E-428 DAC 1/8" FBH

**Serial Number :** 4340-8-0025 A15974  
4340-8-0125 A15975  
4340-8-0225 A15976  
4340-8-0325 A15977  
4340-8-0425 A15978  
4340-8-0525 A15979  
4340-8-0650 A15980  
4340-8-0750 A15981

### ANGLE BEAM (SHEAR WAVE)

**Transducer Size :** 1x3/4 "

**Transducer Frequency** 2.25 Mhz

**Transducer Serial No :** S1652

**Wedge Angle :** 45 DEG

**Calibration Block :** NOTCH AT 3% THICKNESS

**Reference Gain dB :** 55

**Scanning Gain dB :** +10

**Couplant :** OIL SAE 30

**Surface Condition :** 250 rms

**EVALUATION :** ACCEPTED

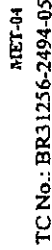
**REMARKS :** NO DEFECTS FOUND

**Evaluated by :** José Gpe Hdz Briones

Level II SNT - TC-1A

FRISA FORJADOS S.A. DE C.V.  
OPEN DIE & ROLLED RING FORGINGS  
PO Box 1273 Monterrey, NL  
64000 Mexico Ph. (52 8) 153-0321 Fax (52 8) 336-3560  
e-mail: frisa@frisa.com





5200 E. McKinney Road  
Baytown, TX 77520

12-1-65





*Metallurgical Chemistry and Testing Laboratory*

3204 BROADWAY (77017)  
POST OFFICE BOX 282288  
HOUSTON, TEXAS 77207-2288  
PHONE: (713) 844-7601  
FAX: (713) 844-1400  
[metallurgy@an-tech.com](mailto:metallurgy@an-tech.com)

December 6, 2005

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091


P.O. No. 10647/24993  
Report No. 05-3238-4  
Correction: 12/8/2005

IDENTIFICATION: 1" x 4" x 6", HT# S02494, SL# 06AA  
MATERIAL: ASTM A-36, Mfg. Jin  
REFERENCE: HOU-24993

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
89.0	80	50
100.0	93	50
104.0	93	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.

  
12-8-05



B/L# 288759

Date 1/30/04

01

PAGE 01

CERTIFIED MILL TEST REPORT

Sold To: DOLPHIN STEEL SALES, INC.  
P.O. BOX 581  
HOUMA LA 70361

Post Office Box 126

A Division of NUCOR Corporation

Jewett, Texas 75846 Telephone (903) 626-4461 Sales (800) 527-6445

Ship To: DOLPHIN STEEL SALES, INC.  
583 THOMPSON ROAD  
HOUMA LA

ISO 9002 Registered by



SIZE GRADE HEAT NUMBER CUSTOMER PO NUMBER

3 X 3 X 1/4  
ASTM A36-03A/A529-03 CR 50 343-0270 59714-5

3 X 3 X 1/4  
ASTM A36-03A/A529-03 CR 50 344-0221 59714-5

3 X 3 X 1/4  
ASTM A36-03A/A529-03 CR 50 345-0265 59714-5

1 X 5  
A36-03A/A709-03A/SA36-98 335-4557 59714-5

3 X 3 X 3/8  
ASTM A36-03A/A529-03 CR 50 343-0229 59714-5

1/4 X 5  
A36-03A/A709-03A/SA36-98 333-5494 59714-5

1/8 X 3  
A36-03A/A709-03A/SA36-98 334-4704 59714-5

STRETCHING IN 8 INCH SCALE  
DELIVERED AND MANUFACTURED IN U.S.A.

C	Mo	SI	B	P	V	ND	CU	Cr	NI	Mn	Band
.13	.79	.18	.042	.020	.006	.011	.38	.17	.14	.045	.014
Tensile 1: 75300 Yield 1: 56200 Elong% 1: 20											
Tensile 2: 74500 Yield 2: 55600 Elong% 2: 21											
.14	.78	.18	.036	.014	.003	.011	.38	.09	.17	.08	.013
Tensile 1: 74500 Yield 1: 54900 Elong% 1: 22											
Tensile 2: 75300 Yield 2: 55300 Elong% 2: 22											
.11	.68	.21	.034	.013	.003	.012	.48	.11	.16	.05	.016
Tensile 1: 73800 Yield 1: 55000 Elong% 1: 22											
Tensile 2: 74100 Yield 2: 55800 Elong% 2: 22											
.11	.66	.18	.029	.003	.004	.004	.30	.13	.23	.04	.008
Tensile 1: 62900 Yield 1: 41900 Elong% 1: 25											
Tensile 2: 62300 Yield 2: 41000 Elong% 2: 24											
.14	.78	.23	.034	.009	.003	.010	.34	.12	.12	.06	.009
Tensile 1: 75000 Yield 1: 54800 Elong% 1: 23											
Tensile 2: 73900 Yield 2: 54500 Elong% 2: 23											
.15	.71	.19	.018	.010	.003	.004	.38	.10	.15	.03	.013
Tensile 1: 68500 Yield 1: 46300 Elong% 1: 22											
Tensile 2: 68400 Yield 2: 47900 Elong% 2: 23											
.12	.66	.23	.035	.007	.003	.004	.34	.11	.11	.03	.022
Tensile 1: 67200 Yield 1: 44800 Elong% 1: 25											
Tensile 2: 67900 Yield 2: 44700 Elong% 2: 25											

ALL MATERIAL STRAND CAST

CHERI STALLURGIST

Ben, [Signature]



AMERICAN ALLOY  
PLATE # DL 282

NET-M  
TC No.: BR29639-2111-01

Jindal United Steel Corporation

5200 E. McKinney Road  
Baytown, TX 77520



METALLURGICAL TEST REPORT

<b>Sold To:</b> AMERICAN ALLOY STEEL INC. 7105 ST. GABRIEL ST. ST. GABRIEL, LA. 70716		<b>Ship To:</b> AMERICAN ALLOY STEEL INC. 7105 ST. GABRIEL ST. ST. GABRIEL, LA. 70716		<b>Approved By:</b> 		<b>Bulletin Num.</b> 29639	
<b>Order No:</b> JUS1154-03		<b>P.O. Number</b> 63556-LA		<b>Shipping Mode:</b> DIRECT TRUCK			
<b>Date</b> 6/23/2005							
<b>Specifications:</b> HOT ROLLED PLATE CUT EDGE ABS GR A131 36 W/LCVN D-CERT TO A572-50 & A131 A131 36 HIGH STRENGTH LOW ALLOY							
<b>Material Description</b>		<b>Rolls</b>		<b>Temp.</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>Test/Plate Identity</b>
03	0.3750	96.0000	480.0000	2	9.802	S02111	01B
						<b>Gauge Tested</b>	<b>Test Cond</b>
						0.375	ABS
						<b>Yield Point (KSI)</b>	<b>Tensile Strength (KSI)</b>
						59	79
						<b>Elongation (%)</b>	<b>Yield Strength Determined at</b>
						20	0.2%
						<b>LCVN</b>	<b>FULL min @ -40°F</b>
						31 FT/LBS	88 - 100 - 60 FULL min @ -4°F
<b>Heat No.</b> S02111 <b>CE:</b> 0.40							
<b>Test Type</b> C <b>Mid</b> 1.34 <b>P</b> 0.012 <b>S</b> 0.009 <b>Si</b> 0.26 <b>Cu</b> 0.03 <b>Ni</b> 0.02 <b>Cr</b> 0.02 <b>Mn</b> 0.010 <b>Su</b> 0.034 <b>Al</b> 0.005 <b>N</b> 0.005 <b>V</b> 0.067 <b>B</b> 0.0003 <b>Ti</b> 0.005 <b>Co</b> 0.010							
<b>Test Type</b> LADIE <b>C</b> 0.15 <b>Mid</b> 1.34 <b>P</b> 0.012 <b>S</b> 0.009 <b>Si</b> 0.26 <b>Cu</b> 0.03 <b>Ni</b> 0.02 <b>Cr</b> 0.02 <b>Mn</b> 0.010 <b>Su</b> 0.034 <b>Al</b> 0.005 <b>N</b> 0.005 <b>V</b> 0.067 <b>B</b> 0.0003 <b>Ti</b> 0.005 <b>Co</b> 0.010							

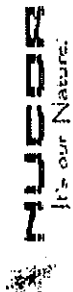
To: OIL STATES-SKAGIT-SMATCO  
AA PL#: D67282

S.O.# : 255796

09/15/2005 From: AMERICAN ALLOY STEEL

P.O.# : 4041098  
Item : 1 (2 PC) 3/8" X .96" X 240"





# Mill Test Report

Page 1

P.O. Box 279  
Winston, NC 27203  
(252) 356-3700

**NUCOR**  
**PLATE MILL**

Issuing Date : 05/10/2005	DrL No. : 98535	Load No. : 160755	Our Order No. : 3457715	Cust. Order No. : HOU-2345
Vehicle No: ALY 91634		Sold To : CHAPEL STEEL CO P O Box 1000	Ship To : CHAPEL STEEL 6805 N. HOUSTON ROSSLYN ROAD RAIL SITE 720703 HOUSTON, TX 77091	
Specification : 2.0000" x 96.000" x 480.000"		ASTM A36-05/ABS Grade A/ABS Grade B/ASME SA36-00a/A709 36-05		
		FAX# 216-793-9415 SPRINGHOUSE, PA 19477		

Marking :

Heat No	C	Min	P	S	Si	Cu	Ni	Cr	Mo	Al	V	Nb	Ti	N	Ca	B	Sn	CEQ	PCM
5103416	0.06	1.05	0.011	0.001	0.30	0.19	0.07	0.08	0.03	0.040	0.006	0.001	0.007	0.0021	0.0004	0.020	0.27	0.14	
Tensile Test																			
Plate Serial No	Pieces	Dir.	Yield	(psi)	Tensile	(psi)	Elongation % in 2"	Elongation % in 8"	Dir.	(ft-lb)	1	(ft-lb)	2	(ft-lb)	3	(ft-lb)	shear	(ft-lb)	Min
5103416-03	3	T	40,100	60,000	24.6	23.2	24.6	23.2	H-L	243.9	253.6	258.6	273.8	251.1	243.2	245.5	254.4	249.3	20
		T	38,600	60,400					H-L	253.6	258.6	263.3	251.1	243.2	245.5	241.6	254.5	254.5	20
5103416-04	3	T	40,100	60,000	24.6	23.2	24.6	23.2	H-L	243.9	253.6	258.6	273.8	251.1	243.2	245.5	254.4	249.3	20
		T	38,600	60,400					H-L	253.6	258.6	263.3	251.1	243.2	245.5	241.6	254.5	254.5	20
5103416-05	1	T	40,100	60,000	24.6	23.2	24.6	23.2	H-L	243.9	253.6	258.6	273.8	251.1	243.2	245.5	254.4	249.3	20
		T	38,600	60,400					H-L	253.6	258.6	263.3	251.1	243.2	245.5	241.6	254.5	254.5	20

Manufactured to fully killed fine grain practice. 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 0.5ELU, method unless otherwise specified. Ceq = Cr (Mn/8) + (C+Mn+V+Si) (Cu+Mn/15)

Pem = C+(Si/20)+(Mn/20)+(Cu/20)+(Nb/50)+(Cr/20)+(Mo/15)+(V/10)+S

Melted and manufactured in the USA, ISO 9001:2000 certified (#12443-0) by SRI Quality System Registrar (#0906-09).

EN 10028-3 1.5Cr1 1020S 3 1.0 compliant For ABS grades only, Quality Assurance Certificate No. 03-14MP-QA-162

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. Depietis, Metallurgist

05/15/2005 11:15:56 AM





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@msn.com

CUSTOMER NAME CHAPEL Steel P.O. NO. 10647/24350 DATE 10-14-05  
IDENTIFICATION 2"x4"x6" PLT# 16395-1 HT# 5103446 816#03  
MATERIAL ASTM A36 SPECIFICATION \_\_\_\_\_  
TEST REQUIRED: PHYSICAL .505", RST, CVN B, DW, HARDNESS, MACRO, HOT ETCH  
CHEMICAL: 1ST 5, 1ST 5+  
METALLURGY: MICRO, GS, PHOTO, McQUAID EHN, MACRO, MICROHARDNESS  
HEAT TREAT: \_\_\_\_\_  
NDE: UT, LP, MP

TENSILE TEST						
SPECIMEN	DIA.	AREA/SQ.IN.	Y.S. PSI	ULT. LD. LBS.	T.S. PSI	%EL IN "%R.A.

IMPACT TEST @ (+) 10 or - (°F) (°C)				
SPECIMEN SIZE	ORIENTATION	FOOT/POUNDS	LATERAL EXPANSION(MILS)	%SHEAR
10mm x 10mm Charpy		231.0	91	100
		229.0	100	100
		211.0	94	100

CHEMISTRY								
C	S	Mn	P	Si	Cr	Mo	Ni	Cu

INVOICE NO \_\_\_\_\_

REPORT NO 05-2756-5

10/13/05





Jindal United Steel Corporation  
5200 E. McKinney Road  
Baytown, TX 77520

# METALLURGICAL TEST REPORT

MET-04  
TC No.: BR31322-2553-01

<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 ROAD 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. 31322
<b>Plates Manufactured in the USA</b>		<b>Order No:</b> JUS1414-01		<b>Approved By:</b> <i>Robert Hudson</i>		
		<b>Date:</b> 10/5/2005		<b>Shipping Mode:</b> DIRECT TRUCK		
		<b>P.O. Number:</b> HOU-2486		<b>DN:</b> 50049 3.1.B / EN 10204 3.1.B		

**Specifications:**  
HOT ROLLED PLATE CUT EDGE ASTM A36 -05 / ABS GR A / 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"							
01	0.5000	96.0000	480.0000	3	19.602	S02553	0.500	07A1	ABS	45	65	27		0.2%						
<div>AMERICAN BUREAU OF SHIPPING</div> <div>ABS</div> <div>HS 646</div> <div>06EX</div>																				
OCT - 5 2006																				

Heat No.: S02553 CE: 0.33

Test Type	C	Mn	P	S	Si	Cu	NI	Cr	Mo	Sn	Al	N	V	B	TI	Cb
LADLE	0.13	1.10	0.014	0.014	0.23	0.02	0.02	0.03	0.010	0.001	0.035	0.006	0.005	0.0010	0.005	0.010

501021011  
9  
005



Rush!!!



Metallurgical Chemistry and Testing Laboratory

3204 BROADWAY (77017)  
POST OFFICE BOX 282265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
metallabtesters@msn.com

CUSTOMER NAME CHAPEL STEEL P.O. NO. 10647/24350 DATE 10-14-05  
IDENTIFICATION 1/2" x 4" x 6" HT\* 502 SS3 EL\* 07A1B  
MATERIAL ASTM A36 SPECIFICATION \_\_\_\_\_  
TEST REQUIRED: PHYSICAL .505", RST CVN B, DW, HARDNESS, MACRO, HOT ETCH  
CHEMICAL: 1ST 5, 1ST 5+  
METALLURGY: MICRO, GS, PHOTO, McQUAID EHN, MACRO, MICROHARDNESS  
HEAT TREAT: \_\_\_\_\_  
NDE: UT, LP, MP

TENSILE TEST						
SPECIMEN	DIA.	AREA/SQ.IN.	Y.S. PSI	ULT. LD. LBS.	T.S. PSI	%EL IN %R.A.

IMPACT TEST @ <u>10</u> or - <u>(°F)</u> <u>(°C)</u>	SPECIMEN SIZE	ORIENTATION	FOOT/POUNDS	LATERAL EXPANSION(MILS)	%SHEAR
	10mm x 10mm Long	-	133.0	100	80
		-	110.0	95	70
		-	100.0	89	60

CHEMISTRY									
C	S	Mn	P	Si	Cr	Mo	Ni	Cu	

INVOICE NO \_\_\_\_\_

REPORT NO 05-2756-1







**BAYOU STEEL CORPORATION**  
(TENNESSEE)

2404 S. ROANE STREET  
HARRIMAN, TENNESSEE 37748  
Telephone (885) 882 5100

**MATERIAL CERTIFICATION REPORT**

SABEL STEEL SERVICES INC.  
P.O. DRAWER 4747  
MONTGOMERY, AL 36103-4747

SABEL STEEL SERVICES  
1435 CHOCTAW DRIVE  
BATON ROUGE, LA 70884

TESTED IN ASTM A6

ACCORDANCE  
WITH

INVOICE NO.

DATE 09/23/05

PO: 43470

PRODUCT FORMS

CUST S-0050 -0021

HEAT NO. 42665 168 Pcs

GRADE A3644W

Length 20'0"

SIZE R 3/4 X 1.502

CHEMICAL ANALYSIS	
C	.15
Mn	.77
P	.022
S	.04
Si	.20
Cu	.38
Ni	.13
Cr	.29
Mo	.041
Cb	.000
V	.000

MECHANICAL PROPERTIES	TEST 1		TEST 2		TEST 3	
	IMPERIAL	METRIC	IMPERIAL	METRIC	IMPERIAL	METRIC
YIELD STRENGTH	51,400 PSI	354 MPa	51,100 PSI	352 MPa	PSI	MPa
TENSILE STRENGTH	72,500 PSI	500 MPa	72,900 PSI	503 MPa	PSI	MPa
ELONGATION	23.0 %	23.0 %	24.0 %	24.0 %	%	%
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	METRIC		INTERNAL CLEANLINESS		GRAIN SIZE	
	IMPERIAL	METRIC	SEVERITY	FREQUENCY	HARDNESS	REDUCTION RATIO
AVERAGE	ft-lbs F	J C				
TEST TEMP						
ORIENTATION						

CUSTOMER Grade & Specs: ASTM A36

CSA G40.20/G40.21-98 GR 44W

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.

NOTARIAL POW REQUEST

SUBSCRIBED BEFORE ME ON \_\_\_\_\_ DAY OF \_\_\_\_\_ 20

IN FRONT OF ME \_\_\_\_\_

COMMISSION EXPIRATION \_\_\_\_\_

SIGNED

ROBERT W. KENNEDY, GENERAL MANAGER TECHNICAL SERVICES

DIRECT ANY QUESTIONS OR NECESSARY CLARIFICATIONS CONCERNING THIS REPORT TO THE SALES DEPARTMENT.

1-800-535-7592 USA

To:

10/03/2005 From: THOMAS PIPE & STEEL

PO # :  
ATTN :  
FAX # :



LOAD NUMBER 315253	TALLY 0000000021793	MILL ORDER NUMBER H-076920-002	CERT NUMBER L136926 Page: 1
ORDER DESCRIPTION CSA 44W, 0.25000 IN, 96.000 IN, 240.000 IN, 96.0000, 240.00		CUSTOMER Sold to: CHAPEL STEEL CO. FORT WASHINGTON PA Ship to: Chapel Steel Co. Houston TX	
QUALITY PLAN DESCRIPTION CSA440.21-44W: CSA 640.21 44W / ASTM A36 / SA36 / A709-36		DATE Prepared: 01/17/2005 10:37	
		CUSTOMER ORDER NUMBER H00-2199	

Shipped Item	Is certified by Sample	Heat Number	Carb	Mang	Phos	Sul	Sil	Copper	Nickel	Chrome	Moly	Co(Nb)	Van	Al	Ti	MN	Ca	S	Sh
5A0454C	B5M5052	B5M5052 ***	0.21	0.86	0.010	0.008	0.04	0.19	0.06	0.05	0.017	0.000	0.003	0.048	0.002	0.008	.0011	.0002	0.0073
5A0454B	B5M5052	B5M5052 ***	0.21	0.86	0.010	0.008	0.04	0.19	0.06	0.05	0.017	0.000	0.003	0.048	0.002	0.008	.0011	.0002	0.0073
5A0454D	B5M5052	B5M5052 ***	0.21	0.86	0.010	0.008	0.04	0.19	0.06	0.05	0.017	0.000	0.003	0.048	0.002	0.008	.0011	.0002	0.0073

Shipped Item	Is certified by Sample	Heat Number	Yield KSI	Tensile KSI	Elong % 2"	% Red area	Bend test	Hard	Charpy			Tested at Deg. F	Min Avg Ft-Lbs
									1	2	3		
5A0454C	S5A0454FTT	B5M5052	64.3	87.4	28.8								
5A0454C	S5A0454MTT	B5M5052	56.2	80.9	30.2								
5A0454B	S5A0454FTT	B5M5052	64.3	87.4	28.8								
5A0454B	S5A0454MTT	B5M5052	56.2	80.9	30.2								
5A0454D	S5A0454FTT	B5M5052	64.3	87.4	28.8								
5A0454D	S5A0454MTT	B5M5052	56.2	80.9	30.2								

MERCURY WAS NOT COME IN CONTACT WITH THIS PRODUCT DURING THE MANUFACTURING PROCESS NOR HAS ANY MERCURY BEEN USED BY THE MANUFACTURING PROCESS

PRODUCED TO A KILLED  
FINE GRAIN PRACTICE  
WITH NO WELD REPAIR

WE HEREBY CERTIFY THAT THE PRODUCT DESCRIBED ABOVE PASSED ALL OF THE TESTS REQUIRED BY THE SPECIFICATIONS

Items: 3 Pieces: 28 Net Wt: 45739 LBS  
\*\*\* indicates heats melted and manufactured in the U.S.A.

*Quilin J*  
CHIEF METALLURGIST

ISO 9001:2000 Registered

Visit our website at [www.NucorTusk.com](http://www.NucorTusk.com)

10/12/05





# GLOBAL X-RAY & TESTING CORPORATION

JOEL MOREAU, President  
Residence: 985-448-8861

Post Office Box 1636  
Morgan City, Louisiana 70381

Bus: 985-631-2426  
Fax: 985-631-0093

## DAILY NDE WORK REPORT

TERMS AND ABBREVIATIONS

022490

BT—BURN THROUGH  
BTA—BURN THROUGH AREA  
C—CRACK  
IU—INTERNAL UNDERCUT

LC—LOW CROWN  
LP—LACK OF PENETRATION  
NF—NON FUSION  
NW—NARROW WELD

OU—OUTSIDE UNDERCUT  
P—POROSITY  
SI—SLAG INCLUSIONS  
SL—SLAG LINES

Customer Oil States Ind. Contractor \_\_\_\_\_  
Address \_\_\_\_\_ Location of Job Latest Edition  
Job No. \_\_\_\_\_ W.O. 24005 AFE \_\_\_\_\_ Other AWS D1.1  
Job Specifications BT of crane pedestal long beam sec. 6

	WELD NO.	PIPE SIZE	RECOMMENDATION		REMARKS		WELD NO.	PIPE SIZE	RECOMMENDATION		REMARKS
			X	ACCEPT REJECT					X	ACCEPT REJECT	
1	LS1	80x11'x45"					31				
2	0-1						32				
3	1-2						33				
4	2-3						34				
5	3-4						35				
6							36				
7							37				
8							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				

Film graded by  
Verlin Jacobs  
Level II

## RADIOGRAPHIC SET-UP

**A** Contact Method ☐ **B** Panoramic Method ☐ **C** Elliptical Method ☐ **D** Superimposed Method ☐ **E** ☒ Long Beam

MAT'L Steel O.F.D. 1.125" DIAMETER 80" TECHNIQUE NO. KT06-REV10  
SOD 16" ma or ci 130ci FOCAL 16.8" FILM D7 SCREENS LEAD 010"  
I.Q.I. 016" EXP. TIME 50 sec FILM PROCESSING Auto 800N TEMP. 31°C UG. 011"  
VOLTAGE \_\_\_\_\_ ISOTOPE IR 192 Other \_\_\_\_\_ Customer Representative Verlin Jacobs  
No. of Welds Checked: 1 No. of Film/Holder: 1 Date 1-3-06  
Linear Ft. Film 45 ft Type 4 1/2 x 17 D7 Technician: Verlin Jacobs Level: II  
Hours Worked: 3 Assistant: \_\_\_\_\_  
Stand-By Time: \_\_\_\_\_ Subsistence (check if applicable) \_\_\_\_\_ Assistant: \_\_\_\_\_  
Travel Time: \_\_\_\_\_ Mileage \_\_\_\_\_ Unit No. \_\_\_\_\_



## GLOBAL X-RAY &amp; TESTING CORPORATION

JOEL MOREAU, President  
Residence: 985-446-6861Post Office Box 1536  
Morgan City, Louisiana 70381Bus: 985-631-2426  
Fax: 985-631-0093

## MT WORK REPORT

Report No. M 52203

CXT MPVWMOOL Rev. 14

CLIENT Oil State DATE 11/12/06  
 CONTRACTOR Oil State JOB LOCATION Highway Rd.  
 JOB NO. WFF 24005 CLIENT REPRESENTATIVE Craig H. Hagan  
 MT TECH. Marshall Allenman Level II REMARKS m.t. inspection

	WELD NO.	WALL THICKNESS	RECOMMENDATIONS			WELD NO.	WALL THICKNESS	RECOMMENDATIONS	
			✓ ACCEPT	REMARKS				✓ ACCEPT	REMARKS
1	100%	m.t.		inspection of all		52			as per on crane pedestal
2						53			
3	Weldment	Marshall 340 L.				54			
4						55			
5						56			
6		All welds accepted				57			
7						58			
8						59			
9						60			
10						61			
11						62			
12						63			
13						64			
14						65			
15						66			Total weld = 591"
16						67			Total Repair = 0"
17						68			
18						69			
19						70			
20						71			
21						72			
22						73			
23						74			
24						75			
25						76			
26						77			
27						78			
28						79			
29						80			1 Can High Lites
30									
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 Electro Spec MODEL ES-X S/N 9572

## CONTRACTS

 PROD SPACING 6" 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: 1/12/05

## ACCEPTANCE CRITERIA

AWS D1.1 Sect. 6.10  
Latest Edition

TOTAL TIME HRS.

(2)



## GLOBAL X-RAY &amp; TESTING CORPORATION

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Morgan City, Louisiana 70381Bus: 985-631-2426  
Fax: 985-631-0093

## MT WORK REPORT

Report No. M 52158

GXT MPVWM 001 Rev. 14

CLIENT Oelsteb DATE 1/11/06  
 CONTRACTOR Oelsteb JOB LOCATION Mulberry Rd.  
 JOB NO. WO# 24005 CLIENT REPRESENTATIVE Craig H. Toole  
 MT TECH. Marshall Allman Level II REMARKS M.T. inspection

	WELD NO.	WALL THICKNESS	RECOMMENDATIONS				WELD NO.	WALL THICKNESS	RECOMMENDATIONS		
			✓ X	ACCEPT REJECT	REMARKS				✓ X	ACCEPT REJECT	REMARKS
1	100%	M.T.			inspection of barrel	51	flange			with weld on crane pedestal	
2						52					
3	Weldment				Model 3401	53					
4						54					
5		80" x 1"				55					
6						56					
7						57					
8						58					
9						59					
10						60					
11						61					
12						62					
13						63					
14						64					
15						65				Total weld = 251"	
16						66				Total Power = 0"	
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 Eaton spec MODEL ESIX S/N 2572CONTRACTS  
PROD SPACING 6" CONTINUOUS (✓)  
AC (✓) DC ( ) HALF WAVE ( ) FULL WAVE ( )  
AMPS 5.75MEDIA  
7C-BLACK WET (✓) 8A-DRY ( ) WHITE HIGHLIGHTER (✓)CALIBRATION  
10# WEIGHT LIFT (✓) FLUX IND. CHECK ( )  
CALIBRATION DATE: 1/11/06

ACCEPTANCE CRITERIA

WAS D11 8-21-06  
1st test EditionTOTAL TIME HRS. (1)





# 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

## UT WORK REPORT

61441

BT—BURN THROUGH  
BTA—BURN THROUGH AREA  
C—CRACK  
IU—INTERNAL UNDERCUT

LC—LOW CROWN  
LP—LACK OF PENETRATION  
NF—NON FUSION  
NW—NARROW WELD

OU—OUTSIDE UNDERCUT  
P—POROSITY  
SI—SLAG INCLUSIONS  
SL—SLAG LINES

GXT UT 003 Rev. 11

CLIENT Oil States  
CONTRACTOR Oil States  
JOB NO. NO. 24005  
UT TECH. Reeie Corneier Level II

DATE 1/11/06  
JOB LOCATION Maiberry Rd.  
CLIENT'S REPRESENTATIVE Craig Thibodeaux  
REMARKS UT inspection

	WELD NO.	WALL THICKNESS	RECOMMENDATION		REMARKS		WELD NO.	WALL THICKNESS	RECOMMENDATION		REMARKS
			✓ X	ACCEPT REJECT					✓ X	ACCEPT REJECT	
1	100%	UT inspection of base metal			5th Flange 3rd weld on		51				
2							52				
3	Crane pedestal weldment	Model 340L					53				
4							54				
5	80" X 1"	✓					55				
6							56				
7							57				
8							58				
9	100%	Lamination scan of base metal			2nd Flange 3rd weld on		59				
10							60				
11	Crane pedestal weldment	Model 340L					61				
12							62				
13	1"	✓					63				
14							64				
15							65				
16							66				
17	100%	Lamination scan of Crane pedestal Flange			Model 340L		67				
18							68				
19	3"	✓					69				
20							70				
21							71				
22							72				
23							73				
24							74				
25							75				
26							76				Total weld = 251"
27							77				Total pipe = 0"
28							78				
29							79				
30							80				

### EQUIPMENT

KRAUT KRAMER Epoch HB  
TRANSDUCER (M H Z) 2.25  
ANGLE USED 50°, 60°, 45° & straight Beam  
REFERENCE STANDARD ASME Sect. 6 (specifically located)  
ASTM A578 Level B

### CALIBRATION

db Gain \_\_\_\_\_ Sweep Delay \_\_\_\_\_  
Zero Delay \_\_\_\_\_ Reference Level \_\_\_\_\_  
SUBSTANCES \_\_\_\_\_  
AUTO TRANSPORTATION MILES \_\_\_\_\_  
WATER TRAVEL TIME HRS. \_\_\_\_\_  
LAND TRAVEL TIME HRS. \_\_\_\_\_  
WORK TIME HRS. \_\_\_\_\_  
STANDBY TIME HRS. \_\_\_\_\_  
TOTAL TIME HRS. 2





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# Material Traceability Log

CRANE WO. NO.:	24005
CUSTOMER:	PEMEX
WELDMENT PART NO.:	N61584-001
WELDMENT S/N:	05307-02
DESCRIPTION:	Upperstructure Weldment
MODEL:	340LA-100
CHECKED BY:	<i>[Signature]</i>
DATE:	12-14-05

[illegible]



ISG PLATE INC. 3<sup>1</sup>

## TEST CERTIFICATE

## SHIP TO:

LONGHORN STEEL & FLAMECUTTING  
C/O A&L TRUCKING  
PTRA SPUR 23  
HOUSTON TX 77041PAGE NO: 01 OF 02  
FILE NO: 4725-01-  
MILL ORDER NO: 31653-00  
MELT NO: U6835  
SLAB NO: 3  
DATE: 07/27/05

## SOLD TO:

LONGHORN STEEL & FLAMECUTTING,  
INC.  
11921 FM 529 ROAD  
HOUSTON TX 77041-3011

## SEND TO:

LONGHORN STEEL & FLAMECUTTING,  
INC.  
11921 FM 529 ROAD  
HOUSTON, TX 77041-3011

02

## P L A T E   D I M E N S I O N S   /   D E S C R I P T I O N

TOTAL QTY	GAUGE	WIDTH	LENGTH	DESCRIPTION	PIECE WEIGHT
1	3"	85"	510"	RECTANGLE	36882#

## C U S T O M E R   I N F O R M A T I O N

CUSTOMER PO: 320958

## S P E C I F I C A T I O N ( S )

THIS MATERIAL HAS BEEN MANUFACTURED AND TESTED IN ACCORDANCE WITH PURCHAS  
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

ASTM A537 95 CL 1 MOD CB .04 MAX, ABS PART-2-

SECT-3 03 GRS DH36/EH36 &amp; ASTM A633 01 GR C

MATERIAL PRODUCED UNDER A CERTIFIED QUALITY MGMT SYSTEM COMPLYING WITH  
ISO 9001 ABS-QE CERT. NO. 30130

## C H E M I C A L   C O M P O S I T I O N

25500

MELT:U6835	C	MN	P	S	CU	SI	NI	CR	MO
	.16	1.43	.008	.003	.15	.29	.08	.10	.02
MELT:U6835	V	TI	B	AL	CB	CA	N	CEF	
	.001	.004	.0002	.041	.029	.002	.0089	.44	

CARBON EQUIVALENT FORMULA (CEF)

$$CEF = C + (MN * .1667) + ((CR + MO + V) * .2000) + ((CU + NI) * .0667)$$

## M A N U F A C T U R E

FINELINE - VACUUM DEGASSED - FINE GRAIN PRACTICE

PA631043

WE HEREBY CERTIFY THE ABOVE  
INFORMATION IS CORRECT:QUALITY ASSURANCE LABORATORY  
COATESVILLE, PA 19320SUPERVISOR - TEST REPORTING  
ELINORE ZAPLITNY



ISG PLATE INC.

## TEST CERTIFICATE

PAGE NO: 02 OF 0:  
FILE NO: 4725-01  
MILL ORDER NO: 31653-01  
MELT NO: U6835  
SLAB NO: 3  
DATE: 07/27/01

## HEAT TREAT CONDITION

MATL OR TEST	HEAT TREAT DESCRIPTION	NOM TEMP	HOLD MINS	COOL MTHD
PL/TEST	NORMALIZE	1650F	91	AIR COOL

## TENSILE PROPERTIES

SLAB NO.	LOC	DIR	YIELD STRENGTH PSI X 100	TENSILE STRENGTH PSI X 100	ELONGATION GAGE LGTH	%	%R.A.
3	BOT.	THRU GA.					73.0
3	TOP.	THRU GA.					53.0
3	BOT.	TRANS.	575	782	2.00"	27.0	

## CHARPY V-NOTCH IMPACT RESULTS

SLAB	LOC	DIR	TEMP	SIZE	FT. LBS.
3	BOT.	TRANS.	-40F	FULL	106 107 108

## 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 DEGASSED AND CALCIUM TREATED  
FOR SULFIDE SHAPE CONTROL.  
FINELINE MOD FOR SULPHUR

B/L #01494 SOU 152018

WE HEREBY CERTIFY THE ABOVE  
INFORMATION IS CORRECT:

QUALITY ASSURANCE LABORATORY  
COATESVILLE, PA 19320

SUPERVISOR - TEST REPORTING  
ELINORE ZAPLITNY

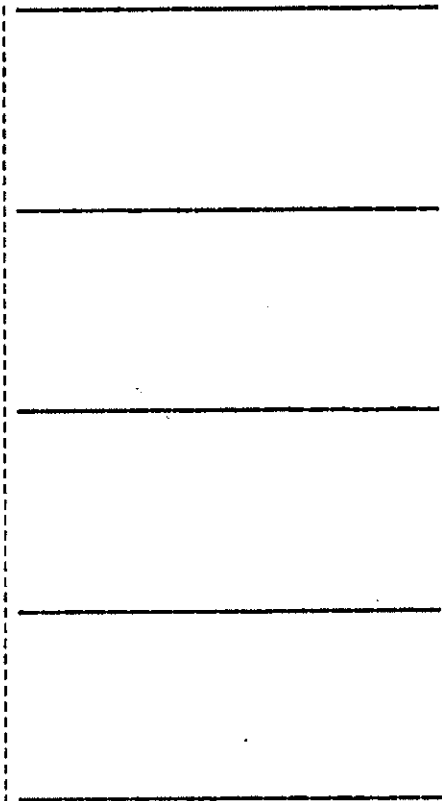
9/22  
12-2-06



REPORT #: TLN115      J. PLATE INC.      Q.A.-INSPECTION DEPARTMENT      DATE: 06/02/2005  
UT NON-DESTRUCTIVE TESTING REPORT

CUSTOMER: LONGS&F      ORDER/ITEM NO: 31653 - 003 INSPECTOR: G. BOOTS  
MATERIAL SPECIFICATION: API 2H-8TH-EDITION 99 50      (LEVEL I SNT-TC-1A)  
CUST NO: 4725-01-02 PURCH ORD NO: 320958  
PART NO:      WITNESSED BY:  
NDE SPEC: A578-85 L-2 9" GRIDS      MARK NO:  
GAUGE: 3.000000      WIDTH: 85.000000      LENGTH: 510.000000      UT: SB  
DIV-LTR: X CHARGE: 17904 POS: 04 PATT: 001 MELT: U6835      SLAB: 03      COUPLANT: SOAP&WATER  
EQUIPMENT USED: PAN EPOCH IIIB SERIAL NUM: 138      CALIB DATE: 09/02/2005  
METHOD: CONTACT      AMPLITUDE: 75      GRID REF: 9"  
TRANSDUCER: AEROTECH      SIZE: 1.000      FREQ: 2.2500      TYPE OF SURFACE: AS ROLLED

LOC-1:



LOC-2

LOC-4

LOC-3:

HEREBY CERTIFY THAT THE ABOVE MATERIAL MEETS THE NON-DESTRUCTIVE TEST REQUIREMENTS FOR THE ABOVE SPECIFICATION. KNOWINGLY OR WILLINGLY RECORDING FALSE, FICTITIOUS, OR FRAUDULENT STATEMENTS ON ENTRIES ON THIS DOCUMENT MAY BE PUNISHED AS A FELONY UNDER FEDERAL STATUTES INCLUDING FEDERAL LAW, TITLE 18, CHAPTER 47.

MICHAEL HARTZ

INSPECTION SUPERVISOR  
LEVEL II SNT-TC-1A

12-205



ASTM A36  
2" X 120.0000" X 480.0000"  
PART NO.

**Attn:**

A36D 211

0002

**P.O. Box 279**

Winston, NC 27986

## PLATE MILL

(252) 356-3700

# Mill Test Report

Page 3

BA No. : 199640

**Load No.: 111720**

Vehicle No: ATW 53058

**Specification : 2.0000" x 120.000" x 430.000"**

ASTM A36-05/ASTM A709 Grade 36-05/ASME SA36-03

**Our Order No.:** 3852411

2014-01-01 00:00:00

Longhorn Steel  
Northwoods Industries

Longhorn Steel & Fabricating  
Northwoods Industrial Park East

Northwoods Industries

Houston, TX 77041

Cust. Order No.: HOU-2528

**Ship To:**

## Longhorn Steel & Flamecutting

11921 FM 529

Houston, TX 77041

**Marking :**

Heat No	C	Mn	P	S	Si	Cu	NI	Cr	Mo	Alz	V	Nb	Ti	N	Ca	B	Sn	CEQ	PCM
5108325	0.19	0.89	0.013	0.001	0.19	0.28	0.09	0.11	0.01	0.008	0.004	0.001	0.001	0.0090	0.0024	0.0003	0.006	0.38	0.28

[illegible]

↑  
24614  
24615

9-8-71

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.

Manufactured to fully filled practice by Electric Arc Furnace. Welding or weld repair was not performed on this material.  
Mercury has been used in the direct manufacturing of this material. Produced as continuous cast air-cooled discrete plate.  
This material was made in the same plant as:  
C-60487, C-60490, C-60491, C-60492, C-60493, C-60494, C-60495, C-60496, C-60497, C-60498, C-60499, C-60500, C-60501, C-60502, C-60503, C-60504, C-60505, C-60506, C-60507, C-60508, C-60509, C-60510, C-60511, C-60512, C-60513, C-60514, C-60515, C-60516, C-60517, C-60518, C-60519, C-60520, C-60521, C-60522, C-60523, C-60524, C-60525, C-60526, C-60527, C-60528, C-60529, C-60530, C-60531, C-60532, C-60533, C-60534, C-60535, C-60536, C-60537, C-60538, C-60539, C-60540, C-60541, C-60542, C-60543, C-60544, C-60545, C-60546, C-60547, C-60548, C-60549, C-60550, C-60551, C-60552, C-60553, C-60554, C-60555, C-60556, C-60557, C-60558, C-60559, C-60560, C-60561, C-60562, C-60563, C-60564, C-60565, C-60566, C-60567, C-60568, C-60569, C-60570, C-60571, C-60572, C-60573, C-60574, C-60575, C-60576, C-60577, C-60578, C-60579, C-60580, C-60581, C-60582, C-60583, C-60584, C-60585, C-60586, C-60587, C-60588, C-60589, C-60590, C-60591, C-60592, C-60593, C-60594, C-60595, C-60596, C-60597, C-60598, C-60599, C-60600, C-60601, C-60602, C-60603, C-60604, C-60605, C-60606, C-60607, C-60608, C-60609, C-60610, C-60611, C-60612, C-60613, C-60614, C-60615, C-60616, C-60617, C-60618, C-60619, C-60620, C-60621, C-60622, C-60623, C-60624, C-60625, C-60626, C-60627, C-60628, C-60629, C-60630, C-60631, C-60632, C-60633, C-60634, C-60635, C-60636, C-60637, C-60638, C-60639, C-60640, C-60641, C-60642, C-60643, C-60644, C-60645, C-60646, C-60647, C-60648, C-60649, C-60650, C-60651, C-60652, C-60653, C-60654, C-60655, C-60656, C-60657, C-60658, C-60659, C-60660, C-60661, C-60662, C-60663, C-60664, C-60665, C-60666, C-60667, C-60668, C-60669, C-60670, C-60671, C-60672, C-60673, C-60674, C-60675, C-60676, C-60677, C-60678, C-60679, C-60680, C-60681, C-60682, C-60683, C-60684, C-60685, C-60686, C-60687, C-60688, C-60689, C-60690, C-60691, C-60692, C-60693, C-60694, C-60695, C-60696, C-60697, C-60698, C-60699, C-60700, C-60701, C-60702, C-60703, C-60704, C-60705, C-60706, C-60707, C-60708, C-60709, C-60710, C-60711, C-60712, C-60713, C-60714, C-60715, C-60716, C-60717, C-60718, C-60719, C-60720, C-60721, C-60722, C-60723, C-60724, C-60725, C-60726, C-60727, C-60728, C-60729, C-60730, C-60731, C-60732, C-60733, C-60734, C-60735, C-60736, C-60737, C-60738, C-60739, C-60740, C-60741, C-60742, C-60743, C-60744, C-60745, C-60746, C-60747, C-60748, C-60749, C-60750, C-60751, C-60752, C-60753, C-60754, C-60755, C-60756, C-60757, C-60758, C-60759, C-60760, C-60761, C-60762, C-60763, C-60764, C-60765, C-60766, C-60767, C-60768, C-60769, C-60770, C-60771, C-60772, C-60773, C-60774, C-60775, C-60776, C-60777, C-60778, C-60779, C-60780, C-60781, C-60782, C-60783, C-60784, C-60785, C-60786, C-60787, C-60788, C-60789, C-60790, C-60791, C-60792, C-60793, C-60794, C-60795, C-60796, C-60797, C-60798, C-60799, C-60800, C-60801, C-60802, C-60803, C-60804, C-60805, C-60806, C-60807, C-60808, C-60809, C-60810, C-60811, C-60812, C-60813, C-60814, C-60815, C-60816, C-60817, C-60818, C-60819, C-60820, C-60821, C-60822, C-60823, C-60824, C-60825, C-60826, C-60827, C-60828, C-60829, C-60830, C-60831, C-60832, C-60833, C-60834, C-60835, C-60836, C-60837, C-60838, C-60839, C-60840, C-60841, C-60842, C-60843, C-60844, C-60845, C-60846, C-60847, C-60848, C-60849, C-60850, C-60851, C-60852, C-60853, C-60854, C-60855, C-60856, C-60857, C-60858, C-60859, C-60860, C-60861, C-60862, C-60863, C-60864, C-60865, C-60866, C-60867, C-60868, C-60869, C-60870, C-60871, C-60872, C-60873, C-60874, C-60875, C-60876, C-60877, C-60878, C-60879, C-60880, C-60881, C-60882, C-60883, C-60884, C-60885, C-60886, C-60887, C-60888, C-60889, C-60890, C-60891, C-60892, C-60893, C-60894, C-60895, C-60896, C-60897, C-60898, C-60899, C-60900, C-60901, C-60902, C-60903, C-60904, C-60905, C-60906, C-60907, C-60908, C-60909, C-60910, C-60911, C-60912, C-60913, C-60914, C-60915, C-60916, C-60917, C-60918, C-60919, C-60920, C-60921, C-60922, C-60923, C-60924, C-60925, C-60926, C-60927, C-60928, C-60929, C-60930, C-60931, C-60932, C-60933, C-60934, C-60935, C-60936, C-60937, C-60938, C-60939, C-60940, C-60941, C-60942, C-60943, C-60944, C-60945, C-60946, C-60947, C-60948, C-60949, C-60950, C-60951, C-60952, C-60953, C-60954, C-60955, C-60956, C-60957, C-60958, C-60959, C-60960, C-60961, C-60962, C-60963, C-60964, C-60965, C-60966, C-60967, C-60968, C-60969, C-60970, C-60971, C-60972, C-60973, C-60974, C-60975, C-60976, C-60977, C-60978, C-60979, C-60980, C-60981, C-60982, C-60983, C-60984, C-60985, C-60986, C-60987, C-60

\*Part = C-58309-A6-ZN7-CurZn-#6601-#C2DZ-#Mar15-V1101-ES  
Modelled and manufactured in the USA. ISO 9001-2000 certified (#12443-0). by SFI Quality Systems Registrar (#0805-09). PED 97/23/CE Conformant.  
EN 50448 3.1 BVEN 10204 3.1 SP2004 compliant. For ABS cradles only. Quality Assurance certificate No. 03-MAFQA-187

T. A. D. D. D.

FD-36 (Rev. 5-22-64)



# Charpy Impact Test Report

Date Received:	11/21/2005	Specification:	A370	Rev.	02	Report#:	051372
Date Completed:	11/22/2005	Procedure:		Rev.		Revision:	1
Customer:		Deviations:	N/A			P.O.#:	322369
Longhorn Steel		Temperature Measuring Device:	Tegam			Page 1 of 1	
Address:		Serial #:	T-159722			Direction:	Longitudinal
11921 FM 529 Houston, TX. 77041		Cal Due:	12/16/2005			Temp.:	+10 F
Material Tested	BHN	Size	Heat #	Units	Results		
A36		1"	S02497	FT/LB	A	B	C
A36		2"	5106325	FT/LB	280	176	139
					62	52	44
							52.7
Additional Data					Lateral Expansion		
Material Tested	A	B	C	Avg.	A	B	C
A36	No Break	100%	100%	100%	N/B	0.081	0.089
A36	40%	40%	40%	40%	0.035	0.035	0.031
							0.034
Comments:					Impact Tester:	SI-1K3	
					Serial #:	1768	
					Cal Due:	12/16/2005	

All tests are performed using calibrated equipment on samples provided by the customer above, unless noted in the data section. This data applies only to samples tested by TQs, Inc. This test report may be reproduced in its entirety without permission from TQS, Inc. All requirements of TQS, Inc. Quality Assurance Program, Rev. A, Dated 7/10/96 have been fulfilled.

Inspected by: Gary Garceau  
Signature: \_\_\_\_\_ Date: 11/28/2005



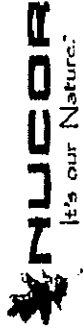
A36D LK

**NUCOR**  
PLATE MILL

P.O. Box 278  
Winton, NC 27986  
(252) 356-3700

# Mill Test Report

Page 1



Issuing Date: 03/26/2004  
Vehicle No: ALY 91727  
Specification: 1.0000" x 96.000" x 240.000"  
ASTM A36/A36M A709 Grade 36-44/ASME SA36-96

Load No.: 81802  
Our Order No.: 27160/21  
Ship To: Longhorn Steel & Flamingcutting  
Northwoods Industrial Park East  
11921 FM 529  
Houston, TX 77041

Cust. Order No.: 6992  
Ship To: Longhorn Steel & Flamingcutting  
Northwoods Industrial Park East  
11921 FM 529  
Houston, TX 77041

Marking:

Heat No	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Alz	V	Nb	Ti	N	Ca	B	Sn	CEQ	PCM
4106299	0.19	0.91	0.012	0.008	0.22	0.25	0.09	0.13	0.02	0.012	0.011	0.002	0.001	0.0101	0.0015	0.0001	0.012	0.39	0.26
Plate Serial No	Tensile Test										Charpy Impacts								
	Pieces	Dir.	Yield (ksi)	Tensile (ksi)	Elongation % in 2"	Elongation % in 8"	Dir.			1	2	3	Ave.	(%) shear	(%) shear	Size	Temp	Ave.	

25596  
25609

03/27/2004 3:39:25 PM

Manufactured to fully killed practice. 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 are in accordance with the requirements of the specification. Operations performed by the manufacturer are in accordance with the applicable standards.

APC  
12-2-05



**The Quality Source**

**Phone: 281-449-5228**

**Fax: 281-449-8699**

**14610 Sheraton**


Houston, TX 77039

# Charpy Impact Test Report

Date Received:	8/31/2005	Specification:	A370	Rev.	02	Report#:	051019
Date Completed:	9/1/2005	Procedure:		Rev.		Revision:	0
Customer:		Deviations:	N/A			P.O.#:	321897
Longhorn Steel		Temperature Measuring Device:	Tegam			Page 1 of 1	
Address:		Serial #:	T-159722			Direction:	Longitudinal
11921 FM 529 Houston, TX 77041		Cal Due:	12/16/2005			Temp.:	+10 F
Material Tested	BHN	Size	Heat #	Units		Results	
A36		5"	S00334	FT/LB		A	Avg.
A36		.75"	A5P0775	FT/LB		142	180.7
A36		1"	4106298	FT/LB		78	73.7
A36		1.5"	5103262-03	FT/LB		79	89.7
A36		2"	E5F110-C11-A04	FT/LB		298	297.7
						295	297.0
Additional Data	Lateral Expansion						
Material Tested	A	B	C	Avg.	A	B	C
A36	85%	85%	85%	85%	0.019	0.014	0.018
A36	40%	40%	40%	40%	0.018	0.018	0.024
A36	60%	60%	60%	60%	0.019	0.062	0.023
A36	N/B	N/B	N/B		N/B	N/B	N/B
A36	N/B	N/B	N/B		N/B	N/B	N/B
Comments:	Impact Tester: SI-1K3						
	Serial #: 1768						
	Cal Due: 12/16/2005						

All tests are performed using calibrated equipment on samples provided by the customer above, unless noted in the data section. This data applies only to samples tested by TQs, Inc. This test report may be reproduced in its entirety without permission from TQs, Inc. All requirements of TQs, Inc. Quality Assurance Program, Rev. A, Dated 7/10/96 have been fulfilled.

Inspected by: Gary Garceau

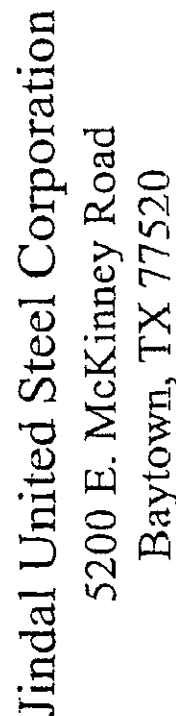
Signature: 

Date: 9/1/2005

12-1-05  
JL



A 36D I''



# METALLURGICAL TEST REPORT

NET-04  
IC No.: BR31438-2497-01

Sold To:	Ship To:
Longhorn Steel & Flamecutting Northwoods Industrial Park East 11921 FM 529 Houston, TX 77041	Longhorn Steel & Flamecutting Northwoods Industrial Park East 11921 FM 529 Houston, TX 77041
Plates Manufactured in the USA	Order No: JUS1321-10
	Date: 10/7/2005 P.O. Number: HOU-2464
<b>Specifications:</b> <b>HOT ROLLED PLATE CUT EDGE ASTM A36 -05 / ABS GR A / A709 - 05 GR 36</b> <b>STRUCTURAL QUALITY</b>	
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."
Approved By: <i>[Signature]</i>	Shipping Mode: DIRECT TRUCK DIN 50049 3.1.B / EN 10204 3.1.B
Bulletin Num. 3143R	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

AMERICAN BUREAU OF SHIPPING

Item No.	Material Description			Bulletin		Heat No.	Gauge Tested	Test Plate Identity	Yield Point (KSI)	Tensile Strength (KSI)	Elongation (%)		Yield Strength Determined at
	Gauge	Width	Length	Qty	Wgt						in 8"	in 2"	
10	1.0000	120.0000	480.0000	1	16,335	S02497	1.000	07D	51	71	24		0.2%
<i>(Handwritten signature across plate)</i> H5640 CUBX													

Heat No.: S02497 CE-0.31

Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mn	Sn	Al	N	V	Ti	Cb
LADLE	0.11	1.10	0.014	0.014	0.28	0.02	0.03	0.03	0.010	0.001	0.035	0.006	0.005	0.0010	0.010

12-2-85



## ४८

12-2-05





# SMI Steel - Alabama and South Carolina

SMI Steel - Alabama  
P.O. Box 321188  
Birmingham, AL 35232-1188  
www.smi-al.com

SMI Steel - South Carolina  
Box 2005  
Cayce, SC 29171-2005  
www.smi-sc.com

## CERTIFIED MILL TEST REPORT

For additional copies call  
(800) 637-3227

We hereby certify that the test results presented here  
are accurate and conform to the reported grade specification.

*Richard S. Bay*  
Richard S. Bay - SMI-SC  
Quality Assurance Manager

HEAT NO.: 72155		SABEL STEEL CO		SABEL STEEL		SHIP#: 300040/262														
SECTION: F 4x14x20"		PO BOX 4747		1500 CHIPPEWA ST		BOL #: 503770														
GRADE: ASTM A36-04/A529-04 GRADE 50		D MONTGOMERY, AL 36103-		I BATON ROUGE, LA 70892-		INV #:														
		T O		T O		CUST PO#: 44358														
		T O		T O		CUST P/N:														
CHEMICAL ANALYSIS			MECHANICAL			TEST 1			TEST 2			TEST 3								
%						IMPERIAL			METRIC			IMPERIAL			METRIC					
C	0.14		Yield Strength			51.9 KSI	357.9 MPa	51.9 KSI	357.9 MPa	51.9 KSI	357.9 MPa									
Mn	0.84		Tensile Strength			73.1 KSI	504.1 MPa	73.3 KSI	505.5 MPa	73.3 KSI	505.5 MPa									
P	0.008		Elongation			30 %	30 %	30 %	30 %	30 %	30 %									
S	0.038		Gauge Length			8 INS	203 MM	8 INS	203 MM	8 INS	203 MM									
Si	0.20		Reduction of Area																	
Cu	0.38		Bend Test																	
Cr	0.09		Diameter																	
Ni	0.13		Charpy Impact																	
Mo	0.034		Test Temp																	
Cb	0.002		Sample Size																	
V	0.000		Orientation																	
Sn			Hardness																	
B																				
Ti																				
C.Eq.	0.34																			
JOMINY RESULTS - Rockwell C hardness at 1/16th inch increments															GRAIN SIZE			INCLUSION RATING		
1	2	3	4	5	6	7	8	9	10	11	12	METHOD								
13	14	15	16	18	20	22	24	26	28	30	32	RESULT			TYPE					
															SIZE					
															H T H T H T H					

100% MELTED AND MANUFACTURED IN THE USA AND FREE OF MERCURY CONTAMINATION IN THE PROCESS  
REMARKS:

*11-29-05*  
11-29-05





# 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

## UT WORK REPORT

61304

BT—BURN THROUGH  
BTA—BURN THROUGH AREA  
C—CRACK  
IU—INTERNAL UNDERCUT

LC—LOW CROWN  
LP—LACK OF PENETRATION  
NF—NON FUSION  
NW—NARROW WELD

OU—OUTSIDE UNDERCUT  
P—POROSITY  
SI—SLAG INCLUSIONS  
SL—SLAG LINES

CLIENT Oil Station DATE 12/2/05  
CONTRACTOR Oil Station JOB LOCATION Mulberry Rd.  
JOB NO. NO 24005 CLIENT'S REPRESENTATIVE Craig Thibodeaux  
UT TECH. Mitch Helbert Level II REMARKS Lamination scan

	WELD NO.	WALL THICKNESS	RECOMMENDATION		REMARKS		WELD NO.	WALL THICKNESS	RECOMMENDATION		REMARKS
			✓	✗					✓	✗	
1	100%	Lamination scan				51	upper structure				Base plate
2						52					
3	Mitch 340 L B. pre welding					53					
4						54					
5						55					
6	3"	✓				56					
7						57					
8						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					

### EQUIPMENT

KRAUT KRAMER EPG 11 HB  
TRANSDUCER (M H Z) 2.25  
ANGLE USED Straight Beam  
REFERENCE STANDARD ASNT Level B

### CALIBRATION

db Gain \_\_\_\_\_ Sweep Delay \_\_\_\_\_  
Zero Delay \_\_\_\_\_ Reference Level \_\_\_\_\_

SUBSISTANCES \_\_\_\_\_

AUTO TRANSPORTATION MILES \_\_\_\_\_

WATER TRAVEL TIME HRS. \_\_\_\_\_

LAND TRAVEL TIME HRS. \_\_\_\_\_

WORK TIME HRS. \_\_\_\_\_

STANDBY TIME HRS. \_\_\_\_\_

TOTAL TIME HRS. (2)





# 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

## UT WORK REPORT

61357

BT—BURN THROUGH  
BTA—BURN THROUGH AREA  
C—CRACK  
IU—INTERNAL UNDERCUT

TERMS AND ABBREVIATIONS  
LC—LOW CROWN  
LP—LACK OF PENETRATION  
NF—NON FUSION  
NW—NARROW WELD

OU—OUTSIDE UNDERCUT  
P—POROSITY  
SI—SLAG INCLUSIONS  
SL—SLAG LINES

CLIENT Oil & Gas DATE 12/15/05  
CONTRACTOR Oil & Gas JOB LOCATION Mulberry Rd.  
JOB NO. W0 24005 CLIENT'S REPRESENTATIVE Clay Thibodeau  
UT TECH. Paul Gervise Level II REMARKS Lamination seen

	WELD NO.	WALL THICKNESS	RECOMMENDATION		REMARKS		WELD NO.	WALL THICKNESS	RECOMMENDATION		REMARKS
			✓	✗					✓	✗	
1	100%	Lamination seen			of upper structure base plate after						
2											
3											
4											
5											
6		3"									
7											
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48											
49											

### EQUIPMENT

KRAUT KRAMER Epoch 4B  
TRANSDUCER (M H Z) 2.25  
ANGLE USED Straight Beam  
REFERENCE STANDARD new Block  
ASTM A578 Level B

### CALIBRATION

db Gain \_\_\_\_\_ Sweep Delay \_\_\_\_\_  
Zero Delay \_\_\_\_\_ Reference Level \_\_\_\_\_  
SUBSTANCES \_\_\_\_\_  
AUTO TRANSPORTATION MILES \_\_\_\_\_  
WATER TRAVEL TIME HRS. \_\_\_\_\_  
LAND TRAVEL TIME HRS. \_\_\_\_\_  
WORK TIME HRS. \_\_\_\_\_  
STANDBY TIME HRS. \_\_\_\_\_  
TOTAL TIME HRS. 2



# GLOBAL X-RAY & TESTING CORPORATION

JOEL MOREAU, President  
Residence: 504-446-6861

Post Office Box 1536  
Morgan City, Louisiana 70381  
Bus: 504-631-2426  
Fax: 504-631-0093

## MT WORK REPORT

Report No. M  
24545

GXT MPVW model Rev. 14

CLIENT Oil state DATE 4/8/06  
CONTRACTOR Oil state JOB LOCATION Mulberry Rd.  
JOB NO. 24005 CLIENT REPRESENTATIVE Craig Philbeck  
MT TECH. Levi Cormier Level II REMARKS m.t. inspection

WELD NO.	WALL THICKNESS	RECOMMENDATIONS		WELD NO.	WALL THICKNESS	RECOMMENDATIONS	
		ACCEPT X	REJECT			REMARKS	ACCEPT X
1	100% M.T.			51			
2				52			
3	Weldment Model 340			53			
4				54			
5				55			
6	All welds accepted			56			
7				57			
8				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			
31							
32							
33							
34							
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50							

100% M.T. inspection of all welds on apparatus  
Weldment Model 340  
All welds accepted  
Total weld = 1760"  
Total Repair = 0"  
2 Cons Highliter

**SURFACE CONDITION**  
GOOD (✓) FAIR ( ) PAINTED ( ) WELD (✓)

**EQUIPMENT**  
MAKE Electro spec MODEL ES-1X S/N 9572

**CONTRACTS**  
PROD SPACING 6" 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: 4/8/06

**ACCEPTANCE CRITERIA**  
AWS D1.1 Sect. 6.10 (latest Edition)

TOTAL TIME HRS. 2



# GLOBAL X-RAY & TESTING CORPORATION

JOEL MOREAU, President  
Residence: 504-446-6861

Post Office Box 1536  
Morgan City, Louisiana 70381

Bus: 504-631-2426  
Fax: 504-631-0093

## MT WORK REPORT

Report No. M  
24531

GXT-mpuwm-001-Rev.14

CLIENT Oilstates DATE 4-5-06  
CONTRACTOR Oilstates JOB LOCATION Mulhenny Rd.  
JOB NO. W0# 24005 CLIENT REPRESENTATIVE Craig Hildreth  
MT TECH. Mitchell Helbert Level III REMARKS MT Insp.

WELD NO.	WALL THICKNESS	RECOMMENDATIONS		WELD NO.	WALL THICKNESS	RECOMMENDATIONS	
		✓ ACCEPT ✗ REJECT	REMARKS			✓ ACCEPT ✗ REJECT	REMARKS
1				51			
2	100% MT Insp. of Coverup			52			
3				53			
4	Welds on 340L			54			
5				55			
6	upper structure			56			
7				57			
8	✓			58			
9				59			
10				60			
11	TOTAL inches = 50"			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			
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50							

**SURFACE CONDITION**  
GOOD (✓) FAIR ( ) PAINTED ( ) WELD ( )

**EQUIPMENT**  
MAKE Ektaspro MODEL ES-X S/N 9453

**CONTRACTS**  
PROD SPACING 3-6" 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: 4-5-06

**ACCEPTANCE CRITERIA**  
AWS D11 Section 10, statically loaded  
latest edition

TOTAL TIME HRS. 1.5





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# Material Traceability Log

CRANE WO. NO.:	24005
CUSTOMER:	PEMEX
WELDMENT PART NO.:	N61586-001
WELDMENT S/N:	05333-03
DESCRIPTION:	Boom Base Weldment
MODEL:	340LA-100
CHECKED BY:	<i>Mike Little</i>
DATE:	1-19-06

[illegible]



Fax:3148519338

Dec 21 2005 14:44

P.08

DEC-20-05 16:28 FROM Independence Tube Corporation

+7085831950

T-896 P.002/017 R-238

15Dec05 10: 8 TEST CERTIFICATE

No: MAR 379254

Sold By: ✓

INDEPENDENCE TUBE CORPORATION

6826 W. 74TH STREET

CHICAGO, IL 60638

Tel: 708-494-0380 Fax: 708-563-1950

P/O No 4666

Rel

S/O No MAR 102289-001

B/L No MAR 63848-005

Inv No MAR -001

Shp

14Dec05

Inv

15Dec05

Sold To: ( 2025)

TUBULAR STEEL

1031 EXECUTIVE PKWY DR

ST. LOUIS, MO 63141-6351

Ship To: ( 2)

TUBULAR STEEL

27700 KATY-BROOKSHIRE

KATY, TX

Tel: 314-851-9200 Fax: 314 851-9336

## CERTIFICATE of ANALYSIS and TESTS

Cert. No: MAR 379254

15Dec05

Part No LINE 101

TUBING A500 GRADE A(C)

4" SQ X 1/2"

Pcs

Wgt

9

7,787

Heat Number

Tag No

E04699

947767

Pcs

Wgt

9

7,787

YLD=61260/TEN=27920/ELS=29.5

Heat Number

\*\*\* Chemical Analysis \*\*\*

E04699

C=0.2100 Mn=0.7800 P=0.0110 S=0.0050 Si=0.0120 Al=0.0430

Cu=0.0200

MELTED IN THE U.S.A.

MANUFACTURED IN THE U.S.A.

MEETS THE REQUIREMENTS OF ASTM A-500 GRADE C-01A



1-10-06









UNITED STATES STEEL

TUBULAR PRODUCTS  
CERTIFIED TEST REPORT

TIME: 13:41:01

(TYPE B - IN ACCORDANCE WITH ISO 10474/EN10204/DIN50049 3.1.b)

MILL ORDER/ITEM NO. DR26835 02	SHIPPER'S NO. 04-18283	P.O. NUMBER 04-18283	O.D.: 1.900 ( 48.260 )		I.D. (mm) WALL: 0.200 ( 5.080 )		In (mm)											
MATERIAL COND: AS ROLLED		CHARTER V-NOTCH IMPACT TESTING																
PRODUCT IDENTIFICATION  A83596	FLAT	BEND	GRAIN SIZE	MIN COLLAPSE	DIR	TEST LOC.	TEMP	SIZE	TEST COND.	% SHEAR								
										1	2	3						
DEG											1	2	3	AVG				
OK											END OF DATA THIS SHEET **							
LEGEND: L - LONGITUDINAL											T - TRANSVERSE		B - BODY		W - WELD		HAZ - HEAT AFFECTED ZONE	
TEST / INSPECTION											YES		RESULTS / COMMENTS					
FULL LENGTH VISUAL											X							
FULL LENGTH EM													OD _____ OD/ID _____ L/T _____					
FULL LENGTH MPI																		
FULL LENGTH UT													OD _____ OD/ID _____ L/T _____					
END AREA INSPECTION (PLAIN END)													MPI _____ UT _____					
SPECIAL END AREA (SEA) INSP.													MPI _____ UT _____					
FULL LENGTH DRIFT													DRIFT MANDREL SIZE: _____					
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: S. ANADELL - MANAGER, Q.A.

DATE 10/07/04





SOUTHERN TUBE, INC.  
3525 Richard Arrington Jr. Blvd. N.  
Birmingham, AL. 35234

Phone (205) 251-1884 Fax (205) 421-4561

TEST REPORT ASTM-E8

Customer: MARMON KEYSTONE-Tarrant

Print Date 05-10-06

Heat No.: S54841

Description: CARBON STEEL TUBE

Size: 4 X 6 X .250

SpecGrade: A500-03/B

Carbon: .040

Manganese: 1.120

Sulphur: .004

Phosphorus: .016

Silicon: .020

Sample number	Date	Tensile	Yield	Elongation
SL4147	05-09-28	67200	60300	23.50

We hereby certify that the above figures are correct as contained in the records of this company and that the tubing was manufactured, tested and inspected in compliance with applicable

Computer Generated Document  
Quality Assurance

Melted & Manufactured in the U.S.A.



Pickup # 10R022  
ITI Ord# 93917

Heat # S54841

Cust PO#54944

gpc  
12-8-05





www.TestMetals.com  
 213 Lyon Lane  
 Birmingham, AL 35211  
 205.940.9480  
 866.RUN.TEST

## REPORT OF ANALYSIS

**Marmon/Keystone Corporation**  
 Attention: Amanda Hathcock  
 105 Goodrich Drive  
 Tarrant, AL 35217-1465

Test Date: 12/05/2005  
 Report Date: 12/06/2005  
 Lab Number: 55108  
 P. O. Number: -

Sample Identification: (5) Sample Coupons

		SPECIMEN IDENTIFICATION					
Properties		Heat # C06435, 10" Sq. x 1/2" Wall x 8"			Heat # S548411, 6" x 4" x 1/4" Wall x 8"		
	Unit	Specimen #1	Specimen #2	Specimen #3	Specimen #1	Specimen #2	Specimen #3
Charpy Impact Testing							
Test Temperature	°F	+10	+10	+10	+10	+10	+10
Width x Thickness	mm	10 x 10	10 x 10	10 x 10	5 x 10	5 x 10	5 x 10
Absorbed Energy	ft-lbf	5	6	6	102	94	97
		Heat # A5W2454, 4" Sq. x 1/2" Wall x 8"			Heat # E04711, 4" Sq. x 1/2" Wall x 8"		
	Unit	Specimen #1	Specimen #2	Specimen #3	Specimen #1	Specimen #2	Specimen #3
Test Temperature	°F	+10	+10	+10	+10	+10	+10
Width x Thickness	mm	10 x 10	10 x 10	10 x 10	10 x 10	10 x 10	10 x 10
Absorbed Energy	ft-lbf	8	7	6	9	22	99
		Heat # B5W7575, 4" Sq. x 1/2" Wall x 8"					
	Unit	Specimen #1	Specimen #2	Specimen #3			
Test Temperature	°F	+10	+10	+10			
Width x Thickness	mm	10 x 10	10 x 10	10 x 10			
Absorbed Energy	ft-lbf	5	5	5			

Test Method(s): ASTM E23

Respectfully Submitted,  
**Materials Technology, Inc.**

Quality Assurance Representative

Tests and analysis performed in accordance with procedures derived from methods described and approved by the ASTM and other accepted industry practices. This report shall not be reproduced, except in full, without the prior written approval of Materials Technology, Inc.

Testing efforts were in accordance with MTI QA Program, Rev. 2 - February 15, 2002

Page 1 of 1

DEC 07 2005 10:57

2059409473

PAGE.01

\*\*\* TOTAL PAGE.02 \*\*\*





## Jindal United Steel Corporation

5200 E. McKinney Road

Baytown, TX 77520

**JINDAL**

## 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. 32051
Plates Manufactured in the USA		Order No: JUS1321-04		Approved By: <i>Helio Green</i>		
		Date: 11/1/2005	P.O. Number: HOU-2464	Shipping Mode: DIRECT TRUCK		
				DIN 50049 3.1.B / EN 10204 3.1.B		

## Specifications:

 HOT ROLLED PLATE CUT EDGE ASTM A36 -05 / ABS CR A / 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	Yield Point (KSI)	Tensile Strength (KSI)	Elongation (%)		Yield Strength Determined at
	Gauge	Width	Length	Qty	Wgt						in 8"	in 2"	
04	0.5000	96.0000	480.0000	1	6,534	S02548	0.750	01C	48	69	25		0.2%

Heat No. S02548 CE:0.33

Test Type	LADLE	P	S	SE	Cu	NI	Cr	Mn	Sn	Al	N	V	B	Ti	Ch
		5.010	0.0070	0.27	0.03	0.02	0.02	0.010	100.0	0.029	0.006	0.005	0.0010	0.005	0.010

 CHAPEL STEEL CO.  
 OIL STATES-SKAGIT SMATCO  
 ASTM A36  
 1/2" X 96.0000" X 240.0000"  
 PART NO.

PO/Rel 4043075

ROBERT HUDSON

 Certificate of Mill Test Results  
 SO HOU-024993-001  
 6Dec05  
 Pg. 1/1

Aut:

 12-4-05



"Rock"  
Hudson

985 868 2926



Metallurgical Chemistry and Testing Laboratory

3204 BRADWAY (77047)  
POST OFFICE BOX 282205  
HOUSTON, TEXAS 77207-2205  
PHONE: (713) 644-7801  
FAX: (713) 644-1468  
www.an-tech.com

December 6, 2005

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/24993  
Report No. 05-3238-1  
Correction: 10/8/2005

IDENTIFICATION: 1/2" x 4" x 6", PLT# H17136, HT# S02548, SL# 03BA  
MATERIAL: ASTM A36, Mfg. Jln  
REFERENCE: HOU-24993

IMPACT TEST

10mm x 10mm CVN (@ +10°F)  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
97.0	84	50
112.0	92	60
112.0	92	60

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.

985  
11  
12-9-05



BR23635-0539-01



Jindal United Steel Corporation

5200 E. McKinney Road

**Baytown, TX 77520**

# METALLURGICAL TEST REPORT

Sold To:	Ship To:	This is to certify that the product described herein was manufactured, sampled, and tested in accordance with the specifications and requirements in such specifications.	Bulletin Num.																																																																																																																																							
Longhorn Steel & Flamingo Northwoods Industrial Park East 11921 FM 829 Houston, TX 77041	Longhorn Steel & Flamingo Northwoods Industrial Park East 11921 FM 829 Houston, TX 77041	Approved By:  Shipping Mode: DIRECT TRUCK DIN S0049 J.I.B / EN 10204 J.I.B	21635																																																																																																																																							
Plates Manufactured in the USA	Order No: JUS0286-33	P.O. Number S9586	Date 9/14/2004																																																																																																																																							
Specifications: HOT ROLLED PLATE CUT EDGE ASME SA516-03A GR70 PL NORM W/LCVN DUAL CERT. 6063 IF APP. PRESSURE VESSEL QUALITY																																																																																																																																										
<div style="float: left;"> <p>#26358</p> </div> <table border="1"> <thead> <tr> <th>Item</th><th>Gauge</th><th>Width</th><th>Length</th><th>Qty</th><th>Weight</th><th>Heat No.</th><th>Gauge Tested</th><th>Test Plate Identity</th><th>Test Cond</th><th>Yield Point (KSI)</th><th>Tensile Strength (KSI)</th><th>Elongation (%) In 8" In 2"</th><th>Yield Strength Determined at</th><th>LCVN FULL mm @ -20 DEG F 15 FT/LBS</th></tr> </thead> <tbody> <tr> <td>33</td><td>4.0000</td><td>96.0000</td><td>220.0000</td><td>1</td><td>23.959</td><td>S00539</td><td>4.000</td><td>02A-A</td><td>PN</td><td>51</td><td>79</td><td>30</td><td>0.2%</td><td>29 - 23 - 30 FULL mm @ -20°F PLATE NORMALIZED 1650 DEG F @ 120 MINS</td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table>				Item	Gauge	Width	Length	Qty	Weight	Heat No.	Gauge Tested	Test Plate Identity	Test Cond	Yield Point (KSI)	Tensile Strength (KSI)	Elongation (%) In 8" In 2"	Yield Strength Determined at	LCVN FULL mm @ -20 DEG F 15 FT/LBS	33	4.0000	96.0000	220.0000	1	23.959	S00539	4.000	02A-A	PN	51	79	30	0.2%	29 - 23 - 30 FULL mm @ -20°F PLATE NORMALIZED 1650 DEG F @ 120 MINS																																																																																																									
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Heat No. S00539 CE:0.45																																																																																																																																										
Test Type	C	MN	F	S	St	CU	Ni	CR	MO	SN	AL	N	V	B	TI	CD																																																																																																																										
LADLE	0.26	1.08	0.013	0.011	0.25	0.03	0.05	0.04	<0.02	<0.02	0.033	<0.02	<0.02	<0.02	<0.02	<0.02																																																																																																																										

1-6-64

Item : 1 (1 PC) 4" X 96" X 189" - REM - - SHIP AS IS.



Jindal United Steel Corporation  
5200 E. McKinney Road  
Baytown, TX 77520

# METALLURGICAL TEST REPORT

NET-04  
TTC No.: BR31230-2481-01

Sold To: <b>CHAPEL STEEL CO.</b> 590 NORTH BETHLEHEM PIKE P.O. BOX 1080 SPRING HOUSE, PA 19477-1080						Ship To: <b>CHAPEL STEEL CO.</b> 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. 31230	
Plates Manufactured in the USA						Order No: JUS1307-13						Approved By: <i>Hilda Green</i>							
						Date 9/30/2005		P.O. Number HOU-2454				Shipping Mode:DIRECT TRUCK							
												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						
Gauge	Width	Length	Qty	Wgt							in 8"	in 2"							
13	2.0000	120.0000	360.0000	1	24.503	S02481	2.000	01A	ABS	40	69	33	0.2%						
No.							2.000	01B	ABS	41	69	33	0.2%						
															HS646096EX				
Specifications: HOT ROLLED PLATE CUT EDGE ASTM A36 -05 / ABS GR. A / A709 - 05 GR. 36 STRUCTURAL QUALITY																			

Heat No. S02481 CE:0.33

Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Cb
LADLE	0.15	1.08	0.009	0.003	0.28	0.01	0.01	0.01	0.003	0.001	0.033	0.004	0.001	0.0002	0.003	0.001

12-9-21





*Metallurgical Chemistry and Testing Laboratory*

3204 BROADWAY (77017)  
POST OFFICE BOX 282285  
HOUSTON, TEXAS 77207-2285  
PHONE: (713) 844-7901  
FAX: (713) 844-1400  
URL: <http://www.an-tech.com>

December 6, 2005

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/24993  
Report No. 05-3238-6  
Correction: 12/8/2005

IDENTIFICATION: 2" x 4" x 6", PLT# H17141, HT# S02481, SL# 02AA  
MATERIAL: ASTM A-36, Mfg. JDS  
REFERENCE: HOU-24993

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
98.0	84	70
97.0	86	70
20.0	18	20

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  
11  
12-8-05





# 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  
1435 CHOCTAW DRIVE  
BATON ROUGE, LA 70884

TESTED IN ASTM A6

INVOICE NO.

DATE 10/27/05

PO: 43974

ACCORDANCE

PRODUCT ANGLES

Cust S-0050 -0021

WITH

HEAT NO. 44284 83 Pcs

GRADE A3652950 -

Length 40'0"

SIZE L 2 X 2 X 1/4 X 3.19

CHEMICAL ANALYSIS	
C	.18
Mn	.95
P	.020
S	.027
Si	.18
Cu	.30
Ni	.11
Cr	.15
Mo	.033
Cb	.000
V	.000
B	
Al	
Sn	
N	
Ti	.005

MECHANICAL PROPERTIES	TEST 1		TEST 2		TEST 3	
	IMPERIAL	METRIC	IMPERIAL	METRIC	IMPERIAL	METRIC
YIELD STRENGTH	53,672 PSI	370 MPa	52,868 PSI	365 MPa	PSI	MPa
TENSILE STRENGTH	78,455 PSI	541 MPa	77,521 PSI	535 MPa	PSI	MPa
ELONGATION	29.0 %	29.0 %	30.0 %	30.0 %	%	%
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	INTERNAL CLEANLINESS		GRAIN SIZE
	IMPERIAL	METRIC	
AVERAGE	ft-lbs	J	HARDNESS
TEST TEMP	F	C	GRAIN PRACTICE
ORIENTATION			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. JOIN

PARISH ON THIS DAY OF , 20

SIGNED

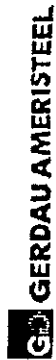
*Timothy R. White*  
TIMOTHY R. WHITE, QUALITY ASSURANCE MANAGER

DIRECT ANY QUESTIONS OR NECESSARY CLARIFICATIONS CONCERNING THIS REPORT TO THE SALES DEPARTMENT.

Michael E. Soileau, # 81887, Notary Public

1-800-535-7692 (USA)





JACKSON STEEL MILL  
801 AMERISTEEL ROAD  
JACKSON TN 38305 USA  
(731) 424-5600

Chemical and Physical Test Report

MADE IN THE UNITED STATES

V-575120

SHIP TO SABEL INDUSTRIES 1500 CHIPPEWA ST. 877-797-8335 BATON ROUGE, LA 70805		INVOICE TO SABEL INDUSTRIES INC PO DRAWER 4747 MONTGOMERY, AL 36103-4747		SHIP DATE 11/29/05 CUST. ACCOUNT NO 37835923	
---	--	---	--	---	--

SHAPE & SIZE	GRADE	SPECIFICATION	SALES ORDER	CUST P.O. NUMBER
A4 X 3 X 1/4	A36	ASTM A36-05	5115012-01	44799
HEAT I.D.	C	Mn P S Si Cu Ni Cr Mo V Nb Sn C Eqv		
N5-5471	16	.70 .010 .030 .20 .42 .08 .14 .030 <.008 <.008 .020 .347		

Mechanical Test: Yield 50790 PSI, 350.18 MPA Tensile: 70390 PSI, 485.32 MPA %El: 32.80in, 32.8200MM  
Mechanical Test: Yield 51670 PSI, 356.25 MPA Tensile: 71750 PSI, 494.7 MPA %El: 32.28in, 32.2200MM

SHAPE & SIZE	GRADE	SPECIFICATION	SALES ORDER	CUST P.O. NUMBER
A4 X 3 X 5/16	A36	ASTM A36-05	5115012-02	44799
HEAT I.D.	C	Mn P S Si Cu Ni Cr Mo V Nb Sn C Eqv		
N5-5491	14	.69 .020 .020 .22 .33 .09 .14 .030 <.008 <.008 .010 .322		

Mechanical Test: Yield 52100 PSI, 359.22 MPA Tensile: 72590 PSI, 500.49 MPA %El: 31.08in, 31.0200MM  
Mechanical Test: Yield 52760 PSI, 363.77 MPA Tensile: 73480 PSI, 506.63 MPA %El: 30.08in, 30.0200MM

SHAPE & SIZE	GRADE	SPECIFICATION	SALES ORDER	CUST P.O. NUMBER
A5 X 4 X 1/4	A36	ASTM A36-05	5115012-03	44799
HEAT I.D.	C	Mn P S Si Cu Ni Cr Mo V Nb Sn C Eqv		
N5-5307	14	.59 .010 .040 .21 .36 .09 .16 .040 <.008 <.008 .010 .33		

Mechanical Test: Yield 52630 PSI, 362.87 MPA Tensile: 72630 PSI, 500.77 MPA %El: 32.58in, 32.5200MM  
Mechanical Test: Yield 51780 PSI, 357.01 MPA Tensile: 72090 PSI, 497.04 MPA %El: 32.08in, 32.0200MM

This material, including the billets, was produced and manufactured in the United States of America.

*A.J. Turner*  
A.J. Turner  
Quality Assurance Manager  
Mill Group

THE ABOVE FIGURES ARE CERTIFIED EXTRACTS FROM THE ORIGINAL CHEMICAL AND PHYSICAL TEST RECORDS AS CONTAINED IN THE PERMANENT RECORDS OF COMPANY.

*A.B. Turner*  
Mgr. Metallurg. Svcs.  
JACKSON STEEL MILL

1-5-06



# 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

Report No. M 52388

CXT MPVW M 001 Rev. 14

CLIENT Oil states DATE 2/20/06  
CONTRACTOR Oil states JOB LOCATION Mulberry Rd.  
JOB NO. WJ# 24005 CLIENT REPRESENTATIVE Craig Thibodeau  
MT TECH. Loeie Cormier Level II REMARKS M.T. inspection

	WELD NO.	WALL THICKNESS	RECOMMENDATIONS		WELD NO.	WALL THICKNESS	RECOMMENDATIONS	
			✓ ACCEPT ✗ REJECT	REMARKS			✓ ACCEPT ✗ REJECT	REMARKS
1	100%	M.T.		inspection of all welds on lattice boom	52			
2					53			
3	base,			Model 340.	54			
4					55			
5					56			
6				All welds accepted	57			
7					58			
8					59			
9					60			
10					61			
11					62			
12					63			
13					64			
14					65			Total weld - 320"
15					66			Total Repair - 0"
16					67			
17					68			
18					69			
19					70			
20					71			
21					72			
22					73			
23					74			
24					75			
25					76			
26					77			
27					78			
28					79			
29					80			
30								
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 Electra spec MODEL ES-X S/N 9572

### CONTRACTS

PROD SPACING 6" CONTINUOUS (✓)  
AC (✓) DC ( ) HALF WAVE ( ) FULL WAVE ( )  
AMPS 575

### MEDIA

7C-BLACK WET (✓) 8A-DRY ( ) WHITE HIGHLIGHTER (✓)

### CALIBRATION

10# WEIGHT LIFT (✓) FLUX IND/CHECK ( )  
CALIBRATION DATE: 2/20/06

### ACCEPTANCE CRITERIA

AWS D1.1 Sect. 6.10 (Int. & Ext. Edition)

TOTAL TIME HRS.

2



# GLOBAL X-RAY & TESTING CORPORATION

JOEL MOREAU, President  
Residence: 504-446-6861

Post Office Box 1536  
Morgan City, Louisiana 70381  
Bus: 504-631-2426  
Fax: 504-631-0093

## MT WORK REPORT

Report No. M

24452

CLIENT Citibank DATE 3/15/06  
CONTRACTOR Citibank JOB LOCATION Malberry Rd.  
JOB NO. 100% 24005 CLIENT REPRESENTATIVE Barry Hildreth  
MT TECH. Bill Currier Level II REMARKS MT inspection

WELD NO.	WALL THICKNESS	RECOMMENDATIONS		WELD NO.	WALL THICKNESS	RECOMMENDATIONS	
		✓ ACCEPT ✗ REJECT	REMARKS			✓ ACCEPT ✗ REJECT	REMARKS
1	100%		inspection of all	51			weld on beam stop watchman
2	(2)		model 3401	52			
3				53			
4				54			180" inspected
5			all weld accepted	55			
6				56			
7				57			
8				58			
9				59			
10	100%		inspection of all weld on lattice / Gusset weldment	60			
11				61			
12			model 3401	62			
13				63			1760" inspected
14			all weld accepted	64			
15				65			
16				66			
17				67			
18				68			
19				69			
20				70			
21				71			
22				72			
23				73			
24				74			Total weld = 1740"
25				75			
26				76			Total Repair = 0"
27				77			
28				78			
29				79			
30				80			2 Cans Highliner
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 Electron spec MODEL ES-V S/N 9572

**CONTRACTS**  
PROD SPACING 6" 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: 3/15/06

**ACCEPTANCE CRITERIA**  
AWS D11.1 Sect. 6.11 (Latest Edition)

TOTAL TIME HRS. 3



# GLOBAL X-RAY & TESTING CORPORATION

JOEL MOREAU, President  
Residence: 504-446-6861

Post Office Box 1536  
Morgan City, Louisiana 70381

Bus: 504-631-2426  
Fax: 504-631-0093

## MT WORK REPORT

Report No. M

24606

GXT MPVW M 001 Rev. 14

CLIENT Oelstater DATE 4/19/06  
CONTRACTOR Oelstater JOB LOCATION Melberry Rd.  
JOB NO. WO# 24005 CLIENT REPRESENTATIVE Craig Hulderman  
MT TECH. Mitch Helbert Level II REMARKS M.T. inspection

	WELD NO.	WALL THICKNESS	RECOMMENDATIONS		WELD NO.	WALL THICKNESS	RECOMMENDATIONS	
			ACCEPT REJECT	REMARKS			ACCEPT REJECT	REMARKS
1	100%	M.T. inspection of all weld on boom			52			
2					53			
3	model 3402				54			
4					55			
5					56			
6		all weld accepted			57			
7					58			
8					59			
9					60			
10					61			
11					62			
12					63			
13					64			
14					65			
15					66			
16					67			
17					68			
18					69			
19					70			
20					71			
21					72			
22					73			
23					74			
24					75			
25					76			
26					77			
27					78			
28					79			
29					80			
30								
31								
32								
33								
34								
35								
36								
37								
38								
39								
40								
41								
42								
43								
44								
45								
46								
47								
48								
49								
50								

Total weld = 36"  
Total reject = 0"

**SURFACE CONDITION**  
GOOD (✓) FAIR ( ) PAINTED ( ) WELD (✓)

**EQUIPMENT**  
MAKE Elexto spr MODEL ESIX S/N 9572

**CONTRACTS**  
PROD SPACING 6" CONTINUOUS (✓)  
AC (✓) DC ( ) HALF WAVE ( ) FULL WAVE ( )  
AMPS 6.75

**MEDIA**  
7C-BLACK WET (✓) 8A-DRY ( ) WHITE HIGHLIGHTER (✓)

**CALIBRATION**  
10# WEIGHT LIFT (✓) FLUX IND. CHECK ( )  
CALIBRATION DATE: 4/19/06

**ACCEPTANCE CRITERIA**  
RWS D.I.1 Sect. 6.10 (Total reduction)

TOTAL TIME HRS. 1





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# Material Traceability Log

CRANE WO. NO.:	24005
CUSTOMER:	PEMEX
WELDMENT PART NO.:	N61587-030
WELDMENT S/N:	05333-05
DESCRIPTION:	Boom Insert Weldment (Mid # 1 - 30')
MODEL:	340LA-100
CHECKED BY:	<i>Mike Rutter</i>
DATE:	1-19-06

[illegible]



R5537461

# MAVERICK

MATERIAL TEST REPORT  
- Semi-Annual, Used, Heat, Ship To: City

Date: 12/29/05  
Time: 14:31:57  
Page - 1

Customer: ATLAS TUBE  
200 CLARK ST  
HARROW, ON NDR 1G0  
CA

MAVERICK TUBE CORPORATION  
16401 SWINGLEY RIDGE RD.  
CHESTERFIELD, MO 63017  
(636) 733-1600

Shipped From: MAVERICK TUBE, L.P. - 102  
102 4950 N COUNTY RD 967  
C BLYTHEVILLE, AR 72315

Specification ASTM A500-03 Gr. B

Load # 1863879 Product 4 X 4 X 500 480.000  
Date Shipped 12/28/05 Item Number 279540  
Sales Order 260136 SO 1.0 Gauge 0.500 Grade A500-B Length 40  
Customer PO 80171474 Mfg. Process COLD FORMED ERW

## CHEMICAL COMPOSITION

Heat #	Test	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	N	Ca	B	N
756847	2385092	.05	1.15	.011	.005	.014	.090	.030	.040	.022	.028	.005	.003	.009
858170	2405241	.05	1.20	.017	.005	.027	.090	.030	.040	.021	.026	.006	.003	.009
Product Analysis														
756847	2389111	.04	1.19	.008	.002	.010	.091	.039	.045	.009	.027	.005	.002	.012
858170	2414180	.04	1.19	.015	.002	.024	.092	.037	.041	.008	.028	.004	.001	.009

## MECHANICAL PROPERTIES

Heat #	Test	Lot Number	Date	Yield PSI	Tensile PSI	Elong % in 2"	Hardness RH B
--------	------	------------	------	--------------	----------------	------------------	------------------

756847	2422911	756847	12/20/05	74,450	76,340	35.80	83.50
858170	2422905	858170	12/20/05	64,870	74,080	35.10	83.00

*gpc*  
1-10-06

\* Melled 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: *[Signature]* Title: *[Signature]*  
Maverick Tube Quality Department Approved  
Signature on File



TIME: 13:41:01

UNITED STATES STEEL



TUBULAR PRODUCTS

CERTIFIED TEST REPORT

(TYPE B - IN ACCORDANCE WITH ISO 10474/EN10204/DIN50049 3.1.b)

MILL ORDER/ITEM NO. DR26835 02	SHIPPER'S NO.	P.O. NUMBER 04-18283	VEHICLE ID.
SOLD TO ADDRESS PIPE DISTRIBUTORS INC P O BOX 23237 HOUSTON TX 77228-3237		MAIL TO ADDRESS PIPE DISTRIBUTORS INC 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-\*42ND EDITION DATED 1/00 PSL-1 GRADE B ASTM A53-\*02 GRADE B ASME SA53-\*2001 EDITION 2003 ADDENDA GRADE B/C ASME SA106-\*2001 EDITION 2003 ADDENDA 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	OD: 1.900 ( 48.260 )		WALL: 0.200 ( 5.080 )		in (mm)	
		YIELD		TENSILE		Y/T	
		MIN:	MAX:	MIN:	MAX:	MIN:	MAX:
A83596	STRIP/L/B	PSI		PSI		ELONG %	
		40000		70000		(IN 2")	
		MIN: 40000		MIN: 70000		MIN: 21.5	
A83596	STRIP/L/B	IN		MIN:		MAX:	
		0.750		78500		0.68	
		END OF DATA THIS SHEET **		MAX: 78500		MAX: 0.68	
A83596	STRIP/L/B	HARDNESS		MIN HYDRO		DINELL SEC:	
		SCALE: HRB		PSI		MIN	
		MIN: 99.0		2500		MAX: 5	
A83596	STRIP/L/B	MIN:		MAX:		MIN:	
		33.0		B 79.0		MAX: 5	
		MAX: 2500		MAX: 2500		MAX: 5	

LEGEND:	L - LONGITUDINAL U - UPSET	T - TRANSVERSE N - NORMALIZED	QT - QUENCHED & TEMPERED SR - STRESS RELIEVED				AR - AS ROLLED				B - BODY				W - WELD			
			C	MN	P	S	SI	CU	NI	CR	MO	AL	N	V	B	TI	CB	CO
			TYPE															
A83596		HEAT	20	106	008	002	18	02	03	06	02	030		002			002	
A83596		PROD	18	105	007	005	17	02	03	06	02	030		003			001	
A83596		PROD	18	105	007	005	17	02	03	06	02	030		003			001	
			** 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

6-01-05





UNITED STATES STEEL

TUBULAR PRODUCTS  
CERTIFIED TEST REPORT

(TYPE B - IN ACCORDANCE WITH ISO 10474/EN10204/DIN50049 3.1.b)

TIME: 13:41:01

MILL ORDER/ITEM NO. DR26835 02	SHIPPER'S NO.	P.O. NUMBER 04-18283	O.D.: 1.900 ( 48.260 ) WALL: 0.200 ( 5.080 ) in (mm)												
MATERIAL COND: AS ROLLED		CHARTER V-NOTCH IMPACT TESTING													
PRODUCT IDENTIFICATION A83596	FLAT	BEND	GRAIN SIZE	MIN COLLAPSE	DIR	TEST LOC.	TEMP	SIZE	TEST COND.	FT-LBS			% SHEAR		
										1	2	3	1	2	3
OK					END OF DATA THIS SHEET **					DEG					
LEGEND: L - LONGITUDINAL T - TRANSVERSE B - BODY W - WELD HAZ - HEAT AFFECTED ZONE															
TESTING / INSPECTION INFORMATION															
TEST / INSPECTION					YES					RESULTS / COMMENTS					
FULL LENGTH VISUAL					X										
FULL LENGTH EMI										OD _____ L _____ L/T _____					
FULL LENGTH MPI										OD _____ OD/ID _____ L/T _____					
FULL LENGTH UT										OD _____ OD/ID _____ L/T _____					
END AREA INSPECTION (PLAIN END)										MPI _____ UT _____					
SPECIAL END AREA (SEA) INSP.										MPI _____ UT _____					
FULL LENGTH DRIFT										DRIFT MANDREL SIZE: _____					
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: S. ANADELL - MANAGER, Q.A.

DATE: 10/07/04





## Jindal United Steel Corporation

5200 E. McKinney Road

Baytown, TX 77520

## METALLURGICAL TEST REPORT

TC No.: BR32051-2548-03

NET-04

<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> 32051	
<b>Order No:</b> JUS1321-04		<b>Approved By:</b> <i>Heather Green</i>		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>Plates Manufactured in the USA</b>		<b>Date:</b> 11/1/2005		<b>Shipping Mode:</b> DIRECT TRUCK	
		<b>P.O. Number:</b> HOU-2464		<b>DTN:</b> 30049 3.1.B / EN 10204 3.1.B	

**Specifications:**  
 HOT ROLLED PLATE CUT EDGE ASTM A36 -05 / ABS GR A / 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"		
04	0.5000	96.0000	480.0000	1	6.534	S02548	0.750	01C	ABS	48	69	25		0.2%	



Heat No.:S02548 CE:0.33																
Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Ch
LADLE	0.14	1.06	0.015	0.007	0.27	0.03	0.02	0.02	0.010	0.001	0.029	0.006	0.005	0.0010	0.005	0.010

12-9-05

CHAPL STEEL CO.  
 OIL STATES-SKAGIT SMATCO  
 ASTM A36  
 1/2" X 96.0000" X 240.0000"  
 PART NO.

PO/Re 4043075

/ROBERT HUDSON

Certificate of Mill Test Results  
 SO HOU-024993-001  
 6Dec05  
 Pg 1/1



"Rock"  
Hudson

985 868 2926



*Metallurgical Chemistry and Testing Laboratory*

3204 BROADWAY (77017)  
POST OFFICE BOX 282285  
HOUSTON, TEXAS 77207-2285  
PHONE: (713) 844-7101  
FAX: (713) 844-1400  
metlab@an-tech.com

December 6, 2005

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/24993  
Report No. 05-3238-1  
Correction: 10/8/2005

IDENTIFICATION: 1/2" x 4" x 6", PLT# H17136, HT# S02548, SL# 03BA  
MATERIAL: ASTM A36, Mfg. Jin  
REFERENCE: HOU-24993

IMPACT TEST

10mm x 10mm CVN (@ +10°F)  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
97.0	84	50
112.0	92	60
112.0	92	60

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.

985  
11  
12-9-05



Issuing Date : 09/28/2005

Vehicle No: ATW 53058

Specification: 2.6000" x 120.000" x 4.10.000"

ASTM A36-05/ASTM A709 Grade 50/ASME SA36-03

**Load No.: 111720**

**Sold To:**

Longhorn Steel & Flaming  
Northwoods Industrial Park East  
11921 FM 529  
Houston, TX 77041

Our Order No. : 3852411

**Ship To:**

Longhorn Steel & Flaming Cutting  
Northwoods Industrial Park East  
11921 FM 529  
Houston, TX 77041

**Marking :**

[illegible]

↑  
24614  
24615

Manufactured to fully fitted 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 the material. Produced as continuous cast as-rolled discrete plate. Made by Electric Arc Furnace. Welding or weld repair was not performed on this material. Produced as continuous cast as-rolled discrete plate.

[illegible]

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. Dapertis

10/03/2005 1:50:26 PM



# Charpy Impact Test Report

1-1-06



ISO 9001:2000 CERTIFIED, INC.  
QUALITY ASSURANCE  
REPORT OF TEST AND ANALYSES

API 11

SHIPMENT NO <b>803-11369</b>	DATE SHIPPED <b>07-16-05</b>	CAR OR VEHICLE NO <b>IHB-DOLTN-UP</b>	BN <b>621440</b>	PAGE <b>8</b>
S O L D I E R LONGHORN STEEL & FLAMECUTTING INC 11921 FM 529 RD HOUSTON TX 77041		S H I P T O LONGHORN STEEL & FLAMECUTTING INC C/O A&L TRUCKING PTR A SPUR 23 HOUSTON TX		

N O T E	SERIAL NUMBER	PAT NO.	HEAT NUMBER	NO PCS	SIZE AND QUANTITY				YIELD POINT	TENSILE STRENGTH	ELONG	RED
					THICKNESS	WIDTH OR GA.	LENGTH	WEIGHT				
					INCHES	INCHES	INCHES	POUNDS	PSI	PSI	IN	%

QUALITY STEEL MELTED & MANUFACTURED IN THE U. S. A.  
 PLATES - API -2H GR 50 INTEGRA 1999 EDITION  
 S1,S3,S4,S5,S12 CE=.43X PER IIW  
 FORMULA, ASTM A633-95 GR C, ABS GRD  
 DH/EH36 REV 2001, ASTM A537-95 PVQ  
 MOD CB.04 MAX CLASS 1, CH-V A20S5  
 PLT T 30/25 FTLES AT -40F, THRU THK  
 PER API-2H S4, NDT API-2H PLT NO  
 BRK AT -30F, UT A578 LEVEL 2 100%-PLT NORM & COOLED IN STILL AIR  
 --- PLATE PASSED NDT API-2H NO BREAK AT -30F---  
 NO WELD REPAIR WAS PERFORMED ON BELOW PLATE(S)

CO# ~~321182~~ GH 841-3646A  
 PLATES HEAT TREATED - TEST SPECIMENS ATTACHED & YIELD STRENGTH @ .5% EUL  
 PLATES ULTRASONICALLY TESTED PER ATTACHMENT  
 OUTSIDE INSPECTION BY AMERICAN BUREAU OF SHIPPING

L033208	831M02130	1	1	120	480	16335	56100	75200	8	28
---------	-----------	---	---	-----	-----	-------	-------	-------	---	----

56  
53

N 1650 DEG F - 49 MIN

Q. QUENCH TEMPERATURE      T. TEMPER TEMPERATURE      N. NORMALIZE TEMPERATURE

WE HEREBY CERTIFY THAT THE MATERIAL DESCRIBED HEREIN HAS BEEN MADE BY THE  
 ISG BURNS HBR PLATE. 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	CHARPY IMPACT														
					THICKNESS	TYPE	SIZE	CIR	TEST TEMP	ENERGY FT LBS			SHEAR(%)			LAT. EXP MILS			
					INCHES				F	1	2	3	1	2	3	1	2	3	
L033208		831M02130			1.000	V	FULL T		-40	186	184	195							

25617

SUBSCRIBED AND SWORN TO BEFORE ME  
 THIS 18 DAY OF 7 2005  
Donna J. Pomeroy  
 NOTARY PUBLIC      DONNA J. POMEROY  
 PORTER COUNTY INDIANA  
 MY COMMISSION EXPIRES: MAY 17, 2007  
 COUNTY OF RESIDENCE: PORTER

HEAT NUMBER	CHEMICAL ANALYSIS																MQUAD GRAIN SIZE
	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Ti	Al	B	Co	N	Sn	
831M02130	.13	1.44	.015	.003	.301	.009	.01	.08	.058	.004	.003	.036	.0002	.034	.005		
	IIW	PCM															
	.40	.22															

Daniel W. Elwood

I certify that the above results are a true and correct copy of actual results contained in records maintained by ISG 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

ISG PV QUALITY ASSURANCE

D. W. ELWOOD

WWE  
 9-29-05



## GLOBAL X-RAY &amp; TESTING CORPORATION

JOEL MOREAU, President  
Residence: 985-446-6861Post Office Box 1536  
Morgan City, Louisiana 70381Bus: 985-631-2426  
Fax: 985-631-0093

## MT WORK REPORT

Report No. M 52269

GXT MPVW model Rev 14

CLIENT Celstar DATE 1/26/06  
 CONTRACTOR Celstar JOB LOCATION Mulberry Rd.  
 JOB NO. Wg# 24005 CLIENT REPRESENTATIVE Chris Huthall  
 MT TECH. Louie Cormive Level II REMARKS mt inspection

	WELD NO.	WALL THICKNESS	RECOMMENDATIONS			WELD NO.	WALL THICKNESS	RECOMMENDATIONS	
			✓ ACCEPT ✗ REJECT	REMARKS				✓ ACCEPT ✗ REJECT	REMARKS
1	100%	mt	✓	Inspection of all welds on lattice boom mid. #1	51				
2					52				
3	Weldment	Model 3401.			53				
4					54				
5					55				
6		All welds accepted			56				
7					57				
8					58				
9					59				
10					60				
11					61				
12					62				
13					63				
14					64				
15					65				
16					66				
17					67				Total weld = 360"
18					68				
19					69				Total repair = 0"
20					70				
21					71				
22					72				
23					73				
24					74				
25					75				
26					76				
27					77				
28					78				
29					79				1 Can Highlighter
30					80				
31									
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**SURFACE CONDITION**  
 GOOD (✓) FAIR ( ) PAINTED ( ) WELD (✓)

**EQUIPMENT**  
 MAKE Electro spec MODEL ES-X SIN 9570

**CONTRACTS**  
 PROD SPACING 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: 1/26/06

**ACCEPTANCE CRITERIA**  
AWS D1.1 Sect. 6.1 (1st Edition)

TOTAL TIME HRS. (2)



# GLOBAL X-RAY & TESTING CORPORATION

JOEL MOREAU, President  
Residence: 504-446-6861

Post Office Box 1536  
Morgan City, Louisiana 70381  
Bus: 504-631-2426  
Fax: 504-631-0093

## MT WORK REPORT

Report No. M  
24653

GXT MPVWMOOL Rev. 1/14

CLIENT Oil State DATE 4/27/06  
CONTRACTOR Oil State JOB LOCATION Mulberry Rd.  
JOB NO. NO # 24005 CLIENT REPRESENTATIVE Timothy Mollere  
MT TECH. metch Helbert Level II REMARKS M.T. inspection

	WELD NO.	WALL THICKNESS	RECOMMENDATIONS		WELD NO.	WALL THICKNESS	RECOMMENDATIONS	
			ACCEPT REJECT	REMARKS			ACCEPT REJECT	REMARKS
1	100%	M.T. inspection of all			51			welds on roller assembly
2					52			
3		model 3402.			53			
4					54			
5					55			
6		All welds accepted.			56			
7					57			
8					58			
9					59			
10					60			
11					61			
12					62			
13					63			Total weld = 350"
14					64			Total repair = 0"
15					65			
16					66			
17					67			
18					68			
19					69			
20					70			
21					71			
22					72			
23					73			
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**SURFACE CONDITION**  
GOOD ( ☒ ) FAIR ( ) PAINTED ( ) WELD ( ☒ )

**EQUIPMENT**  
MAKE ELECTROSPR MODEL ES X S/N 9542

**CONTRACTS**  
PROD SPACING 6 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: 4/27/06

**ACCEPTANCE CRITERIA**  
RWS D.1.1 Sect. 6.10 (4th Edition)

TOTAL TIME HRS. 1





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# Material Traceability Log

CRANE WO. NO.:	24005
CUSTOMER:	PEMEX
WELDMENT PART NO.:	N61587-030
WELDMENT S/N:	05333-06
DESCRIPTION:	Boom Insert Weldment (Mid # 2 - 30')
MODEL:	340LA-100
CHECKED BY:	<i>Mike R...</i>
DATE:	1-19-06

[illegible]



R5537461

Customer: ATLAS TUBE  
200 CLARK ST  
HARROW, ON N0R 1G0  
CA

MAVERICK TUBE CORPORATION  
16401 SWINGLEY RIDGE RD.  
CHESTERFIELD, MO 63017  
(636) 733-1500

Shipped From: MAVERICK TUBE, L.P. - 102  
102 4950 N COUNTY RD 967  
C BLYTHEVILLE, AR 72315

Specification ASTM A500-03 Gr. B

Load # 1863879 Product 4 X 4 X 500 480,000  
Date Shipped 12/28/05 Item Number 279540  
Sales Order 260136 SO 1.0 Gauge 0.500 Grade A500-B Length 40  
Customer PO 80171474 Mfg. Process COLD FORMED ERW

CHEMICAL COMPOSITION

Heat #	Test	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Al	Sn	Nb	V	Ti	Ca	B	N
Heat Analysis																		
756847	2385092	.05	1.15	.011	.005	.014	.080	.030	.040	.022	.028	.005	.001	.003	.011			.009
858170	2405241	.05	1.20	.017	.005	.027	.090	.030	.040	.021	.026	.006	.000	.003	.008			.009
Product Analysis																		
756847	2389111	.04	1.19	.008	.002	.010	.091	.039	.045	.009	.027	.005	.002	.004	.012			
858170	2414180	.04	1.19	.015	.002	.024	.092	.037	.041	.008	.028	.004	.001	.003	.009			

MECHANICAL PROPERTIES

Heat #	Test	Lot Number	Date	Yield PSI	Tensile PSI	Elong % in 2"	Hardness RH B
--------	------	------------	------	--------------	----------------	------------------	------------------

756847	2422911	756847	12/20/05	74,450	76,340	35.80	83.50
858170	2422905	858170	12/20/05	64,870	74,080	35.10	83.00

*gpc*  
1-10-06

\* 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:   
Title   
Signature on File   
Maverick Tube Quality Department Approved

MAVERICK

MATERIAL TEST REPORT  
- Sample, Using Basic Ship Test Only

Date: 12/29/05  
Time: 14:31:57  
Page - 1

1050



**VENDOR**  
LUSS TUBULAR PRODUCTS  
22199 EAST 28TH ST.  
LORAIN, OH 44055

USS TUBULAR PRODUCTS  
2199 EAST 28TH ST.  
LORAIN OH 44055

### SPECIFICATION AND GRADE

PIPE CARBON SMLS STD PIPE API 5L-\*42ND EDITION DATED 1/00 PSL-1 GRADE B ASTM A53-\*02 GRADE B ASME  
SA53-\*2001 EDITION 2003 ADDENDA GRADE B ASTM A106-\*02A GRADE B/C ASME SA106-\*2001 EDITION 2003 ADDENDA  
GRADE B/C BLK REG MILL COAT PE BEV 30 DEG MEETING ALL THE APPLICABLE REQUIREMENTS OF NACE STANDARD  
MR-01-75 \*2002

[illegible]

\*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.





UNITED STATES STEEL

TUBULAR PRODUCTS

CERTIFIED TEST REPORT

(TYPE B - IN ACCORDANCE WITH ISO 10474/EN10204/DIN50049 3.1.b)

TIME: 13:41:01

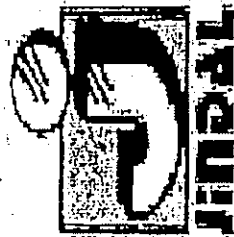
MILL ORDER/ITEM NO. DR26835 02	SHIPPER'S NO. 04-18283	P.O. NUMBER 04-18283	O.D.: 1.900 ( 48.260 )		I.D.: 0.200 ( 5.080 )		WALL in (mm)		in (mm)							
MATERIAL COND: AS ROLLED		PRODUCT IDENTIFICATION		FLAT	BEND	GRAIN SIZE	MIN COLLAPSE	DIR	TEST LOC	TEMP	SIZE	TEST COND	CHARNY V-NOTCH IMPACT TESTING			
A83596		OK		END OF DATA THIS SHEET **		DEG		1			2			3		
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 _____ L/T _____			
FULL LENGTH MPI																
FULL LENGTH UT													OD _____ OD/ID _____ L _____ L/T _____			
END AREA INSPECTION (PLAIN END)													MPI _____ UT _____			
SPECIAL END AREA (SEA) INSP.													MPI _____ UT _____			
FULL LENGTH DRIFT													DRIFT MANDREL SIZE: _____			
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: S. ANADELL - MANAGER, Q.A.

DATE 10/07/04





# Jindal United Steel Corporation

5200 E. McKinney Road

Baytown, TX 77520

## METALLURGICAL TEST REPORT

TC No.: BR32051-2548-03

MET-04

Sold To: CHAPEL STEEL CO. 590 NORTH BETTLEHEM 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. 32051
Plates Manufactured in the USA		Order No: JUS1321-04		Approved By: <i>Helio Green</i>		
		Date: 11/1/2005		Shipping Mode: DIRECT TRUCK		
		P.O. Number: HOU-2464		DIN 50049 3.1.B / EN 10204 3.1.B		

Specifications:  
HOT ROLLED PLATE CUT EDGE ASTM A36 -05 / ABS (GR A / 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"	
04	0.5000	96.0000	480.0000	1	6,534	S02548	0.750	01C	ABS	48	69	25		0.2%
<div>Heat No. S02548 CE:0.33</div> <div></div> <div>H S 650839 AX</div>														

Test Type	C	Mn	P	S	Si	Cu	NI	Cr	Mo	Sa	Al	N	V	B	Ti	Ch
LADLE	0.14	1.06	0.010	0.007	0.27	0.03	0.02	0.02	0.10	100.0	6.029	0.006	0.005	0.0010	0.005	0.010

12-4-05

CHAPPEL STEEL CO.  
OIL STATES-SKAGIT SMATCO  
ASTM A36  
1/2" X 96.0000" X 240.0000"  
PART NO.

PO/Rel 4043075

ROBERT HUDSON

Certificate of Mill Test Results  
SO HOU-024993-001  
6Dec05  
Pg 1/1



"Rock"  
Hudson

985 868 2926



Metallurgical Chemistry and Testing Laboratory

3204 BROADWAY (77017)  
POST OFFICE BOX 282285  
HOUSTON, TEXAS 77207-2285  
PHONE: (713) 644-7001  
FAX: (713) 644-1400  
me:analyzer@an-tech.com

December 6, 2005

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/24993  
Report No. 05-3238-1  
Correction: 10/8/2005

IDENTIFICATION: 1/2" x 4" x 6", PLT# H17136, HT# S02548, SL# 03BA  
MATERIAL: ASTM A36, Mfg. Jin  
REFERENCE: HOU-24993

IMPACT TEST

10mm x 10mm CVN (@ +10°F)  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
97.0	84	50
112.0	92	60
112.0	92	60

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  
12-9-05



ASTM A36  
2" X 120.0000" X 480.0000"  
PART NO.

**Attn:**

A36D 211

**NUCOR**  
**PLATE MILL**

# Mill Test Report

**FOR**  
It's our Nature.

Cust. Order No.: HOU-2528

**Longhorn Steel & Flamecutting  
Northwoods Industrial Park East  
11921 FM 529  
Houston, TX 77041**

Our Order No. : 3852411

Longhorn Steel & Flamecutting  
Northwoods Industrial Park East  
11921 FM 529  
Houston, TX 77061

Load No.: 111720

Vehicle No: ATW 53058  
Specification: 2.8000" x 120.000" x 440.000"  
ASTM A316-05/ASTM A709 Grade 50-95/ASME SA312-03a

### Marketing :

[illegible]

↑  
24614  
24615

Manufactured to fully kiln 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 diaphragm plate.  
Sold by Electric. Method of use will be as above specified. Call - 616-237-1100 (Ext. 151) for literature.

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. R. Dyer

10/03/2005 1:50:25 PM

**I. A. Davidson, M.D., M.Sc., M.A.**

**Doc No. 139340      Indexed 50ct05 by clizl**



All tests are performed using calibrated equipment on samples provided by the customer above, unless noted in the data section. This data applies only to samples tested by TQs, Inc. This test report may be reproduced in its entirety without permission from TQS, Inc. All requirements of TQS, Inc. Quality Assurance Program, Rev. A. Dated 7/10/96 have been fulfilled.

Date: 11/28/2005

**Signature:**



AP1

11

SHIPMENT NO. 803-11369		DATE SHIPPED 07-16-05		CAR OR VEHICLE NO. IHB-DOLTN-UP		BN 621440		PAGE 5				
LONGHORN STEEL & FLAMECUTTING INC 11921 FM 529 RD HOUSTON TX 77041				LONGHORN STEEL & FLAMECUTTING INC C/O A&L TRUCKING PTRA SPUR 23 HOUSTON TX								
NOTE	SERIAL NUMBER	PAT NO.	HEAT NUMBER	NO PCS	SIZE AND QUANTITY				YIELD POINT	TENSILE STRENGTH	ELONG	RED
					THICKNESS	WIDTH OR DIA.	LENGTH	WEIGHT				
					INCHES	INCHES	INCHES	POUNDS	PSI	PSI	IN	%

QUALITY STEEL MELTED & MANUFACTURED IN THE U. S. A.  
PLATES - API -2H GR 50 INTEGRA 1999 EDITION  
S1,S3,S4,S5,S12 CE=.43X PER IIW  
FORMULA, ASTM A633-95 GR C, ABS GRD  
DH/EH36 REV 2001, ASTM A537-95 PVQ  
MOD CB.04 MAX CLASS 1, CH-V A20S5  
PLT T 30/25 FTLBS AT -40F, THRU THK  
PER API-2H S4, NDT API-2H PLT NO  
BRK AT -30F, UT A578 LEVEL 2 100%  
--- PLT NORMALIZED & COOLED IN COOLED IN STILL AIR  
NO WELD REPAIR WAS PERFORMED ON BELOW PLATE(S)  
---PLATE PASSED NDT API-2H NO BREAK AT -30F----

CO# 320958 GH 841-3565B  
PLATES HEAT TREATED - TEST SPECIMENS ATTACHED & YIELD STRENGTH @ .5% EUL  
PLATES ULTRASONICALLY TESTED PER ATTACHMENT  
OUTSIDE INSPECTION BY AMERICAN BUREAU OF SHIPPING  
L032841 812L40870 1 1 120 480 16335 55600 74300 8 26

62  
59

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  
ISG BURNS HBR PLATE. 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	CHARPY IMPACT													
					THICKNESS	TYPE	SIZE	DIR	TEST TEMP	ENERGY			SHEAR(%)			LAT. EXP		
										FT	LBS							
					INCHES				F	1	2	3	1	2	3	1	2	3
L032841		812L40870			1.000	V	FULL	T	-40	140	280	270						

L032841 812L40870 1.000 V FULL T -40 140 280 270

SUBSCRIBED AND SWORN TO BEFORE ME  
THIS 18 DAY OF JUL 20 05  
NOTARY PUBLIC DONNA J. POMEROY  
PORTER COUNTY INDIANA  
MY COMMISSION EXPIRES MAY 17, 2007  
COUNTY OF PORTER

HEAT NUMBER	CHEMICAL ANALYSIS																MCQUAD GRAIN SIZE
	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Ti	Al	B	Co	N	Sn	

812L40870 .13 1.45 .014 .002 .317.013 .01 .07.052.005.003.026.0005 .033.007  
IIW PCM  
.40 .22

25614  
Daniel W. Elwood  
D. W. ELWOOD  
12-2-0

I certify that the above results are a true and correct copy of actual results contained in records maintained by ISG 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 #00477

SI 24 QUALITY ASSURANCE



## GLOBAL X-RAY &amp; TESTING CORPORATION

JOEL MOREAU, President  
Residence: 985-446-6861Post Office Box 1536  
Morgan City, Louisiana 70381Bus: 985-631-2426  
Fax: 985-631-0093

## MT WORK REPORT

Report No. M 52273

GXT MPVLM COIL Run 141

CLIENT Oil state DATE 1/28/06  
 CONTRACTOR Oil state JOB LOCATION Mulberry Rd.  
 JOB NO. wa# 24005 CLIENT REPRESENTATIVE Chris Williams  
 MT TECH. Mitch Helbert Level II REMARKS mt. inspection

	WELD NO.	WALL THICKNESS	RECOMMENDATIONS			WELD NO.	WALL THICKNESS	RECOMMENDATIONS	
			✓ ACCEPT ✗ REJECT	REMARKS				✓ ACCEPT ✗ REJECT	REMARKS
1	100%	m.t.		inspection of all	51				Weld a lattice beam weldment
2					52				
3	Model 3401			Mid. Sub #2	53				
4					54				
5					55				
6					56				
7				ALL weld crystal	57				
8					58				
9					59				
10					60				
11					61				
12					62				
13					63				
14					64				
15					65				
16					66				
17					67				
18					68				
19					69				Total weld = 360"
20					70				Total Repair = 0"
21					71				
22					72				
23					73				
24					74				
25					75				
26					76				
27					77				
28					78				
29					79				1 Can High Titer
30					80				
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**SURFACE CONDITION**  
 GOOD (✓) FAIR ( ) PAINTED ( ) WELD (✓)

**EQUIPMENT**  
 MAKE Electric MODEL ES-X S/N 9572

**CONTRACTS**  
 PROD SPACING 6" 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: 1/28/06

**ACCEPTANCE CRITERIA**  
RWS D1.1 Sub. 6.10.1 test 10.1.1.1

TOTAL TIME HRS. 2





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# Material Traceability Log

CRANE WO. NO.:	24005
CUSTOMER:	PEMEX
WELDMENT PART NO.:	N61588-001
WELDMENT S/N:	05333-01
DESCRIPTION:	Boom Point Weldment
MODEL:	340LA-100
CHECKED BY:	<i>Mike Little</i>
DATE:	2-15-06

[illegible]



R5537461

**MAVERICK**MATERIAL TEST REPORT  
SUMMARY BY HEAT AND ITEM FOR QC REVIEWDate: 12/28/05  
Time: 12:42:50  
Page: 1**Customer:**MAVERICK TUBE CORPORATION  
16401 SWINGLEY RIDGE RD.  
CHESTERFIELD, MO 63017  
(636) 733-1600Shipped From: MAVERICK TUBE, LP. - 102  
102 4950 N COUNTY RD 567  
B BLYTHEVILLE, AR 72315

Specification ASTM A508-03 Gr. B

Load # Product 4 X 4 X 500

Date Shipped Item Number 279531

Sales Order Size 4 X 4 Gauge 0.500 Grade A508-B Length 0

Customer PO Mfg. Process COLD FORMED ERW

**CHEMICAL COMPOSITION**

Heat #	Test	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Al	Sn	Nb	V	Ti	Ca	B	N
<b>Heat Analysis</b>																		
752720	2272920	.04	1.11	.014	.002	.337	.084	.042	.033	.018	.033	.006	.034	.002	.015			.010
<b>Product Analysis</b>																		
752720	2318869	.04	1.16	.015	.003	.245	.089	.045	.033	.011	.034	.006	.032	.002	.016			

**MECHANICAL PROPERTIES**

Heat #	Test	Lot Number	Date	Yield PSI	Tensile PSI	Elong % in	Hardness R H B
752720	2350577	752720	09/01/05	79,230	83,740	29.70	86.50

\* Melted and Manufactured in the U.S.A.\*

WE 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: \_\_\_\_\_  
Title: \_\_\_\_\_

1-3-06  
10-5-06



R5537461

Date: 12/28/05  
Time: 12:42:50  
Page: 2

**MAVERICK**

MATERIAL TEST REPORT  
SUMMARY BY TEST AND ITEM FOR QC REVIEW

**Customer:**

MAVERICK TUBE CORPORATION  
16401 SWINGLEY RIDGE RD.  
CHESTERFIELD, MO 63017  
(636) 733-1600

Shipped From: MAVERICK TUBE, L.P. - 102  
102 4950 N COUNTY RD 967  
B BLYTHEVILLE, AR 72315

Specification ASTM A500-03 Gr. B

Load # Product 4 X 4 X 500

Date Shipped Item Number 279531

Sales Order Size 4 X 4

Gauge 0.500

Grade A500-B

Length 0

Customer PO Mfg. Process COLD FORMED ERW

**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. %
752720	2350657, 2350657, 2350657	752720	L	3/4	22		174.00	169.00	192.00	178.33	95.00	95.00	95.00	95.00

\* 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:

Title

1-3-06



Bodycote Materials Testing Inc, Houston North Laboratory, 4302 Dayco Street, Houston, Texas, 77092  
Tel: 713-939-8690, Fax: 713-939-0249

## Test Certificate

Tubular Steel, Inc.  
Attn: Accounts Payable  
1031 Executive Pkwy  
St. Louis, MO

REF No  
Ord No

0505977 : Issue 2  
16595

Date Tested 12/15/05  
Date Reported 12/28/05

63141

Attn: Dawn Schultz

Item - 4" x 4" x 0.500" Wall Sq Structural Steel Tubing A500B  
HT# 752720

Specification - Client Requirement

Charpy Test - ASTM E 23							
	Position	Dimensions [mm]	Denomination	Test Temp [°F]	Energy Absorbed [ft.lbf]	Average [ft.lbf]	Comments
001:Longitudinal	N/A	10x10x2V	N/A	10.0	254, 66, 23	44.5	See Below
* Results exceeding 80% of machine capacity of 262.0ft-lbf are reported as approximate and are not included in the calculation of the average result							
Item 01: Percent Shear: 100, 30, 10 / Hils Lat Exp: 69, 43, 25							

## Certificate Comments

Corrected Certification:  
Certificate re-issued 12/28/05 to change material grade per clients request.  
This is an electronic copy. See original certificate for photographs and figures where referenced.



Approved By Jim Blevins

.....  
Jim Blevins  
For and on authority of  
Bodycote Materials Testing Inc



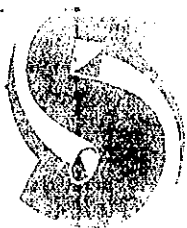
09/14/2005 From: THOMAS PIPE & STEEL

To:

FAX #:

ATTN: :

PO #:



Southland Tube, Inc.  
3525 Richard Arrington Jr. Blvd. N.  
Birmingham, AL. 35234

Phone (205) 251-1884 Fax (205) 421-4561

TEST REPORT ASTM-E8

Customer: SABEL STEEL

Print Date 8/2/2005

Heat No.: S52813

Description: CARBON STEEL TUBE

Size: 3 X 3 X .250 X 20

SpecGrade A500-03 B

Carbon: .05

Manganese: 1.11

Sulphur: .006

Phosphorus: .01

Silicon: .023

Sample number	Date	Tensile	Yield	Elongation
SL3661	7/22/2005	71,600	67,500	26.50

We hereby certify that the above figures are correct as contained in the records of this company and that the tubing was manufactured, tested and inspected in compliance with applicable

Computer Generated Document  
Quality Assurance

Melted & Manufactured in the U.S.A.

Pickup # 08J006  
TI Ord# 90510

Heat # S52813

Cust PO#42765





ID: 418417

06/27/03 02:13PM LTV Copperweld

PAGE 004 OF 004

**COPPERWELD**

Customer Order No.

NEW-247676

COPPERWELD - CHICAGO  
1855 E. 122nd Street  
CHICAGO, IL 60633  
TEL: 1-773-646-4500

**TEST REPORT**

Internal Order No. 826674

Invoice No. 19075111

Date 06/27/03

**Customer:**

NAMASCO CORPORATION  
4501 N. MIRO STREET  
NEW ORLEANS, LA 70117-4439

**Specification:**

3 IN, SQ, 1/4  
40 Ft  
ASTM A500 GRB 01A

**HEAT NO.****CHEMICAL ANALYSIS, %**

HEAT NO.	C	Mn	P	S	SI	AL	CB		CU	NI	CR
A25334* C.E. .29	.05	1.27	.010	.004	.03	.030	.003		.090	.050	.100

**MECHANICAL PROPERTIES**

HEAT NO.	C.I./D.I.	YIELD STRENGTH PSI	TENSILE STRENGTH PSI	ELONGATION %	HARDNESS Rb
A25334		52300	72400	29	

YIELD STRENGTH IS 0.2% OFFSET - ELONGATION IN 2 INCHES

**Other Tests**

\* MELTED &amp; MANUFACTURED IN THE U.S.A. (D)

Copperweld certifies that the material purchased on this order  
meets all chemical and physical requirements in accordance with the  
specification noted above.

*Carrie Lauritzen*  
CARRIE LAURITZEN, QUALITY ASSURANCE MANAGER





CERTIFICATE NO. 34191  
SHEET NO. 1 of 1  
JOB NO. 56017-PT-002  
SAMPLE ID. HT# A25334  
DATE. 21 November, 2005

225 South Hollywood Road, Houma, LA 70360 Phone (985) 851-5310 1-800-445-4619

# Metallurgical Certificate

**Sample** One (1) - 3" x 3" x 1/4" Box Tubing Pipe Section

**from** Oilstates

**for** Physical Testing

Physical Testing is certified and performed in accordance with customer requirements and applicable ASTM standard testing methods and procedures.

## IMPACT TEST DATA:

Specimen Size: 4/10 (4mm x 10mm)

Specimen Orientation: Longitudinal

Test Temperature: +10°F

Specimen ID	Absorbed Energy ( ft-lbs )		% Shear	Lateral Expansion inches
	ft-lbs	Full Size Eq.		
B1	70	175	100	No Break
B2	76	190	100	No Break
B3	62	155	100	0.071
Average	69	173	100	

NOTE: Refer to Oilstates PO# 4042747

CERTIFIED BY:

R.L. Sutton, P.E.

Staff Metallurgist

Reg. No. 24078

This Metallurgical Certificate may not be altered, deleted from, published and/or used except in full; shall not be used for advertising or in connection with advertising of any kind unless permission for the publishing or advertising of an approved abstract has been obtained, in writing, from Partek Laboratories, Inc.









UNITED STATES STEEL

TUBULAR PRODUCTS  
CERTIFIED TEST REPORT

TIME: 13:41:01

(TYPE B - IN ACCORDANCE WITH ISO 10474/EN10204/DIN50049 3.1.b)

MILL ORDER/ITEM NO. DR26835 02	SHIPPER'S NO. 04-18283	P.O. NUMBER 04-18283	O.D.: 1.900 ( 48.260 )		WALL: 0.200 ( 5.080 )		In (mm)				
MATERIAL COND: AS ROLLED		CHARTER V-NOTCH IMPACT TESTING									
PRODUCT IDENTIFICATION A83596	FLAT	BEND	GRAIN SIZE	MIN COLLAPSE	TEST LOC.	TEMP	SIZE	TEST COND.	% SHEAR		
									1	2	3
DEG											
END OF DATA THIS SHEET **											
LEGEND: L - LONGITUDINAL			T - TRANSVERSE		B - BODY		W - WELD		HAZ - HEAT AFFECTED ZONE		
TESTING / INSPECTION INFORMATION											
TEST / INSPECTION					RESULTS / COMMENTS						
FULL LENGTH VISUAL					X						
FULL LENGTH EM					L						
FULL LENGTH MPI					L/T						
FULL LENGTH UT					L/T						
END AREA INSPECTION (PLAIN END)					L/T						
SPECIAL END AREA (SEA) INSP.					UT						
FULL LENGTH DRIFT					UT						
DRIFT MANDREL SIZE:											
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: S. ANADELL - MANAGER, Q.A.

DATE 10/07/04



ASTM A36  
1" X 96.0000" X 240.0000"  
PART NO.



100

Jindal United Steel Corporation

5200 E. McKinney Road  
Baytown, TX 77520

# METALLURGICAL TEST REPORT

TC No.: BR31256-2494-05  
MET-04

<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. 31256	
Plates Manufactured in the USA				Order No: JUS1321-09				Approved By: <i>Heather Green</i>					
				Date 10/17/2005		P.O. Number HOU-2464		Shipping Mode: DIRECT TRUCK				DIN 50049 3.1.B / EN 10204 3.1.B	
<b>Specifications:</b> HOT ROLLED PLATE CUT EDGE ASTM A36 -05 / ABS GR A / 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
Item No.	Gauge	Width	Length	Qty							Wgt		
09	1.0000	96.0000	480.0000	3	39,204	S02494	1.000	12C	ABS	46	66	30	0.2%
HS646096EX													

Heat No.:502494 CE:0.32

Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Ch
LADLE	0.12	1.1	0.015	0.013	0.24	0.05	0.02	0.03	0.010	0.001	0.035	0.008	0.005	0.0010	0.005	0.010

12-1-65





Metallurgical Chemistry and Testing Laboratory

3204 BROADWAY (77017)  
POST OFFICE BOX 282285  
HOUSTON, TEXAS 77207-2285  
PHONE: (713) 844-7501  
FAX: (713) 844-1400  
metlab@an-tech.com

December 6, 2005

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091


P.O. No. 10647/24993  
Report No. 05-3238-4  
Correction: 12/8/2005

IDENTIFICATION: 1" x 4" x 6", HT# S02494, SL# 06AA  
MATERIAL: ASTM A-36, Mfg. Jin  
REFERENCE: HOU-24993

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
89.0	80	50
100.0	93	50
104.0	93	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.

  
12-8-05



Attn:



Jindal United Steel Corporation  
5200 E. McKinney Road  
Baytown, TX 77520

TC No.: DR31743-2646-01

# 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>Order No:</b> JUS1321-04 <b>Date:</b> 10/17/2005 <b>P.O. Number:</b> HOU-2464		<b>Approved By:</b> <i>Helen Green</i> <b>Shipping Mode:</b> DIRECT TRUCK <b>DIN:</b> 50049 3.1.B / EN 10204 3.1.B		<b>Bulletin Num.</b> 31743								
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>Specifications:</b> HOT ROLLED PLATE CUT EDGE ASTM A36 -05 / ABS GR A / A709 - 05 GR 36 STRUCTURAL QUALITY																
<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.																
Material Description		Bulletin		Test/Plate Identity		Yield Point (KSI)		Tensile Strength (KSI)		Elongation (%)		Yield Strength Determined at				
Item No.	Gauge	Width	Length	Qty	Wgt	Heat No.	Gauge Tested	Test/Plate Identity	Yield Point (KSI)	Tensile Strength (KSI)	in 8"	in 2"	Yield Strength Determined at			
04	0.5000	96.0000	480.0000	3	19,602	S02646	0.500	10A	50	68	25		0.2%			
							0.500	10B	47	68	25		0.2%			
AMERICAN BUREAU OF SHIPPING HOUSTON OCT 18 2005										H5646818X						
<b>Heat No.</b> S02646 <b>CE:</b> 0.32																
Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Cb
LADLE	0.11	1.13	0.018	0.015	0.30	0.03	0.06	0.06	0.010	0.001	0.035	0.006	0.005	0.0008		0.010

12-8-05





Metallurgical Chemistry and Testing Laboratory

5204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7601  
FAX: (713) 644-1400  
[www.an-tech.com](http://www.an-tech.com)

December 6, 2005

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Ronslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/24993  
Report No. 05-3238-2  
Correction: 12/8/2005

IDENTIFICATION: 1/2" x 4" x 6", PLT# H17128, IIT# S02646, SL# 10AB  
MATERIAL: ASTM A-36, Mfg. Jin  
REFERENCE: HOU-24993

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
95.0	75	60
93.0	81	60
89.0	80	60

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.

900  
11  
12-9-05









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

CUSTOMER NAME CHapel Steel P.O. NO. 10647/24350 DATE 10-14-05  
IDENTIFICATION 3/4"x4"x6" H7 S02486 PL 02B13  
MATERIAL ASTM A36 SPECIFICATION \_\_\_\_\_  
TEST REQUIRED: PHYSICAL: .505", RST, CVN B, DW, HARDNESS, MACRO, HOT ETCH  
CHEMICAL: 1ST 5, 1ST 5+  
METALLURGY: MICRO, GS, PHOTO, McQUAID EHN, MACRO, MICROHARDNESS  
HEAT TREAT: \_\_\_\_\_  
NDE: UT, LP, MP

TENSILE TEST						
SPECIMEN	DIA.	AREA/SQ.IN.	Y.S. PSI	ULT. LD. LBS.	T.S. PSI	%EL IN "%R.A.

IMPACT TEST @ <u>10</u> or - <u>(°F)</u> °C				
SPECIMEN SIZE	ORIENTATION	FOOT/POUNDS	LATERAL EXPANSION(MILS)	%SHEAR
10mmx10mm Lower		131.0	91	70
-		156.0	96	80
-		150.0	100	90

CHEMISTRY									
C	S	Mn	P	Si	Cr	Mo	Ni	Cu	

INVOICE NO \_\_\_\_\_

REPORT NO 05-2756-2

10/19/05

10/17/05 08:38pm P. 002

713 6441400

AN TECH LABORATORIES



MEET-04  
TTC No.: BR32051-2548-03

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. 32051							
Order No: JUS1321-04		Date : 11/1/2005		P.O. Number : HOU-2464		Approved By: <i>Arthur Green</i>							
Plates Manufactured in the USA		Shipping Mode: DIRECT TRUCK		DIN 50049 3.1.B / EN 10204 3.1.B		Insp.							
Specifications: HOT ROLLED PLATE CUT EDGE ASTM A36 - 05 / ABS GR A / 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
Item No.	Gauge	Width	Length	Qty							Wgt		
04	0.5000	96.0000	480.0000	1	6,534	S02548	0.750	01C	ABS	48	69	25	0.2%
H S 6 5 0 8 3 9 7 A													

Heat No.:S07548 CE:0.33

Heat No. S07548																
CE:0.33																
Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Cb
LADLE	0.14	1.06	0.015	0.007	0.27	0.03	0.02	0.02	0.010	0.001	0.029	0.006	0.005	0.0010	0.005	0.010

**CHAPEL STEEL CO.**  
OIL STATES-SKAGIT SMATCO  
ASTM A36  
1/2" X .96.0000" X 240.0000"  
PART NO.

PO/Rel 4043075

**ROBERT HUDSON**

**Certificate of Mill Test Results**  
SO HOU-024993-001  
6DDec03  
Pg 1/1

6Dcc05  
Pg 1/1

## Alms

12-9-05



"Rock"  
Hudson

985 868 2926



*Metallurgical Chemistry and Testing Laboratory*

3204 BROADWAY (77017)  
POST OFFICE BOX 262285  
HOUSTON, TEXAS 77207-2285  
PHONE: (713) 644-7001  
FAX: (713) 644-1400  
[info@an-tech.com](mailto:info@an-tech.com)

December 6, 2005

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/24993  
Report No. 05-3238-1  
Correction: 10/8/2005

IDENTIFICATION: 1/2" x 4" x 6", PLT# H17136, HT# S02548, SL# 03BA  
MATERIAL: ASTM A36, Mfg. Jln  
REFERENCE: HOU-24993

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
97.0	84	50
112.0	92	60
112.0	92	60

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  
11  
12-9-05



10/01/2003 From: MARMON/KEYSTONE  
M/K OR:  
C.P.O.:60-105303  
C PART:

INIT. :

To: MARMON-BIRMINGHAM  
OR. REF:  
SLSPRS:

## Steel Certificate of Test

# TIMKEN

1835 DUEBER AVE. S.W.  
CANTON, OHIO 44706

Page 1 of 2

WORLDWIDE LEADER IN BEARING AND STEEL

04/25/2003

ID #0050392-1

S Marmon/Keystone Corporation  
O T 10700 MARMON DRIVE  
L O  
D BOLINGBROOK IL 60440 USA

S MARMON/KEYSTONE CORPORATION  
H T 10700 MARMON DRIVE  
I O  
P BOLINGBROOK IL 60440 USA

Customer Order: 60-035253-001 Customer Part Number: 10.1.75130  
Timken Order: 56738-A (1132402) Heat Number(s): W7453

### 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-ULTRASONIC  
Condition: HOT ROLL

### Specification

- ASTM A 106 Rev. 99 GRADES B & C EXCEPT WEIGHING OF INDIVIDUAL TUBES
- ASME SA-106 01/01/2001 GRADES B & C EXCEPT WEIGHING OF INDIVIDUAL TUBES
- ASTM E 213 Rev. 02 01/01/2002 FOR NONDESTRUCTIVE ELECTRIC TESTING
- ASTM A 519 Rev. 96
- 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
W7453 Ladle:	.27	.85	.008	.018	.25	.08	.07	.01	.23	.025	.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

T 10.1.75 130

10-17-03



10/04/2003 From: MARMON/KEYSTONE

To: MARMON-BIRMINGHAM

M/K OR:

INIT. :

OR. REF:

C.P.O.: 60-105303

SLSPRS:

C PART:

## Steel Certificate of Test

# TIMKEN

1835 DUEBER AVE. S.W.  
CANTON, OHIO 44706

Page 2 of 2

WORLDWIDE LEADER IN BEARINGS AND STEEL  
04/25/2003

ID #0050392-1

Customer Order: 60-035253-001 Customer Part Number: 10.1.75130  
Timken Order: 56738-A (1132402) Heat Number(s): W7453

### Metallurgy Information

SPEC: Hardness MIDWALL 22 MAX UOM ROCKWELL C

Heat	Pieces	UOM
W7453	A	MIDWALL 87 / 87 ROCKWELL B

SPEC: Tensile MIN ELONGATION 22 Min STRENGTH UOM PSI TENSILE 70,000.00 Min YIELD .2  
40,000.00 Min

Heat	Pieces	Tensile Strength	UOM	.2% Yld Strength	Elong %	Gauge Length	Specimen	Direction
W7453	A	77,980	PSI	50,953	25.1	2 IN	0.505 in RD	LONG.

Flattening test - Satisfactory

Ultrasonic in lieu of hydrostatic testing - Satisfactory



10-17-03

Q. C. REVIEWED

THE TIMKEN CORPORATION



# Steel Certificate of Test

1835 DUEBER AVE. S.W.  
CANTON, OHIO 44706

Page 1 of 2

# TIMKEN

Where You Turn  
07/08/2005

ID #0111627-1

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: 10-017511-015 Customer Part Number: 6.52.130  
Timken Order: 40653-D (1271286) Heat Number(s): X0788

## 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
X0788 Ladle:	.26	.71	.011	.016	.24	.13	.12	.04	.24	.032	.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*  
1-11-06



# Steel Certificate of Test

1835 DUEBER AVE. S.W.  
CANTON, OHIO 44706

Page 2 of 2

**TIMKEN**  
Where You Turn  
07/08/2005

ID #0111627-1

Customer Order: 10-017511-015 Customer Part Number: 6.52.130  
Timken Order: 40653-D (1271286) Heat Number(s): X0788

## Metallurgy Information

SPEC: Hardness MIDWALL 22 Max UOM ROCKWELL C

Heat	Pieces				UOM
X0788	A	MIDWALL	87	/	88 ROCKWELL B

SPEC: Tensile MIN ELONGATION 22 Min STRENGTH UOM PSI TENSILE 70,000.00 Min YIELD .2  
40,000.00 Min

Heat	Pieces	Tensile Strength	UOM	.2% Yld Strength	Elong %	%Red	Gauge Length	Specimen	Direction
X0788	A	76,490	PSI	43,375	26.7	54.3	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

*ACC*  
1-11-06



# Mill Test Report

Page 2

Issuing Date: 11/19/2003

Our Order No.: 19474/4

Load No.: 57682

B/L No.: 56304

Vehicle No: NOKL 725216

Specification: 1.500" x 96.000" x 240.000"

ASTM A36-01/ASTM A709 Grade 36-01b/ASME SA36-96

Sold To: NAMASCO CORPORATION SOUTHWEST

4501 N MIRO STREET

Ship To: NAMASCO NEW ORLEANS

4501 N MIRO STREET

Marking:

NEW ORLEANS, LA 70117

NEW ORLEANS, LA 70117

Test Note:

Heat No.	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Al	V	Nb	Ti	N	Ca	B	Sn	Ceq	pcm
3105361	0.19	0.87	0.003	0.006	0.18	0.28	0.07	0.09	0.01	0.036	0.003	0.001	0.007	0.0104	0.0001	0.0001	0.006	0.380	0.262

Plate Serial No.	01	2	Tensile Test		Elongation		BHN		Dr.		1		2		3		Charpy Impacts (ft-lbs)		Temp		Size		Min Ave	
			Yield (psi)	Tensile (psi)	(% in 2")	(% in 8")			L		% Shear	% Shear	% Shear	% Shear	% Shear	% Shear	Ave.	Ave.	(deg F)	(deg F)	(mm)	(mm)		
3105361 - 01			42,900	70,600	21.6	21.6					77.9		87.7		81.6		82.4		10	+10	10		15	
			48,000	73,400	20.1	20.1																		



Manufactured to fully killed fine grain practice. Welding or weld repair was not performed on this material.  
Mercury has not been used in the direct manufacturing of this material. Yield by 0.5EUL method. Produced as discrete plate.  
 $Ceq = C + (Mn / 6) + ((Cr + Mo + V) / 5) + ((Cu + Ni) / 15)$   
 $pcm = C + (Si / 30) + (Mn / 20) + (Cu / 20) + (Ni / 60) + (Cr / 20) + (Mo / 15) + (V / 10) + 58$   
Melted and manufactured in the USA. ISO 9001-2000 certified (#12443-0) by SRI Quality System Registrar (#9885-09).  
DIN 50049 3.1.B/EN 10204 3.1.B compliant. Produced under ABS Quality Assurance certificate No. 03-MMPOA-182.

We hereby certify that the contents of this report are accurate and correct. All test results and operation performed by the material manufacturer are in compliance with the applicable specifications.

*T. A. Deparis*  
T. A. Deparis, Metallurgist



A36D 11/4

المشقة

TC No.: BR26208-1678-02  
AFT-04





Jindal United Steel Corporation

5200 E. McKinney Road

Baytown, TX 77520

# METALLURGICAL TEST REPORT

<b>Sale To:</b> Longhorn Steel & Flamecutting Northwoods Industrial Park East 11921 FM 529 Houston, TX 77041		<b>Order No:</b> JUS0654-01		<b>Approved By:</b> 		<b>Shipping Mode:</b> DIRECT TRUCK DIN 50049 3.1.B / EN 10204 3.1.B		<b>Approved By:</b> 		<b>Shipping Mode:</b> DIRECT TRUCK DIN 50049 3.1.B / EN 10204 3.1.B		<b>Inspected By:</b>		<b>Inspected Date:</b>		<b>Inspected Location:</b>		<b>Inspected Quantity:</b>		<b>Inspected Remarks:</b>																	
<b>Plates Manufactured in the USA:</b>		<b>Date:</b> 2/12/2005		<b>P.O. Number:</b> WLY-2841		<b>Order No:</b> JUS0654-01		<b>Approved By:</b>		<b>Shipping Mode:</b> DIRECT TRUCK		<b>Approved By:</b>		<b>Shipping Mode:</b> DIRECT TRUCK		<b>Inspected By:</b>		<b>Inspected Date:</b>		<b>Inspected Location:</b>																	
<b>Specifications:</b>		<b>Material Description:</b>		<b>Heat No.:</b>		<b>Gauge Tested:</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>Inspected By:</b>		<b>Inspected Date:</b>																	
<b>Item No.:</b> 01		<b>Gauge:</b> 1.2500		<b>Width:</b> 120.0000		<b>Length:</b> 480.0000		<b>Qty:</b> 1		<b>Wgt:</b> 20,419		<b>Heat No.:</b> S01678		<b>Gauge Tested:</b> 1.250 03A 1.250 03B		<b>Test/Plate Identity:</b>		<b>Yield Point (KSI):</b> 42 43		<b>Tensile Strength (KSI):</b> 69 69		<b>Elongation (%):</b> 26 28		<b>Yield Strength Determined at:</b> 0.2% 0.2%		<b>Inspected By:</b>		<b>Inspected Date:</b>		<b>Inspected Location:</b>		<b>Inspected Quantity:</b>		<b>Inspected Remarks:</b>			
<b>Heat No.:</b> S01678		<b>CF:</b>		<b>Test Type:</b> LADLE		<b>C:</b> 0.17		<b>Mn:</b> 1.17		<b>P:</b> 0.011		<b>S:</b> 0.019		<b>Si:</b> 0.32		<b>Cu:</b> 0.03		<b>Ni:</b> 0.03		<b>Cr:</b> 0.01		<b>Mn:</b> 0.001		<b>Sn:</b> 0.002		<b>Al:</b> 0.034		<b>N:</b> 0.006		<b>V:</b> 0.003		<b>B:</b> 0.0010		<b>Ti:</b> 0.002		<b>Cb:</b> 0.001	

501a-111







2/28 27240E  
Date 9/11/03

# NUCOR

## BAR MILL GROUP

### JEWETT DIVISION

CERTIFIED MILL TEST REPORT

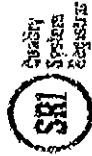
Post Office Box 126 Jewett, Texas 75846 Telephone (903) 626-4461 Faxes (800) 527-6445

15001

Sold to:

ISO 9002 Registered by

Ship to:



SIZE	GRADE	HEAT NUMBER	CUSTOMER FC NUMBER	C	MC	SI	S	P	V	MS	CU	NI	MO	SC	TEST
1 X 3 X 3/8	ABS A/A35 03A	315 1696 NEW 253468		.13	.070	.21	.012	.019	.074	.104	.42	.18	.17	.048	.010
				Tensile 1: 74000 Yield 1: 52300 Elongation 1: 24											
				Tensile 2: 71300 Yield 2: 51300 Elongation 2: 22											
4 X 1 X 1/4	ABS A/A35 02A	315 1671 NEW 253468		.13	.080	.25	.027	.069	.006	.060	.41	.18	.15	.056	.014
				Tensile 1: 70600 Yield 1: 50500 Elongation 1: 25											
				Tensile 2: 71400 Yield 2: 50700 Elongation 2: 25											
1 X 2	A36 01A/A35 01A/0A35 98	333 1505 NEW 254232		.14	.073	.22	.031	.015	.003	.004	.47	.17	.14	.042	.016
				Tensile 1: 69400 Yield 1: 43100 Elongation 1: 21											
				Tensile 2: 67900 Yield 2: 41800 Elongation 2: 21											

REMARKS: IN 2 HRS. RAGE

REMOVED AND RECONSTRUCTED IN 2 HRS. RAGE

ON 9/10/03, DURING THE 2ND HRS. RAGE, THE 2ND HRS. RAGE WAS OBSERVED AND THE 2ND HRS. RAGE WAS OBSERVED

ON 9/10/03, DURING THE 2ND HRS. RAGE, THE 2ND HRS. RAGE WAS OBSERVED AND THE 2ND HRS. RAGE WAS OBSERVED

*Ben R. Kemp*

CRACKS: NO CRACKS

ON 9/10/03, DURING THE 2ND HRS. RAGE, THE 2ND HRS. RAGE WAS OBSERVED AND THE 2ND HRS. RAGE WAS OBSERVED

ON 9/10/03, DURING THE 2ND HRS. RAGE, THE 2ND HRS. RAGE WAS OBSERVED AND THE 2ND HRS. RAGE WAS OBSERVED



AMERICAN ALLOY  
PLATE # D67279  
MET 44  
TC No: BR29639-199841

Jindal United Steel Corporation  
5200 E. McKinney Road  
Baytown, TX 77520



# 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: Prime Grain, Si-AL Fully Killed Steel		Bulletin Num. 29639						
Order No: JIS1154-03		Date: 6/23/2005		Approved By: <i>[Signature]</i>								
Plates Manufactured in the USA		P.O. Number: 63556-LA		Shipping Mode: DIRECT TRUCK								
Specification: HOT ROLLED PLATE CUT EDGE ABS GR AH/DH 36 W/LCVN D-CERT TO A572-50 & A131 AH/DH 36 HIGH STRENGTH LOW ALLOY		Imp.:		DIN 5049 3.1.B / EN 10204 3.1.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.						
Material Description		Bulletin		Tensile		Elongation (%)		Yield		LCVN		
Item No.	Gauge	Width	Length	Qty	Wgt	Heat No.	Gauge Tested	Test/Plate Identity	Test Cond	Yield Point (KSI)	Strength Determined at	FULL mm @ -40 DEG F
03	0.3750	96.0000	480.0000	3	14.703	S01990	0.375 0.375	02B 02C	ABS ABS	57 58	0.02% 0.02%	150 - 155 - 175 FULL mm @ -40° 180 - 145 - 139 FULL mm @ -40°
Certified a true copy of the original, retained in our file.												
AMERICAN ALLOY STEEL, INC.												
D67279												
MATERIAL CONFORMS TO A572-50 & A131												
CERTIFIED BY AMERICAN ALLOY STEEL, INC.												
DATE: 6-26-05												
Heat No. S01990												
CE: L40												
Test Type: C												
LADLE												
C												
Mn												
P												
S												
Si												
Cu												
Ni												
Cr												
Mo												
Sn												
Al												
N												
V												
B												
Ti												
Ch												
0.001												
0.003												
0.001												

To: OIL STATES-SKAGIT-SMATCO

AA PL#: D67279

S.O. #: 255796

Item : 1 (1 PC) 3/8" X .96" X 240"

P.O. #: 4041098

09/15/2005 From: AMERICAN ALLOY STEEL



B/L# 60655.

NUCOR STEEL  
A Division of NUCOR Corporation  
JEWETT, TEXAS 75846 PH (903) 626-4461

Date 8/01/97

## CERTIFIED MILL TEST REPORT

Sold To: 43054  
MARKLE STEEL CO.  
P. O. BOX 2346  
HOUSTON TX 77001

Ship TO:  
MARKLE STEEL CO  
1709 DELANO ST  
HOUSTON TX

8 INCH  
SCALE

SIZE GRADE	HEAT NUMBER	CUSTOMER PO NUMBER	TENSILE PSI	YIELD PSI	ELONG %	C	Mn	Si	S	P	V	Nb	Cu	Cr	Ni	Mo	Bend No Test
3/4 X 2 1/2 ASTM A36-94/ASME SA36-95	371-0513	97071327	66300	43600	27	.140	.670	.260	.026	.005	.000	.000	.450	.100	.110	.029	
1/2 X 2 1/2 ASTM A36-94/ASME SA36-95	371-1412	97071327	73900	51000	25	.164	.680	.268	.040	.020	.005	.005	.575	.236	.164	.032	
3/8 X 2 ASTM A36-94/ASME SA36-95	372-1807	97071327	67900	48800	28	.154	.593	.196	.024	.005	.003	.002	.278	.159	.101	.035	
1/4 X 1 1/4 ASTM A36-94/ASME SA36-95	371-0516	97071327	79200	60700	22	.180	.780	.310	.025	.005	.000	.000	.420	.150	.180	.030	
1/2 X 1 1/2 ASTM A36-94/ASME SA36-95	373-1712	97071327	73900	50700	22	.145	.749	.235	.024	.009	.003	.004	.350	.189	.141	.036	
3/8 X 2 1/2 ASTM A36-94/ASME SA36-95	372-1784	97071327	65700	46300	23	.144	.747	.233	.027	.010	.003	.003	.426	.115	.105	.019	
1/4 X 2 ASTM A36-94/ASME SA36-95	372-1801	97071327	66800	51200	24	.125	.741	.243	.024	.015	.003	.003	.370	.184	.134	.033	
3/8 X 4 ASTM A36-94/ASME SA36-95	371-1746	97071327	65700	48100	24	.137	.616	.245	.018	.005	.003	.002	.184	.087	.090	.019	
1/4 X 3 1/2 ASTM A36-94/ASME SA36-95	372-1437	97071327	68600	51000	29	.116	.627	.205	.026	.016	.004	.002	.357	.151	.111	.020	

FABRICATED AND MANUFACTURED IN U.S.A.

ALL MATERIAL STRAND CAST

CHIEF METALLURGIST





12/29/05  
Time: 14:31:57  
Page - 1

# MAVERICK

MATERIAL TEST REPORT  
- See Sup. Used, Heat Ship To: Qty

RS537461

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, L.P. - 102  
102 4950 N COUNTY RD 967  
C BLYTHEVILLE, AR 72315

Specification ASTM A500-03 Gr. B

Load #	1863879	Product	4 X 4 X 500 480.000
Date Shipped	12/28/05	Item Number	279540
Sales Order	260136	Size	4 X 4
Customer PO	80171474	Gauge	0.500
		Grade	A500-B
		Length	40
		Mfg. Process	COLD FORMED ERW

## CHEMICAL COMPOSITION

Heat #	Test	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Al	Sn	Nb	V	Ti	Ca	B	N
Heat Analysis																		
756847	2385092	.05	1.15	.011	.006	.014	.090	.030	.040	.022	.028	.005	.001	.003	.011			.009
858170	2405241	.05	1.20	.017	.005	.027	.090	.030	.040	.021	.026	.006	.000	.003	.008			.009
Product Analysis																		
756847	2389111	.04	1.19	.008	.002	.010	.091	.039	.045	.009	.027	.005	.002	.004	.012			
858170	2414180	.04	1.19	.015	.002	.024	.092	.037	.041	.008	.028	.004	.001	.003	.009			

## MECHANICAL PROPERTIES

Heat #	Test	Lot Number	Date	Yield PSI	Tensile PSI	Elong % in 2"	Hardness RH B
MECHANICAL PROPERTIES							
756847	2422911	756847	12/20/05	74,450	76,340	35.80	81.50
858170	2422905	858170	12/20/05	64,870	74,080	35.10	83.00

*[Signature]*  
1-10-06

\* Melled 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: \_\_\_\_\_  
Title: \_\_\_\_\_  
Maverick Tube Quality Department Approved  
Signature on File



## GLOBAL X-RAY &amp; 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

Report No. M 52262

GXT MPVWMOOL Rev 1.1

CLIENT Oil state DATE 1/25/06  
CONTRACTOR Oil state JOB LOCATION Mulberry Rd.  
JOB NO. W# 24005 CLIENT REPRESENTATIVE Clay H. H. H.  
MT TECH. Lacie Cormier Level II REMARKS M.T. inspection

	WELD NO.	WALL THICKNESS	RECOMMENDATIONS			WELD NO.	WALL THICKNESS	RECOMMENDATIONS	
			ACCEPT REJECT	REMARKS				ACCEPT REJECT	REMARKS
1	100%	MT		inspection of constant welds on Boom Point					
2	weldment	Model 3401.							
3									
4									
5									
6		All welds accepted							
7									
8									
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50									

**SURFACE CONDITION**  
GOOD ( ☒ ) FAIR ( ) PAINTED ( ) WELD ( ☒ )

**EQUIPMENT**  
MAKE Electro Spec MODEL ES-X S/N 9542

**CONTRACTS**  
PROD SPACING 6" 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: 1/25/06

**ACCEPTANCE CRITERIA**  
AWS D1.1 Sect. 6.10 (Latest Edition)

TOTAL TIME HRS. 1



# 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

Report No. M 52386

GXT MPVWM 001 Rev. 14

CLIENT Oil Star DATE 2/17/06  
CONTRACTOR Oil Star JOB LOCATION Mulberry Rd.  
JOB NO. Wp # 24005 CLIENT REPRESENTATIVE Craig Hildner  
MT TECH. Lois Cormier Level II REMARKS m.t. inspection

	WELD NO.	WALL THICKNESS	RECOMMENDATIONS		WELD NO.	WALL THICKNESS	RECOMMENDATIONS	
			ACCEPT REJECT	REMARKS			ACCEPT REJECT	REMARKS
1	100%	m.t.		inspection of all	51			welds on Kellie beam top
2					52			
3	weldment			Model 340 J.	53			
4					54			
5					55			
6				All welds accepted	56			
7					57			
8					58			
9					59			
10					60			
11					61			
12					62			
13					63			
14					64			
15					65			Total weld = 640"
16					66			Total repair = 0"
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								
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 Electro spec MODEL ES-X S/N 9542

**CONTRACTS**  
PROD SPACING 6" 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: 2/17/06

**ACCEPTANCE CRITERIA**  
AMS D1.1 Sect. 6.10 (total dilution)

TOTAL TIME HRS. (2)



# OCEANEERING® INSPECTION

REPORT NO. 376315

(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>5-22-06</b>
Billing Address	Project <b>NO # 24005</b>	Oil Job Number <b>52348</b>
	P.O. #	PKC / AFE #
	S.S. Procedure # <b>AWT MC-02-REV1</b>	Acceptance Criteria <b>AWT 2.1.1</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

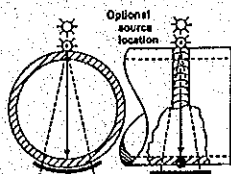
Job Description:

WET MAG PARTICLE									
WELD NO.	PIPE SIZE	RECOMMENDATION			WELD NO.	PIPE SIZE	RECOMMENDATION		
		✓	X	REMARKS			✓	X	REMARKS
1					31				
2	100 % MT OF LOAD				32				
3	CELL INDICATOR				33				
4	BRACKETS				34				
5					35				
6					36				
7					37				
8					38				
9	MTI				39				
10					40				
11					41				
12					42				
13	ALL WELDS ACCEPTED				43				
14					44				
15	20 AWS 2.1.1 LATEST				45				
16					46				
17	EDITION				47				
18					48				
19					49				
20					50				
21	TOTAL COST = \$ 25.00				51				
22					52				
23					53				
24					54				
25					55				
26					56				
27					57				
28					58				
29					59				
30					60				

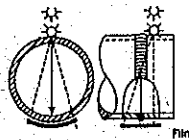
Technique: check exposure setup

SFD

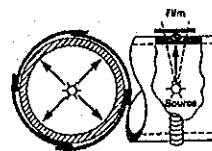
Thickness



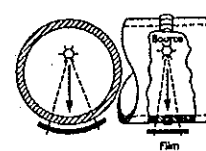
DWE/SWV ☐



DWE/DWV ☐



Panoramic ☐



SWE/SWV ☐

Film Delivered to: SS Manager: \_\_\_\_\_ Client: \_\_\_\_\_ Customer Representative: Amel J. Malen  
 X-Ray: \_\_\_\_\_ MAK V: \_\_\_\_\_ Gamma Ray: \_\_\_\_\_ Curies: \_\_\_\_\_ Date: 5-23-06 Technician: J. HEARD  
 No. of Welds Checked: \_\_\_\_\_ Focal Size: \_\_\_\_\_ Ug: \_\_\_\_\_ Assistant: \_\_\_\_\_ Assistant: \_\_\_\_\_  
 Linear Ft. Film: \_\_\_\_\_ Type: \_\_\_\_\_ Instrument: ESX-115  
 Penetrant-A \_\_\_\_\_ B \_\_\_\_\_ C \_\_\_\_\_ Required wire: \_\_\_\_\_ Angles Used: WET MAG  
 Dye Penetrant: \_\_\_\_\_ Ultrasonic: \_\_\_\_\_ Magnetic Particle: ✓ Freq: 145 Cal Bloc: 1016  
 Hours Worked: 1 Travel Time: \_\_\_\_\_ Mileage: \_\_\_\_\_ Couplant: 700CK  
 Sheet # \_\_\_\_\_ of \_\_\_\_\_ 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.





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# Material Traceability Log

CRANE WO. NO.:	24005
CUSTOMER:	PEMEX
WELDMENT PART NO.:	N61591-001
WELDMENT S/N:	05307-05
DESCRIPTION:	Bridle Weldment
MODEL:	340LA-100
CHECKED BY:	<i>Mike Miller</i>
DATE:	4-12-06

[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	SAGINAW PIPE	
H	1980 HWY 31 S	
I	PO BOX 8	
P	SAGINAW, AL	35137-0000
T		
O		

S	ASTM A572/A572M GR50-03a
P	ASTM A709/A709M-03a GR50 (345)
C	
F	
I	
C	
A	
T	
I	
O	
N	
S	ASTM A6/A6M-04a

S	SAGINAW PIPE	
O	1980 HWY 31 S	
L	PO BOX 8	
D	SAGINAW, AL	35137-0000
T		
O		

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														
1	S18 - 70.0 40' W460 x104.2 12.192 M	3	254954	.74	55000	74000	24			.07	1.12	.023	.039	.31	.32	.12	.16	.04	.00	.023	.33		
				.74	54000	73000	25											.01	.17				
					379	510	24																
					372	503	25																
2	S20 - 66.0 40' W508 x 98.2 12.192 M	3	243934	.76	58000	76000	24			.07	1.10	.019	.020	.28	.38	.13	.15	.02	.00	.021	.31		
				.78	59000	76000	25											.01	.17				
					400	524	24																
					407	524	25																
3	S20 - 66.0 40' W508 x 98.2 12.192 M	6	243935	.76	51000	67000	26			.07	1.10	.015	.021	.27	.41	.14	.13	.02	.00	.021	.32		
				.78	57000	73000	26											.01	.17				
					352	462	26																
					393	503	26																
4	S20 - 66.0 50' W508 x 98.2 15.240 M	3	243935	.76	51000	67000	26			.07	1.10	.015	.021	.27	.41	.14	.13	.02	.00	.021	.32		
				.78	57000	73000	26											.01	.17				
					352	462	26																
					393	503	26																

*gpc*  
12-3-05

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.

*Day Lennell*

QUALITY ASSURANCE

CUSTOMER COPY

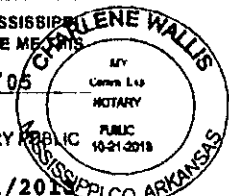
STATE OF ARKANSAS COUNTY OF MISSISSIPPI  
SWORN TO AND SUBSCRIBED BEFORE ME THIS

12 Day of 10/05

*Charlene Wallis*

NOTARY PUBLIC

MY COMMISSION EXPIRES 10/21/2015





COD QC - 3.1 B - REV2/2005

**SINARA GROUP S.A.****S.C. ARTROM - S.A. STEEL TUBES ENTERPRISE**


Drăgănești Street, no. 30, 230119 SLATINA, OLT, ROMANIA

Tel: +40-249-436 862, Fax: +40-249-434 330, 437 288

E-mail: office@artrom.ro; www.artrom.ro

J28/9/1991, VAT No: 1510210/1992, Share Capital: 30792730,2 RON

**MILL'S TEST CERTIFICATE**

No.: 11274 Date: 28.10.2005	Manufacturer's mark : 	Customer Order No.: 4847-0504-0703 2087
<b>CUSTOMER :</b> SEBA PIPE LTD. 9801 WESTHEIMER SUITE 203 HOUSTON, TX 77042 U. S. A.		
<b>Specifications:</b> ASTM A 519-03; ST-001, Rev.1 ASTM A106-02; ASME SA 106-01; NACE MR01.75-03		<b>Dimensions:</b> 5.000" x 0.750" <b>Steel :</b> GRADE 1026 / GRADE B/C
<b>Description of Goods :</b> PO 4847- 0504-0703 PRIME NEWLY PRODUCED SEAMLESS CARBON STEEL HOT- FINISHED MECHANICAL TUBING ACCORDING TO LATEST EDITIONS OF SPECIFICATIONS ASTM A519-03 GRADE 1026, ASTM A106-02 GR. B/C, ASME SA106-01 GR. B/C AND NACE MR01.75-03 AND SEBA TUBULAR ST-001 REV. 1		
<b>Heat No.:</b> 17059		
<b>Quantity</b>	<b>Pcs</b>	<b>Length m</b>
	15	95.96
		<b>Theoretical Weight kg</b>
		4861.06

**Ladle Chemical Analysis**

C	Mn	S	P	Si	Ni	Cr	Mo	Cu	Al	V	Nb	CEQ
0.28	0.90	0.006	0.020	0.24	0.10	0.15	0.02	0.22	0.033	0.010	0.001	0.49
Cu+Ni+Cr+Mo+V: 0.50						Cr+Mo: 0.17						

**Product Chemical Analysis**

C	Mn	S	P	Si	Ni	Cr	Mo	Cu	Al	V	Nb
0.27	0.90	0.008	0.021	0.23	0.10	0.15	0.03	0.22	0.033	0.009	0.001
0.28	0.89	0.006	0.019	0.24	0.11	0.14	0.01	0.23	0.030	0.010	0.003

**Mechanical Properties**

TENSILE TEST -at room temperature Test Specimen : Round longitudinal / 0.5 inch	Yield stress 0.2% OFFSET/ 0.5% EUL PSI	UTS PSI	Elongation in 2 in. %	Reduction of area %
Dimension - Specimen (inch) 0.4988	48200/49600	80400	25	57
Section - Specimen (inch <sup>2</sup> ) 0.1954				
Length - Specimen (Lo) (inch) 2				

Non-destructive testing in lieu of hydrostatic test  
Test US acc. API SCT 7 th Ed. Sec 10.15 A.2: OK  
Flattening test (ASTM A530): OK

Process of melting -electric arc furnace -argon rinse, fully killed  
Hardness HRC max 22 (BHN: 161- 164- 161)  
Grain size ASTM E 112 : 8.5

Visual and dimensional inspection of the tubes were performed and the results were satisfactory  
" This product is free from mercury contamination "  
" NO WELD REPAIR HAS BEEN PERFORMED ON TUBES "

**QUALITY DEPARTMENT MANAGER**

Dipl. Eng. Magdalena Popescu

**MILL INSPECTOR**

Cornel Stefanescu

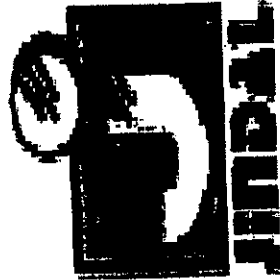
S.C. ARTROM S.A.  
AVIZAT C.T.C.  
3  
SLATINA



3-11-06

THIS IS FOR CERTIFY THAT THE MATERIAL HEREIN DESCRIBED HAS BEEN MANUFACTURED WITH THE ORDERED SPECIFICATION AND THAT INFORMATION IS CORRECT, THEY MEET THE SPECIFICATION'S REQUIREMENTS AND CONTAINED THE RECORDS OF THE COMPANY.





# Jindal United Steel Corporation

5200 E. McKinney Road

Baytown, TX 77520

## METALLURGICAL TEST REPORT

MET-04  
TC No.: BR34053-2916-02

<b>Sold To:</b> CHAPAL STEEL CO. 590 NORTH BETHLEHEM PIKE P.O. BOX 1000 SPRING HOUSE, PA 19477-1000		<b>Ship To:</b> CHAPAL 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. 34053</b>	
<b>Order No:</b> JUS1642-09		<b>Approved By:</b> <i>Helen Gurn</i>					
<b>Date:</b> 1/19/2006		<b>P.O. Number:</b> HOU-2662		<b>Shipping Mode:</b> DIRECT TRUCK			
<b>Plates Manufactured in the USA</b>				<b>DIN 50049 3.1.B / EN 10204 3.1.B</b>			

**Specifications:**  
HOT ROLLED PLATE CUT EDGE ASTM A36 -05 / ABS GR A/B & A709 - 05 GR 36  
STRUCTURAL QUALITY

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	Wgt							in 8"	in 2"		
09	1.0000	96.0000	480.0000	1	13.068	S02916	1.000	08B	ABS	42	66	29	0.2%	34 - 35 - 42 3/4mm @ 32°F	FULL mm @ 32DEG F 25 FT/LBS
<div>AMERICAN BUREAU OF SHIPPING ABS HOUSTON, TEXAS 77002 10 2013 <i>Handwritten Signature</i></div>															
														HS6754412X	

Heat No.: S02916		CE: 0.36														
Test Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Cb
LADLE	0.15	1.08	0.020	0.009	0.25	0.05	0.05	0.08	0.010	0.001	0.035	0.005	0.005	0.0005	0.005	0.010

2-6-06



*Metallurgical Chemistry and Testing Laboratory*

3204 BROADWAY (77017)  
POST OFFICE BOX 282265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
metalltesters@an.com

January 30, 2006

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/25563  
Report No. 06-0189-3

IDENTIFICATION: 1" x 4" x 6", HT# S02916, SL# 05BA  
MATERIAL: ASTM A36  
REFERENCE: HOU25563

IMPACT TEST

10mm x 10mm CVN @ +10°F

(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
65.0	62	30
89.0	81	40
77.0	70	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.

PC  
  
2-6-06

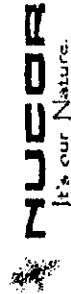


**NUCOR**  
P.O. Box 279  
Winston, NC 27986  
(252) 356-3700

**PLATE MILL**

## Mill Test Report

Page 4



Issuing Date : 04/05/2006  
Vehicle No : TTPX 804094  
Specification : 2.0000" x 96.0000" x 480.0000"  
ASTM A36-04/ABS Grade A/ABS Grade B/ASME SA36-00/A709 36-04

Load No. : 98219  
Our Order No. : 3357315  
Ship To : CHAPEL STEEL CO  
P O Box 1000  
FAX# 215-793-9415  
SPRINGHOUSE, PA 19477

Cust. Order No. : HOU-2230  
Ship To : CHAPEL STEEL  
6606 N. HOUSTON ROSSLYN ROAD  
RAIL SITE 720703  
HOUSTON, TX 77081

Marking :

Heat No	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Alz	V	Nb	Ti	N	Ca	B	Sn	CEQ	PCM
5102560	0.07	1.11	0.008	0.001	0.33	0.33	0.08	0.07	0.03	0.039	0.006	0.006	0.001	0.001	0.0016	0.0001	0.017	0.30	0.16
Plate Serial No	Tensile Test										Charpy Impacts								
	Pieces	Dir.	Yld	Tensile	Elongation % in 2"	Elongation % in 8"	Dir.	1	2	3	(ft-lb) shear	(ft-lb) shear	(ft-lb) shear	(ft-lb) shear	(ft-lb) shear	Ave.	Size	Temp (°F)	Ave.
5102560-03	3	T	40,900	62,200	25.6	22.0	H-L	247.0	258.7	251.3	252.3	251.3	250.8	251.3	251.3	251.3	10mm	32	20
		T	44,900	61,700			H-L	245.7	257.3	250.8							10mm	32	20

Manufactured to fully killed fine grain practice. 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 0.5SEUL method unless otherwise specified. Ceq = Cr (Mn/8) + (Cu+Ni/15)

Pcm = Cr (Si/20) + Mn/20 + (Cu/20) + (Ni/20) + (V/10) + 58  
Milled and manufactured in the USA. ISO 9001:2000 certified (#12443-0) by SRI Quality System Registrar (#0985-09)  
EN 50049 3.1 B EN 10204 3.1 B compliant For ABS grades only. Quality Assurance certificate No. IQ-MMPQA-192

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. Deparis, Metallurgist

04/13/2006 2:12:19 PM





Metallurgical Chemistry and Testing Laboratory

3204 BROADWAY (77017)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 844-7501  
FAX: (713) 844-1400  
metalltesters@msn.com

CUSTOMER NAME CHAPEL STEEL P.O. NO. 10647/22540 DATE 4-28-05  
IDENTIFICATION 2"x4"x16" HT S102560 MC# 03 NUCOR  
MATERIAL A37M A36 SPECIFICATION \_\_\_\_\_  
TEST REQUIRED: PHYSICAL: .505", RST, CVN B, DW, HARDNESS, MACRO, HOT ETCH  
CHEMICAL: 1<sup>ST</sup> 5, 1<sup>ST</sup> 5+  
METALLURGY: MICRO, GS, PHOTO, McQUAID EHN, MACRO, MICROHARDNESS  
HEAT TREAT:  
NDE: UT, LP, MP

TENSILE TEST						
SPECIMEN	DIA.	AREA/SQ.IN.	Y.S. PSI	ULT. LD. LBS.	T.S. PSI	%EL IN "%R.A.

IMPACT TEST @ 10 or - (°F) (°C)				
SPECIMEN SIZE	ORIENTATION	FOOT/POUNDS	LATERAL EXPANSION(MILS)	%SHEAR
10mm x 10mm LONG -		217.0	81	100
-		212.0	84	100
-		221.0	83	100

CHEMISTRY							
C	S	Mn	P	Si	Cr	Mo	Ni Cu

INVOICE NO \_\_\_\_\_

REPORT NO 05-1085



Attn:

**NUCOR**  
**PLATE MILL**  
P.O.Box 279  
Winton, NC 27986  
(252) 356-3700

**Mill Test Report**  
Page 3

**NUCOR**  
It's our Nature.

Issuing Date : 11/06/2006  
Vehicle No: ATW 63009  
Specification : 2.0000" x 96.000" x 489.000"  
ASTM A36-05/ABS Grade A/ABS Grade B/ASME SA36-03/A709 36-05

Load No. : 114731  
Sold To : CHAPEL STEEL CO  
P O Box 1000  
FAX# 216-793-9415  
SPRINGHOUSE PA 19477

Cust. Order No. : HOU-2646  
Ship To : CHAPEL STEEL  
6605 N. HOUSTON ROSSLYN ROAD  
RAIL SITE 726703  
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
5107099	0.06	1.10	0.015	0.012	0.29	0.19	0.07	0.09	0.00	0.024	0.006	0.006	0.001	0.0071	0.0007	0.0004	0.010	0.28	0.14
Plate Serial No	Tensile Test										Charpy Impacts								
	Pieces	Dir.	Yield	Tensile	Elongation	Dir.		1		2		3		Avg.		Shear		Size	Temp (F)
5107099-06	3	T	37,400	59,200	33.7	H-L	250.4	249.7	251.6	253.2	254.6	250.9	251.6	252.3	252.2	250.6	252.3	10mm	32
		T	39,700	58,000	24.0	H-L	249.2	247.7	250.9	251.6	253.2	250.9	251.6	252.3	252.2	250.6	252.3	10mm	32
5107099-06	1	T	37,400	59,200	33.7	H-L	250.4	249.7	251.6	253.2	254.6	250.9	251.6	252.3	252.2	250.6	252.3	10mm	32
		T	39,700	58,000	24.0	H-L	249.2	247.7	250.9	251.6	253.2	250.9	251.6	252.3	252.2	250.6	252.3	10mm	32

Manufactured to fully killed line 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 were performed by the material manufacturer and are in compliance with the applicable specifications.

Yield by 0.50% method unless otherwise specified. Ceq = C + (Mn/6) + ((Cr + Mo + V)/5) + ((Cu + Ni)/15).  
Pcm = C + Si/20 + Mn/20 + Ni/20 + Cr/20 + Mo/10 + V/10 + Nb/10 + Ti/10 + B.  
Certified and manufactured in the USA. ISO 9001:2000 certified (#12493-0) by SRI Quality System Registrar (#00085-09). PED 07/23/06 C-Compliant.  
DN 50049 3 1 BSEN 10204 3 1 B2004) compliant. For ABS grades only. Quality Assurance certificate No. 03-44MPOA-162.

11/09/2006 4:14:57 PM

T. A. Depietre, Metallurgist





Metallurgical Chemistry and Testing Laboratory

3204 BROADWAY (17617)  
POST OFFICE BOX 262265  
HOUSTON, TEXAS 77207-2265  
PHONE: (713) 644-7501  
FAX: (713) 644-1400  
E-MAIL: [info@an-tech.com](mailto:info@an-tech.com)

January 3, 2006

Page 1 of 1

Chapel Steel  
Attn: Jennifer Joiner  
6605 N. Houston Rosslyn Rd.,  
Houston, TX 77091

P.O. No. 10647/25230  
Report No. 05-3483-3

IDENTIFICATION: 2" x 4" x 6", HT# 5107099 SL# 05  
MATERIAL: ASTM A36

IMPACT TEST

10mm x 10mm CVN @ +10°F  
(Longitudinal)

<u>Foot/Pounds</u>	<u>Lateral Expansion (mils)</u>	<u>%Shear</u>
217.0	107	100
112.0	94	60
214.0	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.

9cc  
1-10-06





# 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.

PO: 45665

ACCORDANCE

WITH

PRODUCT

FLATS

DATE 02/15/06

Cust S-0050 -0021

HEAT NO. 46D92

GRADE A3652950 -

Length 20'0"

36 PCS

SIZE F 4 X 1/2 X 6.808

CHEMICAL ANALYSIS	
C	.13
Mn	.81
P	.016
S	.025
Si	.17
Cu	.24
Ni	.21
Cr	.14
Mo	.056
Cb	.022
V	.000
B	.008
Al	
Sn	
N	
Ti	

MECHANICAL PROPERTIES	TEST 1		TEST 2		TEST 3	
	IMPERIAL	METRIC	IMPERIAL	METRIC	IMPERIAL	METRIC
YIELD STRENGTH	56,834 PSI	392 MPa	55,955 PSI	386 MPa	PSI	MPa
TENSILE STRENGTH	74,622 PSI	515 MPa	73,346 PSI	506 MPa	PSI	MPa
ELONGATION	34.0 %	34.0 %	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	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: 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

DATE OF THE CERTIFICATION: 02/15/06

SIGNED

MARK EDWARDS, QUALITY ASSURANCE SUPERVISOR

*Mark Edwards*

DIRECTOR OF QUALITY ASSURANCE, BAYOU STEEL CORPORATION

05/1  
FAX  
ATTN  
PO #

From: THOMAS PIPE & STEEL

To:



# GLOBAL X-RAY & TESTING CORPORATION

JOEL MOREAU, President  
Residence: 504-446-6861

Post Office Box 1336  
Morgan City, Louisiana 70381

Bus: 504-631-2426  
Fax: 504-631-0093

## MT WORK REPORT

Report No. M  
24555

GXT MPVWM001 Rev. 14

CLIENT Oil states DATE 4/18/06  
CONTRACTOR Oil states JOB LOCATION Mulberry Rd.  
JOB NO. W0# 24005 CLIENT REPRESENTATIVE Craig Phillips  
MT TECH. Louis Carmine level II REMARKS M.T. inspection

	WELD NO.	WALL THICKNESS	RECOMMENDATIONS		WELD NO.	WALL THICKNESS	RECOMMENDATIONS	
			ACCEPT REJECT	REMARKS			ACCEPT REJECT	REMARKS
1	100%	m.T.		inspection of all welds on brittle weldment	52			
2					53			
3	model 340L				54			
4					55			
5					56			
6					57			
7					58			
8					59			
9					60			
10					61			
11					62			
12					63			
13					64			
14					65			
15					66			
16					67			
17					68			
18					69			
19					70			
20					71			
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39								
40								
41								
42								
43								
44								
45								
46								
47								
48								
49								
50								

100% m.T. inspection of all welds on brittle weldment  
model 340L  
All welds accepted

Total weld = 340"  
Total repair = 0"

**SURFACE CONDITION**  
GOOD (✓) FAIR ( ) PAINTED ( ) WELD (✓)

**EQUIPMENT**  
MAKE ELECTRO SPEC MODEL E3-X S/N 9572

**CONTRACTS**  
PROD SPACING 6 CONTINUOUS (✓)  
AC (✓) DC ( ) HALF WAVE ( ) FULL WAVE ( )  
AMPS 5.75

**MEDIA**  
7C-BLACK WET (✓) 8A-DRY ( ) WHITE HIGHLIGHTER (✓)

**CALIBRATION**  
10# WEIGHT LIFT ( ) FLUX AND CHECK ( )  
CALIBRATION DATE: 4/18/06

**ACCEPTANCE CRITERIA**  
AWS D1.1 Sect. 6.10 (1st ed. 11/90)

TOTAL TIME HRS 1



# GLOBAL X-RAY & TESTING CORPORATION

JOEL MOREAU, President  
Residence: 504-446-6861

Post Office Box 1536  
Morgan City, Louisiana 70381

Bus: 504-631-2426  
Fax: 504-631-0093

## MT WORK REPORT

Report No. M

24649

GXT MPVWM 001 Rev.14

CLIENT Oilstate DATE 4/26/06  
CONTRACTOR Oilstate JOB LOCATION Mathew Rd.  
JOB NO. W# 24005 CLIENT REPRESENTATIVE David J. Malone  
MT TECH. Mitch Herbert Level II REMARKS M.T. Inspection

	WELD NO.	WALL THICKNESS	RECOMMENDATIONS				WELD NO.	WALL THICKNESS	RECOMMENDATIONS		
			✓	✗	REMARKS				✓	✗	REMARKS
1					100% M.T. inspection of all weld on pendant links.		52				
2							53				
3					All weld accepted		54				
4							55				
5							56				
6							57				
7							58				
8							59				
9							60				
10							61				
11							62				
12							63				
13							64				
14							65				
15							66				
16							67				Total weld = 40"
17							68				Total Repair = 0"
18							69				
19							70				
20							71				
21							72				
22							73				
23							74				
24							75				
25							76				
26							77				
27							78				
28							79				
29							80				
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42											
43											
44											
45											
46											
47											
48											
49											
50											

SURFACE CONDITION  
GOOD (✓) FAIR ( ) PAINTED ( ) WELD (✓)

EQUIPMENT  
MAKE ElectroSpec MODEL ES-X S/N 2572

CONTRACTS  
PROD SPACING 6" 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: 4/26/06

ACCEPTANCE CRITERIA  
RWS D1.1 Sect. 6.10 (2004 Edition)

TOTAL TIME HRS. 1





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**Bosnor**

**S. A. DE C. V. / Pemex**

# **Vendor Data Book**

**P.O. # 1550-0268/05-01**

**Serial # 24005C**

**Volume: 1**

## **Nautilus Crane Model 340LA-100**

### **Section 2.0**

### **Pin Certificates**



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA





# Lattice Boom Style

## PIN CERTIFICATE SHEET

DATE: February 9, 2006  
CUSTOMER: PEMEX

REV.: A

MODEL NO.: 340LA-100

WORK ORDER NO.: 24005 & 24105

MATERIAL: SS = Stainless Steel with 100,000 PSI Minimum Yield		4140 = 4140 with 100,000 PSI Minimum Yield		S = Special			
COATING: U = Uncoated		F = Fluorocarbon Coated		S = Special			
COMPONENTS	PART NUMBER/REV.	PIN NO.*	HEAT NO.	MATERIAL		COATING (4140 Only)	
				SS	4140	U	F
BOOM FOOT PIN 4" x 15 5/8"	N61595-001 (2) Rev. B	P1 P2	546180	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
GANTRY / UPPERSTRUCTURE PIN 4" x 12 3/8"	N61596-001 (2) Rev. C	P3 P4	546180	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
MAIN IDLER PIN 3" x 36"	N61604-001 (2) Rev. C	P5 P6	537700	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
LOWER AUXILIARY EXTENSION PIN 3" x 12 3/4"	N61605-001 (1) Rev. C	P7	537700	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
BOOM CONNECTION PIN 2 1/2" x 7 3/8"	N60986-004 (8) Rev. C	P8-P15	G11116	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
BOOM LIFTING PADEYE PIN 2 1/2" x 9 1/2"	N60986-005 (4) Rev. C	P16-P19	G11116	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
BRIDLE / GANTRY PIN 3" x 26"	N61603-001 (2) Rev. C	P20 P21	537700	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
MAIN EXTENDED WEDGE SOCKET PIN 1 1/4" x 6 1/8"	N60645-001 (1) Rev. B	P22	R0582-B70	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
LOAD CELL PIN 1 1/4" x 5 1/4"	N60646-004 (2) Rev. C	P23 P24	R0582-B70	<input checked="" 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:

  
5-17-06





# EDELSTAHL WITTEN-KREFELD GMBH

Austraße 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: 30.06.05

Seite/Page: 1 / 2

Zertifiziert nach	ISO 9001 VDA 6, Teil 1	Werkstofflieferant gemäß Druckgerätee-richtlinie 97 / 23 EG
	AD2000 W 0 TRD 100	

Abnahmeprüfzeugnis nach  
Inspection Certificate acc.to/Certificat de réception selon  
Zeugnis-Nr./Certificate No./No.de Certificat

DIN EN 10204 3.1/01.05  
DIN EN 10204 3.1B/08.95  
959209/705337/bit

Edelstahl Witten-Krefeld GmbH, D-58449 Witten  
ThyssenKrupp Specialty Steels  
NA, Inc.  
365 Village Drive  
US- Carol Stream, Illinois 60188

Herstellerzeichen/Supplier's Mark/Marque d'usine	
Prüfstempel/Inspector's stamp/Poinçon de l'expert	

Warenempfänger  
Best Stainless & Alloys  
3616 Old Spanish Trail  
US-77021 Houston TX

Ihre Auftr.-Nr. vom Your order No. date /No.de votre commande du 01D04567/BSS&A 22192 / 05.11.04	Your material No. 3309
Unsere Auftr.-Nr. Our order No./No.de notre commande 260345 / 5	Unsere Material-Nr. Our material No./No.de notre matériel 2219276
Unsere Abteilung/Our department/Notre département VBR4	Telefon/Téléphone/Téléphone 02302/294215

## Produkt/Product/Produit

STAINLESS STEEL BARS  
TYPE 303, 17-4 PH  
HOT ROLLED, SOLUTION ANNEALED,  
STRAIGHTENED, PEELED  
ASTM A 370-02, ASTM A 564-02A,  
ASME SA 564-01, AMS 5643 P, UNS-S-17400  
AMS 7303, ASTM A 184

Fertigungsauftr.-Nr./Production lot-No./Lot de fabrication No. : 65777  
Lieferschein-Nr./Delivery note/No. de l'avis de livraison :  
Schmelzen-Nr./Heat No./No.de coulée : 546180  
Stückzahl/Piece No./Nombre des pièces :  
Gewicht/Weight/Masse :  
Zeichnungs-Nr./Drawing No./No.du dessin :  
Format/Shape/Profil : rund / round / rond  
Durchm./Breite/Diameter/width/Diamètre/largeur : 102.616 [mm] / 4.040 [in]  
+0.508/-0.000 [mm] / +0.020 [in]  
Dicke/Thickness/Epaisseur :  
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.

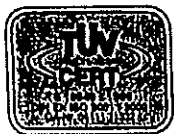
Lieferzustand/Condition as supplied/Etat de livraison: 1040 °C/Water  
NO WELDING HAS BEEN PERFORMED

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.

EDELSTAHL WITTEN-KREFELD GMBH  
Abnahmetechnik/Inspection department/Département de Réception

Abnahmebeauftragter/Der Werkssachverständige  
Test House Manager/Works' inspector/Responsible Reception/L'Agent Réceptionnaire de l'usine





# EDELSTAHL WITTEN-KREFELD GMBH

Austraße 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: 28.06.05

Seite/Page: 2 / 2

Zeugnis-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	Fertigungsauftr.-Nr. Production lot-No./Lot de fabrication No.
958896/705040/bit	260345 / 10	01D04567/BSS&A 22192	67147

Schmelzen-Nr. Heat No./No.de coulée	Erschmelzungsart Steelmaking process/Procédé d'élaboration	Sekundärmetallurgie Secondary metallurgy/Metallurgie secondaire
546180	E	VOD

## Chemische Zusammensetzung/ Chemical Composition/ Composition chimique

	C	Si	Mn	P	S	Cr	Mo	Ni	Cu	Nb	
Ist/Actual/Actuel	0.024	0.41	0.90	0.021	0.004	15.60	0.05	4.63	3.15	0.25	(%)

## Härte/ Hardness/ Dureté

Lieferzustand/Condition as supplied/Etat de livraison

Proben-Nr./Specimen-No./No.d'éprouvette	59777	
Ist/Actual/Actuel	307	[HB]

## Zugversuch/ Tensile test/ Essai de traction

Referenzzustand/Reference condition/Etat de référence: 1040 °C 60 min./ /Water+ 480 °C 60 min./ /Air

Probenabm./Specimen dimension/Dimension d'éprouvette	Probenrichtung/Specimen direction/Sens de Prélèvement		Prüftemp./Test temperature/Température d'essai			
Zugprobe; 12,5 mm rd	längs/longitudinal/longueur		23 [°C]			
Proben-Nr./Specimen-No./No.d'éprouvette	Rp0.2 [MPa (N/mm²)]	Rp0.2 [Ksi]	Rm [MPa (N/mm²)]	Rm [Ksi]	A2'' [%]	Z [%]
56206	1188	172	1322	192	18.0	57

## Gefügeuntersuchung/ Examination of microstructure/ Examen de structure MICRO- AND MACROSTRUCTURE NO OBJECTIONS

## Ferritgehalt/ Ferrite content/ Contens de ferrite

Proben-Nr./Specimen-No./No.d'éprouvette	Ferrit/Ferrite/Ferrite
59778	2(%)

Delivery has been checked by US-testing

Identity has been checked(Spectro.)

Visual inspection and control of dimensional accuracy have been performed

Das Material ist frei von Radioaktivität./The Product is free from radioactive./Le matériel n'est pas radioactif.  
El material es libre de radioactividad.

## Erläuterung/ Explanations/ Explications

■ Erschmelzungsart/Steelmaking process/Procédé d'élaboration

E = Elektrostahl / Electric-arc-furnace steel / Acier électrique

■ Sekundärmetallurgie/Secondary metallurgy/Metallurgie 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 a été vérifiée et est conforme aux stipulations de l'acceptation de la commande.

1-25-04



SHT 10

# SPECIALTY HEAT TREAT, INC.

## CERTIFICATE OF HEAT TREATMENT

CUST NO: B043  
CUST NAME: BEST STAINLESS & ALLOYS  
CUST ADDR: 3616 OLD SPANISH TRAIL  
HOUSTON, TX 77021  
QUANTITY: 9  
LOCATION/DATA: BARN  
DATE RECD: 01/12/06  
CUST PH: 713-749-5900/5907  
CUST PO# 6387  
CUST REF# HN  
MAIL: 17-4 ANN  
WGT: 4,100  
DUE DATE: 01/12/06  
STICKER #: 38390

DESC: HN 537700 1 @ 3"OD X 265"LG 1 TP @ 6"LG  
HN 241029 1 @ 3 1/2"OD X 280 3/4"LG 1 TP @ 6"LG  
HN 546180 4"OD X 1 @ 257"LG; 1 @ 263"LG 1 TP @ 6"LG  
HN 539350 1 @ 5"OD X 242"LG 1 TP @ 6"LG

PROCESS INSTRUCTIONS: HEAT TREAT TO H1150

PROCESSED AS FOLLOWS:

5" - MCS

CONTROLLED BY FURNACE INSTRUMENT:

PROCESS	TIME	TEMP IN DEG F	COOLING METHOD
AGE HARDEN	4 HOURS	1150	A/C TO AMBIENT

HARDNESS TESTED: CK TP (2 PLCS) PER HN 537700 = 31-31 RC  
HN 241029 = 31-31 RC; HN 546180 = 31-31 RC  
HN 539350 = 31-32 RC  
CK 1 PC PER SIZE HN 537700 = 31 RC  
HN 241029 = 31 RC; HN 546180 = 31 RC  
HN 539350 = 31 RC

HN 546180  
MECHANICAL PROPERTIES OF A 0.505" DIA TP PER ACCU-TEST LAB#: 309841.0

TENSILE	YIELD .2% OFF	YIELD. EUL	ELONG IN 2"	REDUCTION
137,800 PSI	113,500 PSI	PSI	19.3%	61.6%

HN 537700  
MECHANICAL PROPERTIES OF A 0.508" DIA TP PER ACCU-TEST LAB#: 309839.0

TENSILE	YIELD .2% OFF	YIELD. EUL	ELONG IN 2"	REDUCTION
139,600 PSI	115,400 PSI	PSI	20.3%	63.0%

HN 539350  
MECHANICAL PROPERTIES OF A 0.504" DIA TP PER ACCU-TEST LAB#: 309842.0

TENSILE	YIELD .2% OFF	YIELD. EUL	ELONG IN 2"	REDUCTION
142,400 PSI	116,400 PSI	PSI	19.9%	56.6%

HN 241029  
MECHANICAL PROPERTIES OF A 0.504" DIA TP PER ACCU-TEST LAB#: 309840.0

TENSILE	YIELD .2% OFF	YIELD. EUL	ELONG IN 2"	REDUCTION
144,000 PSI	129,800 PSI	PSI	19.4%	59.7%

ALL MATERIALS ON THIS ORDER WERE  
PROCESSED IN ACCORDANCE WITH OUR  
QUALITY MANUAL QM REV 4 DATED 1/31/99.

SPECIALTY HEAT TREAT, INC.

BY

REC  
1-25-06





# EDELSTAHL WITTEN-KREFELD GMBH

Austraße 4  
D-48452 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: 1 / 2

Zertifiziert nach:	ISO 9001 VDA 6, Teil 1	Werkstofflieferant gemäß Druckgerätnormen 97/23 EG
	AD2000 W 0 TRD 100	

Abnahmeprüfzeugnis nach  
Inspection Certificate acc.to/Certificat de réception selon  
Zeugnis-Nr./Certificate No./No.de Certificat

DIN EN 10204 3.1/01.05  
DIN EN 10204 3.1B/08.95  
964679/704412/bit

Krefeld Witten - Krefeld GmbH, D-58449 Witten  
ThyssenKrupp Specialty Steels  
NA, Inc.  
365 Village Drive  
US- Carol Stream, Illinois 60188

Herstellerzeichen/Supplier's Mark/Marque d'usine	WK
Prüfstempel/Inspector's stamp/Poinçon de l'expert	QA

Wackermaier  
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 VBR4	Telefon/Telephone/Téléphone 02302/294215

## Produkt/Product/Produit

STAINLESS STEEL BARS  
TYPE 430, 17-4 PH  
HOT ROLLED, SOLUTION ANNEALED,  
STRAIGHTENED, PEELED  
ASTM A 370-02, ASTM A 564-02A,  
ASME SA 564-01, AMS 5643 P, UNS-S-17400  
AMS 2303, ASTM A 484

Fertigungsauftr.-Nr./Production lot No./Lot de fabrication No. 162157  
Lieferschein-Nr./Delivery note/No. de l'avis de livraison :  
Schmelzen-Nr./Heat No./No.de coulée : 537700  
Stückzahl/Piece No./Nombre des pièces :  
Gewicht/Weight/Masse :  
Zeichnung-Nr./Drawing No./No. du dessin :  
Format/Shape/Profil : rund / round / rond  
Durchm./Breite/Diameter/width/Diamètre/largeur : 77.216(mm) / 3.040(in)  
+0.506/-0.000(mm) / +0.020(in)  
Dicke/Thickness/Epaisseur :  
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/Etat 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.

EDELSTAHL WITTEN-KREFELD GMBH  
Abnahmetechnik/Inspection department/Département de Réception

Abnahmebeauftragter/Der Werkstachverständige  
Test House Manager/Works' inspector/Responsable Réception/L'Agent Réceptionnaire de l'usine

11-8-05





# **EDELSTAHL WITTEN-KREFELD GMBH**

Außenstraße 4  
D-58452 Witten  
Telefon: (02302)29-0  
Telefax: (02302)29-40 00  
Postanschrift: D-58449 Witten  
<http://www.edelstahl-witten-krefeld.de>

Uhrzeit/Date: 11.07.05

Seite/Page: 2/2

Zugprobe-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	Fertigungsauftr.-Nr. Production lot-No./Lot de fabrication No.
964679/704412/bit	260345 / 1	01204567/US&A 22192	42157

Schmelz-Nr. Heat No./No. de coulée	Erschmelzungsart Steelmaking process/Procédé d'élaboration	Sekundärmetallurgie Secondary metallurgy/Metallurgie secondaire
537700	E	VOD

## **Chemische Zusammensetzung/ Chemical Composition/ Composition chimique**

	C	Si	Mn	P	S	Cr	Mo	Ni	Cu	Nb	
Ist/Actual/Actuel	0.021	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	361	[HB]

## **Zugversuch/ Tensile test/ Essai de traction**

Referenzzustand/Reference condition/Etat de référence: 1040 °C 60 min./ /Wasser+ 480 °C 60 min./ /Aix

Probenabm./Specimen dimension/Dimension d'éprouvette	Probenrichtung/Specimen direction/Scus de Prélèvement		Prüftemp./Test temperature/Température d'essai			
Zugprobe: 12,5 mm rd	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
38247	1 [%]

Delivery has been checked by US-testing

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**

- Erschmelzungsart/Steelmaking process/Procédé d'élaboration
- E = Elektro Stahl / Electric-arc-furnace steel / Acier électrique
- Sekundärmetallurgie/Secondary metallurgy/Metallurgie secondaire
- VON = 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 a été vérifiée et est conforme aux stipulations de l'acceptation de la commande.

11-8-05



**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	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

*gpc*  
11-8-05



**Tensile  
Certification  
Report**

**Tejas Testing & Inspection, Inc.**  
4601 South Pinemont, Suite 136  
Houston, TX 77041  
Phone: (713) 939-0440 • Fax: (713) 939-0430

OK

Report: T030875 -Customer: K & D Heat Treat, Inc.PO Number 5922Material: 17-4PHHT No. 537700No. Pieces: 1Customer Info.: TEST PIECE: 3"OD X 6"LGSpecification: 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

TIP Representative

Date: 11/3/2005

REC  
088  
11  
11-8-05





# EDELSTAHL WITTEN-KREFELD GMBH

Austraße 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: 1 / 2

Zertifiziert nach:	ISO 9001	Werkstofflieferant gemäß Druckgerätesrichtlinie 97/23 EG
	VDA 6, Teil 1 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./Certificate No./No.de Certificat 964679/704412/bit

Edelstahl Witten-Krefeld GmbH, D-58449 Witten  
ThyssenKrupp Specialty Steels  
NA, Inc.  
365 Village Drive  
US- Carol Stream, Illinois 60188

Herstellerzeichen/Supplier's Mark/Marque d'usine	
Prüfstempel/Inspector's stamp/Poinçon de l'expert	

## Werkstoffdaten:

Best Stainless & Alloys  
3616 Old Spanish Trail

US-77021 Houston TX

Ihre Auftr.-Nr. vom Your order No. date /No.de votre commande du 01D04567/BSS&A 22192 / 05.11.04	Ihre Material-Nr. Your material No. 3309
Unsere Auftr.-Nr. Our order No./No.de votre commande 260345 / 1	Unsere Material-Nr. Our material No./No.de votre matériel 2219273
Unsere Abteilung/Our department/Nous département VBR4	Telefon/Telephone/Téléphone 02302/294215

## Produkt/Product/Produit

STAINLESS STEEL BARS  
TYPE 316, 17-4 PH  
HOT ROLLED, SOLUTION ANNEALED,  
STRAIGHTENED, PEEL.FO  
ASTM A 370-02, ASTM A 564-02A,  
ASME SA 564-01, ASME SA 564 P, UNS-S-17400  
AMS 2303, ASTM A 434

Fertigungsauftr.-Nr./Production lot-No./Lot or fabrication No.	162157
Liefererschein.-Nr./Delivery note/No. de l'avis de livraison	1
Schmelzen-Nr./Heat No./No.de coulée	537700
Stückzahl/Piece No./Nombre des pièces	1
Gewicht/Weight/Masse	1
Zeichnungs-Nr./Drawing No./No.de dessin	1
Format/Shape/Profil	rund / round / rond
Durchm./Breite/Diameter/width/Diamètre/largeur	177.216 [mm] / 3.040 [in] + 0.508 / - 0.000 [mm] / + 0.020 [in]
Dicke/Thickness/Épaisseur	1
Länge/Length/Longueur	16095 - 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/Weiss  
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.

EDELSTAHL WITTEN-KREFELD GMBH  
Abnahmetechnik/Inspection department/Département de Réception

Abnahmebeauftragter/Der Werkssachverständige  
Test House Manager/Works' Inspector/Responsable Réception/L'Agent Réceptionnaire de l'usine

1-23-06





# EDELSTAHL WITTEN-KREFELD GMBH

Aachenstraße 4  
D-58452 Witten  
Telefon: (02302)29-0  
Telefax: (02302)29-40 00  
Postfachschiff D-58449 Witten  
http://www.edelstahl-witten-krefeld.de

Datum/Date: 11.07.05

Seite/Page: 2 / 2

Zertifikat-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	Fertigungsauftr.-Nr. Production lot-No./Lot de fabrication No.
964679/704412/bil	160345 / 1	01D04367/BSS&A 22192	62157

Schmelz-Nr. Heat No./No. de coulée	Erstschmelzungsart Steelmaking process/Procédé d'élaboration	Sekundärmetallurgie Secondary metallurgy/Metallurgie 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	58246	
ist/Actual/Actuel	361	(HB)

## Zugversuch/ Tensile test/ Essai de traction

Referenzzustand/ Reference condition/ Etat de référence: 1040 °C 60 min./ / Water + 480 °C 60 min./ / Air

Probennr./Specimen dimension/Dimension d'éprouvette		Probenrichtung/Specimen direction/Sens de Prélèvement		Prüftemp./Test temperature/Température d'essai		
Zugprobe: 12,5 mm rd		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-testing

Identity has been checked (Spectro.)

Visual inspection and control of dimensional accuracy have been performed

Das Material ist frei von Radioaktivität./ The Product is free from radioactive./ Le matériel n'est pas radioactif.  
El material es libre de radioactividad.

## Erläuterung/ Explanations/ Explications

• Erstschmelzungsart/ Steelmaking process/ Procédé d'élaboration:

E = Elektrostahl / Electric-arc-furnace steel / Acier électrique

• Sekundärmetallurgie/ Secondary metallurgy/ Metallurgie 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, été vérifiée et est conforme aux stipulations de l'acceptation de la commande.

96  
1-25-06



SHT 10

WO# 245810

# SPECIALTY HEAT TREAT, INC.

## CERTIFICATE OF HEAT TREATMENT

CUST NO: B043 CUST PH: 713-749-5900/5907  
CUST NAME: BEST STAINLESS & ALLOYS CUST PO# 6387  
CUST ADDR: 3616 OLD SPANISH TRAIL CUST REF# HN  
HOUSTON, TX 77021  
QUANTITY: 9 MAIL: 17-4 ANN WGT: 4,100  
LOCATION/DATA: BARN DUE DATE: 01/12/06 STICKER #: 38390  
DATE RECD: 01/12/06

DESC: HN 537700 1 @ 3"OD X 265"LG 1 TP @ 6"LG  
HN 241029 1 @ 3 1/2"OD X 280 3/4"LG 1 TP @ 6"LG  
HN 546180 4"OD X 1 @ 257"LG; 1 @ 263"LG 1 TP @ 6"LG  
HN 539350 1 @ 5"OD X 242"LG 1 TP @ 6"LG

PROCESS INSTRUCTIONS: HEAT TREAT TO H1150  
PROCESSED AS FOLLOWS:  
5" = MCS

CONTROLLED BY FURNACE INSTRUMENT:

PROCESS	TIME	TEMP IN DEG F	COOLING METHOD
AGE HARDEN	4 HOURS	1150	A/C TO AMBIENT

HARDNESS TESTED: CK TP (2 PLCS) PER HN 537700 = 31-31 RC  
HN 241029 = 31-31 RC; HN 546180 = 31-31 RC  
HN 539350 = 31-32 RC  
CK 1 PC PER SIZE HN 537700 - 31 RC  
HN 241029 = 31 RC; HN 546180 = 31 RC  
HN 539350 = 31 RC

HN 546180

MECHANICAL PROPERTIES OF A 0.505" DIA TP PER ACCU-TEST LAB#: 309841.0

TENSILE	YIELD .2% OFF	YIELD. EUL	ELONG IN 2"	REDUCTION
137,800 PSI	113,500 PSI	PSI	19.3%	61.6%

HN 537700

MECHANICAL PROPERTIES OF A 0.508" DIA TP PER ACCU-TEST LAB#: 309839.0

TENSILE	YIELD .2% OFF	YIELD. EUL	ELONG IN 2"	REDUCTION
139,600 PSI	115,400 PSI	PSI	20.3%	63.0%

HN 539350

MECHANICAL PROPERTIES OF A 0.504" DIA TP PER ACCU-TEST LAB#: 309842.0

TENSILE	YIELD .2% OFF	YIELD. EUL	ELONG IN 2"	REDUCTION
142,400 PSI	116,400 PSI	PSI	19.9%	56.6%

HN 241029

MECHANICAL PROPERTIES OF A 0.504" DIA TP PER ACCU-TEST LAB#: 309840.0

TENSILE	YIELD .2% OFF	YIELD. EUL	ELONG IN 2"	REDUCTION
144,000 PSI	129,800 PSI	PSI	19.4%	59.7%

ALL MATERIALS ON THIS ORDER WERE  
PROCESSED IN ACCORDANCE WITH OUR  
QUALITY MANUAL QM REV 4 DATED 1/31/99.

SPECIALTY HEAT TREAT, INC.

BY

*Termy*





## Certificate of Test



\*\*\*\*\*  
\* CERTIFICATION \*  
\*\*\*\*\*

HEAT G11116 ORDER 0471835/007 SON 22857A BOL 0135054 TAG 1773599 01/09/06

SHIP TO:

G11116

----- YOUR ORDER & DATE -----  
43538-2 1/09/06 CUST# FRYSTE01 CUST TAG#S# 16930

----- ITEM DESCRIPTION -----  
GRADE 17-4  
Size 17-4 CFA RND BAR 2-1/4 H1150 Country of Melt: USA  
Ship Condition H1150 Country of Mfg.: USA  
NAFTA Country of Origin is Country of Melt.

Total Bundles 1 SON Weight 2177

----- SPECIFICATIONS -----  
THE PRODUCTS LISTED ON THIS MILL TEST REPORT SATISFY PREFERENCE CRITERION B AS DEFINED IN ARTICLE 401 OF THE NORTH AMERICAN FREE TRADE AGREEMENT.  
AMS 5643Q ASME SA564 TYPE 630 E04 A05  
ASTM A564 04 TYPE 630 AGED AT 1150F FOR 4 HR, AC  
CONDITION H1150 AISI 630, UNS S17400  
ASME SA564 E01 A05 NO WELD REPAIR  
FREE OF MERCURY CONTAMINATION

----- MECHANICAL & OTHER TESTS -----  
Test Condition H1150  
Hardness as shipped 327 HBW Hardness as tested 327 HBW  
Hardness as shipped ( 35 HRC ) Hardness as tested ( 35 HRC )  
Grain size 5.0 Tensile strength, KSI (MPa) 148.7 (1025)  
Micro OK 0.2% Yield Strength, KSI (MPa) 132.6 ( 914 )  
Intergranular corrosion OK  
Macro OK  
Elongation % in 4D 19.5  
Reduction of area % 61.3  
Charpy (ft lb) 62 61 78 Avg 67  
Charpy Test Temperature RT  
Lateral Exp (mils) 35 35 45 Avg 38  
Ferrite 0  
Ductile Fracture 88

21142

----- CHEMICAL COMPOSITION -----  
Carbon (C) .032 Manganese (Mn) .880  
Phosphorus (P) .024 Sulphur (S) .023  
Silicon (Si) .360 Chromium (Cr) 15.480  
Nickel (Ni) 4.360 Cobalt (Co) .050  
Copper (Cu) 3.720 Moly (Mo) .350  
Nitrogen (N) .028 Columbium (Cb) .270  
Tin (Sn) .011 Vanadium (V) .080  
Columbium/ Tantalum (Cb+Ta) .270  
Iron (Fe) Balance  
Frequency .000 Severity .000  
Melt Practice EAF  
Refining Practice AOD  
De-long Ferrite

Knowingly & willfully falsifying or concealing a material act on this form, or making false, fictitious or fraudulent statements or representations herein could constitute a felony punishable under federal statutes.

We hereby certify that the test results shown in this report are correct and accurate as contained in the records of the company and are in compliance with the specifications, codes, and standards listed above.

M.F. Marcano, Quality Manager

*Handwritten signature: M.F. Marcano*





# GLORIA MATERIAL TECHNOLOGY CORP. INSPECTION CERTIFICATE

台南縣新營市新中路35號1樓  
TEL NO. 35, HSIEN CHUNG RD., HSIEN YING,  
TAIWAN, TAIWAN, R.O.C.  
TEL: (06) 5520000  
FAX: (06) 5520088

## MILL TEST CERTIFICATES

L/C NO.: 5136767

Messrs:

Order No: 2003002869

Grade: 630(H1150)PSQ

P.O.NO.: 1589

FILE NO: 2003003040-A2

Size: 1.25"

Date: 07/29/2003

HEAT-Lot No: R0582-B70

Weight: 820KG

Pcs: 23

Condition: HR-Solution Annealed-Aged-Centerless Ground

### Chemical Composition (wt%)

	C	Si	Mn	P	S	Ni	Cr	Mo	Cu
Min.						3.00	15.00		3.00
Max.	0.07	1.00	1.00	0.040	0.030	5.00	17.50	0.50	5.00
Result	0.02	0.35	0.63	0.023	0.014	4.60	16.77	0.21	3.05

### Nb+Ta

Min.	0.150
Max.	0.450
Result	0.300

### Mechanical Properties Spec.

	Hardness (1/2R)	$\delta$ -Ferrite
Spec. Min.	277HB	
Spec. Max.		5%
Result	291HB	1.6%

### Tensile Test

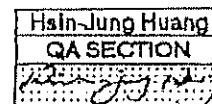
	Elongation(A)	Tensile Strength(Rm)	Yield Strength(Rp)	Reduction of Area(Z)
Unit	%	KSI	KSI	%
Min.	16	135	105	50
Max.				
Result	23	146	131	67

### Specification:

1.ASTM A564-99, 2.ASTM A370-97a, 3.ASTM E18-02, 4.ASTM E10-01, 5.AMS 5622D, 6.AMS 5643Q.

### Remark:

1.ACCORDING TO TUBULAR STEEL SPECIFICATION TSI-B5174H1150PSQ, 2.HEAT TREATMENT RESULT:ASTM A564-TYPE 630-CONDITION H1150, 3.CORROSION TEST:MACRO/MICRO STRUCTURE-GOOD, 4.SURFACE CONDITION:MATERIAL HAS AN OVALITY OF 1/2 OF THE DIAMETRICAL TOLERANCES, 5.MATERIAL IS FREE FROM WELDS OR WELD REPAIRS, 6.MATERIAL IS FREE FROM KNOWN CONTACT WITH MERCURY & RADIUM, 7.MELTING PROCESS:EAF+LHF+VOD/VOD.



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.





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**Bosnor**

**S. A. DE C. V. / Pemex**

# **Vendor Data Book**

**P.O. # 1550-0268/05-01**

**Serial # 24005C**

**Volume: 1**

## **Nautilus Crane Model 340LA-100**

### **Section 3.0**

### **Ballring Certificates**



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA





## Certificate of Compliance

Cert Number: 4565

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: 4038246  
Customer Part Number: N46397-002  
Model No: A22-80E3 REV. A  
OIS Number: 1028241-1  
Serial No: Quantity: 1

ASSY #	INNER #	OUTER #	CERT #
MD29110-A1	91030-1	91020-1	207922C91030/207922C91020

Tested in accordance with the requirements of API spec 2C, para 8.3.2, dated 4/3/95

Comments: We certify that the records are on file which contain  
objective evidence of conformance, and that the records are  
available upon request.

  
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: 31-Jan-06



**Aurora Bearing Plant Final Assembly Data Sheet**

DATE:

Customer:	Oilstates	OIS Number:	1028241-1
Model No:	A22-80E3	REV#:	1
Bearing S/N:	MD29110-A1	Inner S/N:	91030-1
		Outer S/N:	91020-1
		Inner S/N:	
		Outer S/N:	

Print Requirements	Actual Dimensions
1: 7.00 +.040/-0.060 OVERALL HT.	6.995
2: 6.50 +.020/-0.040 OUTER HT.	6.502
3: 8.50 +.020/-0.040 INNER HT.	6.494
4: 5.00 +.080/-0.020 GEAR HT.	5.007
5: 91.160 +/-0.039 O.D.	91.160
6: 85.500 +/-0.022 OUTER B.C.	85.504
7: (48) 1-1/2-6 UNC-2B	OK TG238
8: (48) 2.25 MIN DP	2.330
9: 5.592 +/-0.022 OUTER CHORD	5.594
10: 73.000 +/-0.022 INNER B.C.	72.991
11: (51) 1-1/2-6 UNC-2B	OK TG238
12: (51) 2.25 MIN. DP	2.417
13: 4.408 +/-0.022 INNER CHORD	4.411
14: (4) 1/8-27 NPT	COMPLETE
15: RADIAL CLEARANCE .008 / .014	.012
16: 91.6817 / 91.6500 (1.000)	91.669
17: APPEARANCE / SEALS / SOFT SPOT	OK / OK / OK
18:	
19: CERTIFICATION W/SHIPMENT:	
20: -API CERTIFICATE OF CONFORMANC	YES
21: -DIMENSIONAL DATA	YES
22: -MATERIAL CERTIFICATION	YES

Approved by: David J. Rose  
Title: Quality Control Manager

Stamp: A18  
Date: 31 JANUARY 2006



A ThyssenKrupp  
Technologies  
Company

# Rotek Incorporated

## CERTIFICATION OF TEST

CERTIFICATION NO. 207922C91020



ThyssenKrupp

OSI  
15  
2/7/06

Customer Order No.	Rotek Order No.	SPECIFICATION	Date Printed
AUR	MC91020	AISI 4140 FER API-2C	1/31/06

S  
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P

Part No.	PCS	Rotek Heat Code
ROUGH RINGS A2280A1 ( 91.190 79.440 X 6.500)	2	A410
Heat No. A0394	Material Vendor ELLWOOD QUALITY STEELS	

### CHEMICAL ANALYSIS

C	MN	P	S	SI	NI	CR	MO	CU	V	CB
.410	.930	.006	.012	.230	.090	1.040	.240	.120	.005	.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	
302	141,400	118,200	18	.58	5	SIZE = .502

### CLEANLINESS RATING PER E-45

A		B		C		D	
T	H	T	H	T	H	T	H
.50	1.00	.00	.00	.00	.00	1.00	.50

### CHARPY IMPACT TEST RESULTS (FT. LBS.)

TEMP. °F.	#1	#2	#3
-20C	54.0	54.0	58.0

ULTRASONIC INSPECTED

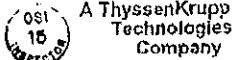
HEAT TREATMENT AUST. QUENCHED & TEMPERED

NOTES:

WE HEREBY CERTIFY THE ABOVE RESULTS ARE CORRECT AS REPORTED AND CONTAINED WITHIN COMPANY RECORDS.

*Harry E. [Signature]*  
AUTHORIZED SIGNATURE





2-706  
KD

A ThyssenKrupp  
Technologies  
Company

# Rotek Incorporated

## CERTIFICATION OF TEST

CERTIFICATION NO. 207922C91030



ThyssenKrupp

Customer Order No.	Rotek Order No.	SPECIFICATION	Date Printed
AUR	MC91030	AISI 4140 PER API-2C	1/31/06

S O L D	S H I P
------------------	------------------

Part No.	PCS	Rotek Heat Code
ROUGH RINGS A2280A2 ( 79.560 69.500 X 6.500 )	2	A410
Heat No. A0394	Material Vendor ELLWOOD QUALITY STEELS	

### CHEMICAL ANALYSIS

C	MN	P	S	SI	NI	CR	MO	CU	V	CB
.410	.930	.006	.012	.230	.090	1.040	.240	.120	.005	.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	
302	141,400	118,200	16	58	5	SIZE = .502

### CLEANLINESS RATING PER E-45

A		B		C		D	
T	H	T	H	T	H	T	H
.50	1.00	.00	.00	.00	.00	1.00	.50

### CHARPY IMPACT TEST RESULTS (FT. LBS.)

TEMP. F.	#1	#2	#3
-20C	54.0	54.0	58.0

ULTRASONIC INSPECTED

HEAT TREATMENT AUST. QUENCHED & TEMPERED

NOTES:

WE HEREBY CERTIFY THE ABOVE RESULTS ARE CORRECT AS REPORTED AND CONTAINED WITHIN COMPANY RECORDS.

*Harry Friedman*  
AUTHORIZED SIGNATURE





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**Bosnor**

**S. A. DE C. V. / Pemex**

# **Vendor Data Book**

**P.O. # 1550-0268/05-01**

**Serial # 24005C**

**Volume: 1**

## **Nautilus Crane Model 340LA-100**

### **Section 4.0**

### **Ballring Clearance Reports**



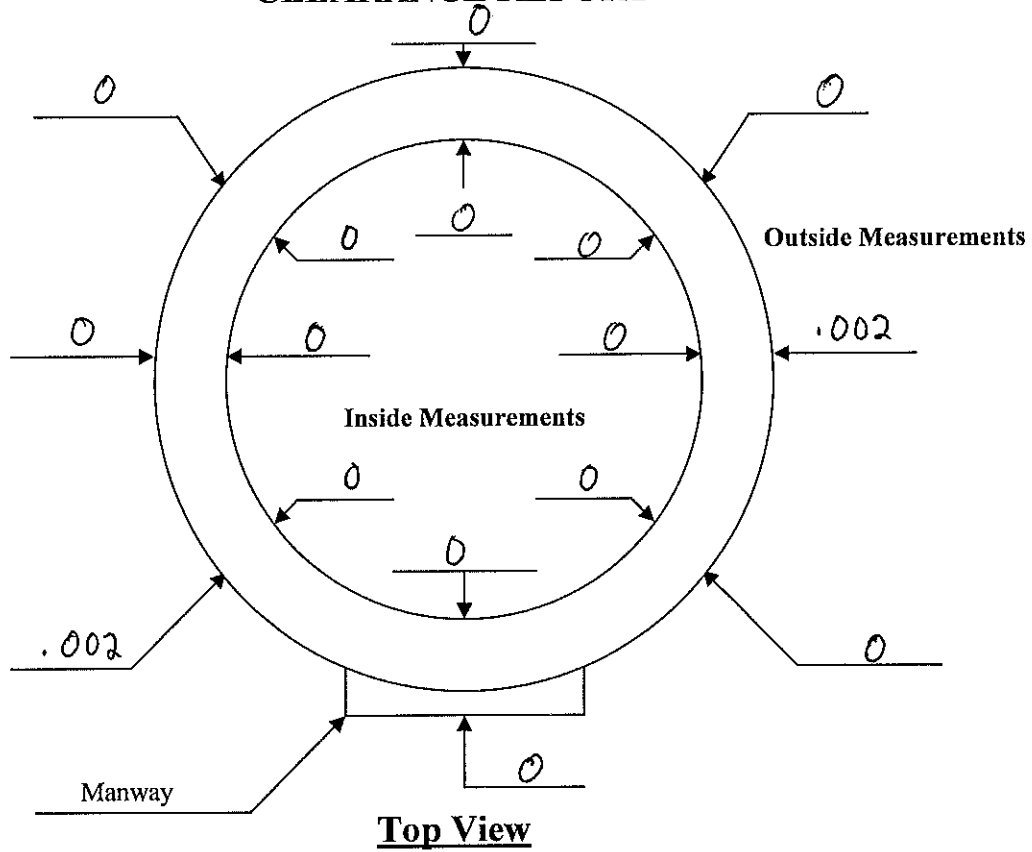
SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA







## BALLRING TO PEDESTAL CLEARANCE REPORT



Weldment Serial Number: 05334-03

Weldment Part Number: N2005SK1-171

Crane Model Number: 340LA-100

Crane Serial Number: 24005

Customer: Bosner / Pemex

Remarks: All Bolts Fit

Inspector:

*[Signature]*

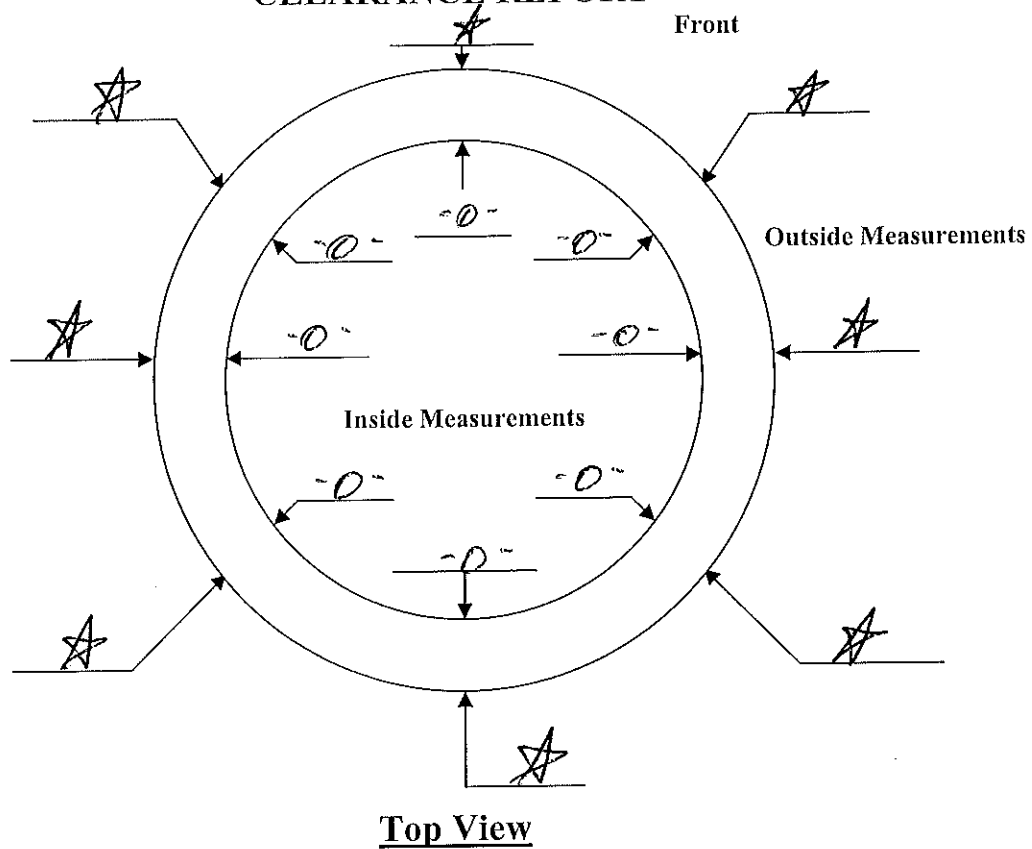


Date Inspected:

2/11/05



## BALLRING TO TURRET/UPPER STRUCTURE CLEARANCE REPORT



Weldment Serial Number: 05307-02

Weldment Part Number: N41584-001


Crane Model Number: 340L

Crane Serial Number: 24005

Customer: Pemex

Remarks: All bolts fit, all  
machined holes are  
within tolerances

*☆ indicates less than .003*

Inspector: Terrell J. Mollere 

Date Inspected: 3/31/06





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**Bosnor**

**S. A. DE C. V. / Pemex**

# **Vendor Data Book**

**P.O. # 1550-0268/05-01**

**Serial # 24005C**

**Volume: 1**

## **Nautilus Crane Model 340LA-100**

### **Section 5.0**

### **Bolt Certificates**



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA





# Cardinal Fastener Test Certification

Reported: 11/8/2005

**Certification No.:** 24159 **Shop Order#:** 00237357  
**Order No.:** 114256 1 **Heat No.:** 400860  
**Customer PO:** SM1101 **Grade:** GR8  
**Customer No.:** 000000071290 **Thread Class:** 2A  
**Customer:** SOUTHERN FASTENER HOUMA **Shipped Qty:** 92  
**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: GR8 HHCS ZINC  
Bedford Heights, Ohio 44146 **Headmark:** YELLOW / CHARPY / HT# HEAD  
**Laboratory:** Cardinal Fastener & Specialty Co.,  
**Address:** 5185 Richmond Road  
Bedford Heights, Ohio 44146  
**Notes:**



<b>Test No.:</b> 31901	<b>Order No.:</b> 230726 0	<b>Test Date:</b> 5/11/2005	<b>Test Disposition:</b> PASS
<b>Specification:</b> MET_SAEJ429_GR8[1/2"TO 1 1/2">2 1/2D] May 98	<b>Test Facility:</b> CFS	<b>LotSize(pcs/lbs):</b> 559	
<b>Tech. Name:</b> DFD	<b>Tech. Title:</b> LT	<b>Sample Size:</b> 5	
<b>Notes:</b> Wedge Test Per SAE J429 ; WEDGE ANGLE 6 DEGREES Hardness Per ASTM E18 CHARPY V-NOTCH @ 0 DEGREES F. RESULTS: 1] 49 FT. LBS., 2] 49 FT. LBS., 3] FT. LBS. AVG.- 49 FT. LBS. ACCEPT.			
Inspection (min. - max.) units		Disposition	Sample Values:
HARDNESS (33, 39) Rc		PASS	36 35 34 34 35
SURFACE HARDNESS (0, 58.6) 30N		PASS	56 57 57 56 56
TENSILE (150000, 999999) PSI		PASS	165119 161507 160413 159546 161011

<b>Test No.:</b> 32416	<b>Order No.:</b> 400860 0	<b>Test Date:</b> 7/19/2005	<b>Test Disposition:</b> PASS
<b>Specification:</b> CHEM_GRADE 4140	<b>Test Facility:</b> ALTON STEEL	<b>LotSize(pcs/lbs):</b> 20000	
<b>Tech. Name:</b> R CAULEY	<b>Tech. Title:</b> QA	<b>Sample Size:</b> 1	
<b>Notes:</b> S2 R2 C1			
Inspection (min. - max.) units		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) %	PASS	0.921
MOLYBDENUM (0, 999) %	PASS	0.183
ALUMINUM (0, 999) %	PASS	0.005
VANADIUM (0, 999) %	PASS	0.037

Cert No: 24159

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.

*Donna L. Kelly*  
(Approval)

Q.A.

(Title)

11/8/2005

(Date Approved)



# KREHER STEEL COMPANY, LLC.

## CARDINAL FASTENER & SPEC

PO/Rel 98736

### Certificate of Mill Test Results

SO 1 -132347-001

1Mar03

Pg 1/1

HOT ROLLED ROUNDS 4140  
1.3125 X 24"  
PART NO.

I hereby certify that this data is correct as  
contained in the records of this company.

AMS

## CERTIFIED MILL TEST REPORT



Alton Steel Test Lab  
#5 Cut Street  
Alton, IL 62002-9011  
(618) 463-4490 EXT 2486  
(618) 463-4491 (Fax)

#### BILL TO

Kreher Steel Company, LLC  
1550 North 25th Avenue  
Melrose Park, IL 60160

#### SHIP TO

Kreher Steel Company, LLC  
1550 North 25th Avenue  
Melrose Park, IL 60160

Date 09/11/2004  
ASI Ord No. 2635  
ASI Ord Line Item 1

Customer PO 91961  
Customer PT.

Specifications  
SAE 4140  
ASTM A322-91

Item Description  
Steel Bar, Hot Rolled, 1.3125, 24" O"

Heat Number

Yield PSI

Tensile PSI

% Elongation

% RA

Bond 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
✓ 400860	0.42	0.92	0.011	0.029	0.26	0.25	0.090	0.921	0.183	0.013	0.005	0.011	0.037	0.0002	0.0045
✓ 400871	0.41	0.92	0.013	0.015	0.26	0.24	0.060	0.926	0.182	0.014	0.005	0.009	0.034	0.0002	0.0032

#### JOMINY HARDENABILITY USING ASTM A-255-99 CALCULATED FROM CHEMICAL OI

Heat Number	GS	OI	J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J11	J12	J13	J14	J15	J16	J17	J18	J19	J20	J21	J22	J23	J24	J25	J26	J27
400860	7	8.31																											
400871	8	5.25																											

#### SPECIAL TEST RESULTS

Heat Number	TA	TB	TC	TD	HA	HB	HC	HD	S	O	B	O	B	R	C	A	B	RC	RD	SHN
400860																				
400871																				

#### ADDITIONAL COMMENTS

RR=36.22:1

No mercury, lead, cadmium, 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.

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

Subscribed and sworn to before me, a Notary Public, in and for  
the county of Madison, State of Illinois

(Approved) Robert Cauley

this \_\_\_\_\_ Day of \_\_\_\_\_

My commission expires \_\_\_\_\_

(Notary Public)

*R Cauley*




# Cardinal Fastener Test Certification

Reported: 2/13/2006

3-13-06  
OS  
15

Certification No.:	25063	Shop Order#:	00239896
Order No.:	115845 1	Heat No.:	501332
Customer PO:	4044753	Grade:	GR8
Customer No.:	000000071290	Thread Class:	2A
Customer:	SOUTHERN FASTENER HOUMA	Shipped Qty:	73
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:			



Test No.:	31857	Order No.:	501332 0	Test Date:	5/5/2005	Test Disposition:	PASS
Specification:	CHEM_GRADE 4140					Test Facility:	ALTON STEEL
Tech. Name:	R CAULEY	Tech. Title:	QA			Lot Size (pcs/lbs):	12630
Notes:	MACRO ETCH RESULTS: S1 R2 C1					Sample Size:	1

Inspection (min. - max.) units	Disposition	Sample Values:
CARBON (0, 999) %	PASS	0.41
MANGANESE (0, 999) %	PASS	0.79
PHOSPHORUS (0, 999) %	PASS	0.011
SULFUR (0, 999) %	PASS	0.03
SILICON (0, 999) %	PASS	0.026
COPPER (0, 999) %	PASS	0.23
NICKEL (0, 999) %	PASS	0.095
CHROMIUM (0, 999) %	PASS	0.906
MOLYBDENUM (0, 999) %	PASS	0.156
ALUMINUM (0, 999) %	PASS	0.005
VANADIUM (0, 999) %	PASS	0.034



Test No.: 34285      Order No.: 233993 0      Test Date: 9/12/2005      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): 540  
 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. RESULTS: 1] 52 FT. LBS., 2] 49 FT. LBS.,  
 3] 55 FT. LBS. AVG. - 52 FT. LBS. ACCEPT.

Inspection (min. - max.) units	Disposition	Sample Values:				
HARDNESS (33, 39) Rc	PASS	37	35	34	35	34
SURFACE HARDNESS (0, 58.6) 30N	PASS	58	57	56	57	56
TENSILE (150000, 999999) PSI	PASS	171889	164912	160681	164809	155604

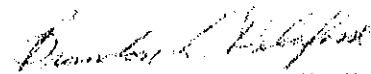
Cert No: 25063

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)

2/13/2006  
 (Date Approved)



# CERTIFIED MILL TEST REPORT

**ASI**  
ALTON STEEL INC

Alton Steel Test Lab  
#5 Cut Street  
Alton, IL 62002-9011  
(618) 463-4490 EXT 2486  
(618) 463-4491 (Fax)

1/4 41401 RUN 1 7 2005  
32572

3-13-06

**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	05/06/2005	Customer PO	17843	Specifications
ASI Ord No.	5167			4140H
ASI Ord Line Item	1			ASTM A 304-04, ASTM A 322-91

Heat Number    Item Description    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
501332	0.41	0.79	0.01	0.03	0.26	0.23	0.10	0.91	0.16	0.02	0.01	0.01	0.03	0.00	0.00

## JOMINY HARDENABILITY USING ASTM A-255-99 CALCULATED FROM CHEMICAL DI

Heat Number	J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J12	J14	J16	J18	J20	J24	J28	J32	G5	D1
501332	56	56	56	56	56	55	53	52	51	49	47	45	42	41	40	38	36	34	7.00	4.83

## SPECIAL TEST RESULTS

Heat Number	TA	TB	TC	TD	HA	HB	HC	HD	S	O	S	O	S	R	C	A	B	RC	RB	BHN
501332																				258

## ADDITIONAL COMMENTS

RR=36.22:1

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) Mick Lawrence

*Mick Lawrence*



# 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  
**Notes:**

**Shop Order#:** 00239888  
**Heat No.:** 501432  
**Grade:** GR8  
**Thread Class:** 2A  
**Shipped Qty:** 635  
**Heat Treat Spec:**  
**Supplier:**  
**Finish Spec.:**  
**Supplier:**  
**Item description:** 1 1/2 x 6 x 5 : GR8 HHCS / CAD  
**Headmark:** PLATED / CHARPY / HT# HEAD



**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.: 38166 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): 848  
 Notes: Wedge Test Per SAE J429; WEDGE ANGLE 6 DEGREES Sample Size: 6  
 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	162099	159089	162391	159629

Test No.: 38432 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): 841  
 Notes: Wedge Test Per SAE J429; WEDGE ANGLE 6 DEGREES Sample Size: 6  
 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	165072	164855	163687

Cert No: 25556

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.

*[Signature]*  
 (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)

1124140TR  
3684

## BILL TO

Turret Steel Industries, Inc.  
P.O. Box 55  
Leedsdale, PA 15056

## SHIP TO

Turret Steel Industries, Inc.  
CWC-Delivered To Customers Trucks  
Alton, IL 62002

Date 05/20/2005  
ASI Ord No. 5452  
4-6-06 ASI Ord Line Item 1

Customer PO 18027-3  
Customer PT.

Specifications  
SAE 4140H  
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	0.022	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	RR	BHN
501432																				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.

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

Subscribed and sworn to before me, a Notary Public, in and for the county of Madison, State of Illinois

(Approved) Rubert Cauley

this \_\_\_\_\_ Day of \_\_\_\_\_

My commission expires \_\_\_\_\_

(Notary Public)

R Cauley

FEB 23 2006





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**Bosnor**

**S. A. DE C. V. / Pemex**

# **Vendor Data Book**

**P.O. # 1550-0268/05-01**

**Serial # 24005C**

**Volume: 1**

## **Nautilus Crane Model 340LA-100**

### **Section 6.0**

### **Wire Rope Certificates**



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA





SO # 1208819

1913 FT

**BRIDON**

AMERICAN

**CERTIFICATE OF EXAMINATION OR TEST OF WIRE ROPE**

**MATERIAL SUPPLIED**

WIRE ROPE DESCRIPTION: 7/8" 18X19 DY18 RREG HPTP

CUSTOMER: CERTEX USA/HARAHAN, LA

CUSTOMER ORDER NO: 1201204

BRIDON AMERICAN ORDER NO.: 46085

DATE TESTED: 2/20/06

REEL NUMBER: 062463A00

MINIMUM BREAKING FORCE: 87,600 LBS. 39,735 KGS.

ACTUAL BREAKING FORCE: 88,900 LBS. 40,325 KGS.  
DATE: 2/20/06 CO# 10 CHECK BY:

SIGNED: *David M. Sleight* TECHNICAL DIRECTOR

NOTE: NOMINAL BREAKING FORCE IS SUBJECT TO AN ACCEPTANCE STRENGTH OF 2% PER FED. STD. RR-W-410. D.  
MINIMUM BREAKING FORCE IS NOT SUBJECT TO A 2% TOLERANCE.

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



SO # 1208896

443 FT



2-23-06

**BRIDON**

AMERICAN

**CERTIFICATE OF EXAMINATION OR TEST OF WIRE ROPE**

**MATERIAL SUPPLIED**

WIRE ROPE DESCRIPTION: 3/4" 18X19 DY18 RREG DPTP

CUSTOMER: CERTEX USA/HARAHAN, LA

CUSTOMER ORDER NO: 1201204

BRIDON AMERICAN ORDER NO.: 46085

DATE TESTED: 2/01/06

REEL NUMBER: 062466B00

MINIMUM BREAKING FORCE: 64,800 LBS. 29,393 KGS.

ACTUAL BREAKING FORCE: 66,300 LBS. 30,073 KGS.

DATE: 2/01/06 CD# 10 CHECK BY:

SIGNED: *David M. Schleitholm* TECHNICAL DIRECTOR

NOTE: NOMINAL BREAKING FORCE IS SUBJECT TO AN ACCEPTANCE STRENGTH OF 2% PER FED. STD. RR-W-410. D.  
MINIMUM BREAKING FORCE IS NOT SUBJECT TO A 2% TOLERANCE.

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



Bethlehem Wire Rope ®

# Certificate

of  
Examination and Test of Bethlehem Wire Rope ®  
Before Being Taken Into Use

Reel No 5085947

This Certificate when properly executed by a competent person, in accordance with 29CFR 1919.37, is accepted by the Government of the United States of America as being in accordance with the requirements of 29CFR 1918.12 and 1919.33.

Name and address of maker or supplier of Bethlehem Wire Rope ®



Wire Rope Works, Inc.  
100 Maynard Street  
Williamsport, PA 17701

Date Tested: Tuesday, April 19, 2005

Actual Break Strength in Pounds: 60,800

Description: 3/4 0626 BR HIP RR IN

Size: 3/4 (in inches, unless otherwise specified)

Number of Strands: 06 Number of Wires per Strand: 26

Finish: Bright (Uncoated)

Grade: Extra Improved Plow

Lay: Right Regular Lay

Core: Wire Rope

Design load, subject to any stated qualifying conditions such as minimum pulley diameter, direct tensile load, etc. ;  
"Using a design factor of 5 the design working load would be one-fifth of the rated catalog breaking strength."

Name and address of public service, association, company, or firm making the examination and test:

Wire Rope Works, Inc.  
100 Maynard Street  
Williamsport, PA 17701

Position of signatory in public service, association, company, or firm making the examination and test:

Director of Engineering

I certify that the above particulars are correct and that the examination and test were carried out by a competent person.

Certificate No. : 005973

Signature: 

per authority of

Lamar McIntosh  
Director of Engineering

Date: 4/22/05

In substantial agreement with I.L.O. Form No. 5



CERTEX - Houma  
(985)872-2434/  
985-872-2247



ISO 9001-2000 CERTIFIED



## CERTIFICATE OF PROOF TEST

CUSTOMER NAME	CUSTOMER ORDER NUMBER	OUR ORDER NUMBER
2008500 OIL STATES SKAGIT-SMATCO, LLC	4044564	1208819-0
PROOF LOAD	NUMBER OF ASSEMBLY(S) COVERED BY THIS CERTIFICATE	
0 LBS	1	
ASSEMBLY(S) SERIAL NUMBER(S)		
1208819-0-2-001	Through	1208819-0-2-001
ASSEMBLY(S) DESCRIPTION		
1 3/4" X 55' DOM PENDANT LINE W/OPEN SWAGE SOCKET EA END. OPPOSITE PLANE		
WORKING LOAD LIMIT	DEGREE ANGLE FROM HORIZONTAL	
62000 LBS	0	

This is to certify that CERTEX has subjected the above assembly(s) or hardware to a tension load stated herein. The tension load was applied to each leg or branch, (if a multiple leg or branch assembly) and its attachments.

Date:

3-15-06

Signature:

Louis J Ledet

### DEFINITIONS AND WARNINGS GOVERNING THE PURCHASE AND USE OF THIS PRODUCT

**WORKING LOAD LIMIT:** The load which a new assembly may handle under given operating conditions and at an assumed DESIGN FACTOR.

**PROOF TEST:** A nondestructive tension test used to verify construction and workmanship of the assembly(s). It does not constitute a representation or guarantee that the assembly(s) is appropriate for any particular use. CERTEX makes no express or implied warranties concerning the assembly(s). CERTEX makes no warranty of merchantability or fitness for a particular use with respect to the assembly(s). Under NO circumstance will CERTEX be liable for any special, indirect, incidental, or consequential damages.

**CONFORMANCE:** The products listed above are in conformance with the specifications and provisions set forth in the literature current at the time of their manufacture.

**NOMINAL STRENGTH:** The published (catalog) strength calculated by a standard procedure that is accepted by the industry. There are many other factors that may affect the strength of the assembly and/or hardware. Such factors include, but are not limited to:

1. Method of end termination or attachment used
2. Type of hitch: vertical, choker, basket
3. Radius of curvature around which assembly is bent

**WARNINGS:** The terms "WORKING LOAD LIMIT", "PROOF TEST", "CONFORMANCE" and "NOMINAL STRENGTH" contain no implication of what load an assembly will withstand if any of the basic factors are changed or it suffers abuse. Such changes will lessen the capacity of the assembly or hardware. Examples of such changes and abuses include, but are not limited to the following:

1. Twisting, knotting or kinking of the assembly legs
2. Obvious damage or disfigurement
3. Deterioration of the assembly by strain, usage, weathering, corrosion or lapse of time
4. Overload
5. Used for any purpose other than that for which it was intended
6. Excessive acceleration or deceleration of the load, shock loading, or vibratory fatigue
7. Increased angles too far from vertical due to load size, hitch or assembly length
8. Chemical or acid conditions and/or excessive temperatures
9. Cutting, due to unpadding edges of the load
10. Foreign matter, i.e. sand, grit or metal shavings
11. Ultraviolet rays

The "DEFINITIONS AND WARNINGS GOVERNING THE PURCHASE AND USE OF THIS PRODUCT" appearing on this certificate, must be adhered to.

CERTEX WILL ASSUME NO OBLIGATIONS OR LIABILITIES, EXPRESSED OR IMPLIED, OTHER THAN THOSE CONTAINED IN THIS CERTIFICATE.

PLEASE REFER TO OSHA STANDARD 1910.184 AND ASME (OR ANSI) B30.9 FOR INFORMATION REGARDING THE CORRECT USE OF ASSEMBLY(S).

ALL ASSEMBLY(S) SHOULD BE INSPECTED REGULARLY FOR SIGNS OF DAMAGE, ABUSE AND WEAR.





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**Bosnor**  
S. A. DE C. V. / Pemex

# Vendor Data Book

P.O. # 1550-0268/05-01

Serial # 24005C

Volume: 1

## Nautilus Crane Model 340LA-100

### 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. 590341 Line 3  
Customer Purchase Order No. 4043036  
Crosby Group Order No. 590341

**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. 06-329-26	M080T18EH 18" 80 TON API 2C CRANE BLOCK W/.875" WIRE LINE	1	04/28/06	160,000 Lbs
PART NO. 8027563	PICS: HOOK - 5GB WEB - GEBM TRUNNION - FHBX PLATE DE-ADAPTER - CHBL		HUB - GFCF SIDE PLATE - CHBF CENTER PIN - FDHD	

(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.

(Date) May 16, 2006 (Signature) Catherine Choate  
CATHERINE CHOATE



OB0005.05 1  
Back Order Discounted Order-  
Customer No. 2980 Order Number 590341  
OIL STATES SKAGIT-SMATCO LLC, AHSC

Order Inquiry 4/29/06 8:29:26  
4 % Entered By DOUG CROSBY  
Last maintained by DOUG 12/13/05  
OIL STATES SKAGIT-SMATCO LLC, AHSC

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  
4043036 12/05/05 12/05/05 MK 52 - 12

Inv#: 165017 Ship: 4/28/06 Frt Amt:

Pick: MKLTL Acct#:

Inv Date: 4/28/06 Priority: 1 Frt Code: 1

Line #	Qty Ordered	Qty Allocat	Qty Shipped	Prod #	Ctlg#	Description	Sell Price	C	M
				SH-	JOBS	24005.12.00 LINE ONE			
				SH-		24105.12.00 LINE ONE			
1	2	0	2	8011311	UB500	UTILITY OHB10T 150#			
2	2	0	0	7777777	PART	**** CANCELLED****			
				SH-	383	CRN, BLK W/API			
3	2	0	2	8027563	383	CRANE BLK 7/8L SP			
				SE		YELLOW			
				HB		YELLOW			

Records to Roll (1-24): 8 Total Weight

4030.00 Order Total:

F1=End

F3=Fold

F6=New Inquiry

F7=Ship History

F24=More keys



15Nov05 13:48

# TEST CERTIFICATE

No: 1 73563

**KREHER STEEL COMPANY, LLC**

P/O No 56300

Rel

S/O No 1 141186-001

B/L No 1 115553-001

Inv No

Shp 15Nov05  
Inv

Sold To: ( 378)  
CROSBY-LEBUS MFG.  
P.O. BOX 271  
LONGVIEW, TX 75606

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 73563  
15Nov05

Part No  
HOT ROLLED ROUNDS 4130  
6.5000 X 20'

Pcs Wgt  
34,630

KREHER CERTS WITH SHIPMENT  
NO SUBCH  
KDP# 0092986

Heat Number	Tag No
X2617	677520
X2617	677527
X2617	677528
X2617	677529
X2617	677530

Pcs	Wgt
	6,940
	6,875
	6,920
	6,950
	6,945

Heat Number  
X2617

\*\*\* Chemical Analysis \*\*\*  
C=0.3200 Mn=0.5400 P=0.0120 S=0.0220 Si=0.2400 Cr=0.9900  
Mo=0.2000 Ni=<.14> Cu=<.26> Al=<.034> V=<.002> Sn=<.012>  
GR=<FINE>

\*\*\* Jominy Tests \*\*\*

1=	2=	3=	4=	5=	6=	7=	8=
9=	10=	12=	14=	16=	18=	20=	24=
28=	32=						

I hereby certify that this data is correct as  
contained in the records of this company.

*Dir Rodz*

319-A 75 Ton Hook  
PIC: 5GB  
HEAT: X2617

X2617



Tulsa Materials  
3100 North Hemlock Circle  
Broken Arrow, OK 74012-1115 USA

## SHERRY Laboratories

Testing Today - Protecting Tomorrow®  
LABORATORY REPORT

Tel: 918-258-6066  
800-982-8378  
Fax: 918-258-1154

Attn: Bucky Weaver  
Crosby Group, Inc.  
P.O. Box 3128  
Tulsa, OK 74101

Report No.: 08040072-002-v1  
Date Received: 4/4/2006  
Date Reported: 4/7/2006  
P.O. No.: M0604073

Sample Description: 76 Ton Hook (test bar) API 2C, PIC CODE 5GB, W/O 325092, P/N 8012273

### Tensile Test (Round) per ASTM E8-04

Parameter	Result
Orientation	Longitudinal at 4/5 Radius
Diameter, inch	0.497
Tensile Strength, psi	106,000
Yield Strength, psi at 0.2% offset	82,600
Elongation in 2 inch, %	22
Reduction of Area, %	64

### Rockwell Hardness Test per ASTM E18-05

Parameter	Result
Location	Charpy
Reading 1	HRBW 97
Reading 2	HRBW 97
Reading 3	HRBW 97

### Impact Test per ASTM A370-05/ASTM E23-05

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	42, 81, 89	26, 62, 62	35, 75, 80

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.



**McKISSICK®**

P.O. BOX 3128 TULSA, OK. 74101

**the Crosby group, inc.**TELEPHONE 918/834-4611  
TELEX 262569 CRSBY UR  
FAX 918/834-9447**DESCRIPTION/SPECIFICATIONS:**

P/N 91411

HUB

PIC: GFCE

**CHEMICAL ANALYSIS**

HEAT NO: X0513	C. .26	Mn. .84	P .008	S .018	Si .24
	Cr .15	V .001	Mo .05	Ni .16	Cu .25
	Al .033				

**YIELD STRENGTH**

56,400

**TENSILE STRENGTH**

82,230

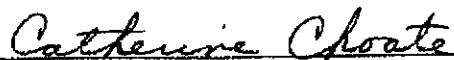
**ELONGATION**

26 %

**SHIPPED TO MCKISSICK ON 02/24/06 FROM THE MANUFACTURER:  
TIMKEN CORP.**

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

*products of uncompromising quality...*

CROSBY Clips &amp; Fittings, LEBUS Load Binders, McKISSICK Blocks &amp; Sheaves, CROSBY- WESTERN Blocks, NATIONAL Swaging Systems

Plants and facilities in: Jacksonville, Arkansas - Los Angeles, California - Atlanta, Georgia - Chicago, Illinois - Tulsa, Oklahoma - Harrisburg, Pennsylvania  
Dallas, Texas - Longview, Texas - Seattle, Washington - Toronto (Brampton), Ontario - Bamsley, England - Mechelen (Putte), Belgium - Cergy St. Christophe, France



**McKISSICK®**

P.O. BOX 3128 TULSA, OK. 74101

**the Crosby® group, inc.**

TELEPHONE 918/834-4611

TELEX 262569 CRSBY UR

FAX 918/834-9447

---

**DESCRIPTION/SPECIFICATIONS:****P/N 94090****WEB:****PIC— GEBM**

---

**CHEMICAL ANALYSIS**

<b>HEAT NO:</b> 6100091	<b>C.</b> .36	<b>Mn.</b> .69	<b>P</b> .012	<b>S</b> .001	<b>Si</b> .24
	<b>Cu</b> .34	<b>Ni</b> .14	<b>Cr</b> .14	<b>Mo</b> .02	<b>V</b> .01
	<b>Sn</b> .012	<b>Al</b> .037	<b>Nb</b> .002		

**YIELD STRENGTH**

58,500

**TENSILE STRENGTH**

89,450


**ELON**

16.5 %

**SHIPPED TO MCKISSICK ON 02/09/06 FROM THE MANUFACTURER:  
NUCOR PLATE MILL**

THE ABOVE DATA WERE TRANSCRIBED FROM THE 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**

*products of uncompromising quality . . .*

**CROSBY Clips & Fittings, LEBUS Load Binders, McKISSICK Blocks & Sheaves, CROSBY- WESTERN Blocks, NATIONAL Swaging Systems**

*Plants and facilities in: Jacksonville, Arkansas - Los Angeles, California - Atlanta, Georgia - Chicago, Illinois - Tulsa, Oklahoma - Harrisburg, Pennsylvania  
Dallas, Texas - Longview, Texas - Seattle, Washington - Toronto (Brampton), Ontario - Barroley, England - Mechelen (Putte), Belgium - Cergy St. Christophe, France*



**McKISSICK®**

P.O. BOX 3128 TULSA, OK. 74101

**the Crosby group  
INC.**TELEPHONE 918/834-4611  
TELEX 262569 CRSBY UR  
FAX 918/834-9447**DESCRIPTION/SPECIFICATIONS:****TRUNNION****P/N 2008049****PIC: FHBX****CHEMICAL ANALYSIS**

<b>HEAT NO:</b> 54546	<b>C.</b> .20	<b>MN.</b> 1.04	<b>P</b> .007	<b>S</b> .008	<b>SI</b> .20
	<b>Cr</b> .24	<b>Mo</b> .07	<b>Al</b> .021	<b>Nb</b> .01	<b>V</b> .01
	<b>Ni</b> .16	<b>Cu</b> .10			

**PHYSICAL PROPERTIES  
(P S I)****YIELD STRENGTH**

33,000

**ELON %**

29.6

**TENSILE STRENGTH**

49,700

**CHARPY "V" NOTCH**

-29 ° C = (FT-LBS)

109 - 69 - 84 - 87

**SHIPPED TO MCKISSICK ON 10/19/05 FROM THE MANUFACTURER :  
FERROSTAAL INC.**

THE ABOVE DATA WERE TRANSCRIBED FROM THE 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.

*Catherine Choate*  
QUALITY ASSURANCE CLERK  
CATHERINE CHOATE

*products of uncompromising quality . . .***CROSBY Clips & Fittings, LEBUS Load Binders, McKISSICK Blocks & Sheaves, CROSBY- WESTERN Blocks, NATIONAL Swaging Systems**

Plants and facilities in: Jacksonville, Arkansas - Los Angeles, California - Atlanta, Georgia - Chicago, Illinois - Tulsa, Oklahoma - Harrisburg, Pennsylvania  
Dallas, Texas - Longview, Texas - Seattle, Washington - Toronto (Brampton), Ontario - Barnsley, England - Mechelen (Putte), Belgium - Cergy St. Christophe, France



11:11 SVCP-90-078



PLATE  
HEAT: 23663-208398

PIC: CHBF  
P/N 2008033

**CROSBY/McKISSICK PRODUCT**  
**NUMBER: 2008033**

DESCRIPTION/SPECIFICATIONS:  
.75" A-516 PLATE      PIC: PLATE— CHBF

**CHEMICAL ANALYSIS**

HEAT NO: 23663	C. .22	MN. 1.09	P .017	S .009	SI .27
	Cr .08	Mo .01	Ni .03	Cu .10	V .01
	Al .043	Nb .01			

**PHYSICAL PROPERTIES**  
(P S I)

**YIELD STRENGTH**  
54,000

**ELON %**  
24

**TENSILE STRENGTH**  
82,000

**CHARPY "V" NOTCH**  
-50° F (FT-LBS)  
43 - 45 - 39 - 42

THE ABOVE DATA WERE TRANSCRIBED FROM THE MANUFACTURER'S CERTIFICATE OF TEST AFTER A VERIFICATION FOR COMPLETENESS AND SPECIFICATION REQUIREMENTS OF THE INFORMATION ON THE CERTIFICATE. ALL 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.

*Catherine Choate*  
QUALITY ASSURANCE ASSISTANT  
CATHERINE CHOATE



[illegible]



# CERTIFICATE OF MATERIAL TEST REPORTS



Castle Metals®

## CUSTOMER

MC KISSICK PRODUCTS CO  
2857 DAWSON ROAD  
PO BOX 3128  
TULSA OK 74101-3128 USA

CASTLE METALS CERTIFIES THAT THE  
FOLLOWING INFORMATION IS TAKEN  
FROM CHEMICAL AND METALLURGICAL  
TEST REPORTS FURNISHED TO US BY  
OUR SUPPLIER AND WHICH ARE ON FILE  
IN OUR OFFICE.

WE CERTIFY THAT WE HAVE NO KNOWLEDGE  
OF MERCURY OR RADIOACTIVE MATERIAL USED  
IN THE MELTING OR PROCESSING OF STEEL  
SOLD BY OUR COMPANY.

MANUFACTURER (MILL)			CUST. ORDER NO.		CUST. REQUISITION NO.	
MAGELLAN CORPORATION			M-0511937			
MC	HEAT NO.	ORDER NO.	LINE NO.	SHIP QTY.	SHIP DATE	
13738	B04106	236147	1	2,685.0		

## DESCRIPTION

3.7500 RD A8620 HR 18/24 PART NO. 92740

* * * CHEMICAL ELEMENTS * * *							
C	MN	P	S	SI	NI	CR	MO
.19	.72	.015	.02	.24	.43	.42	.21
* * * MECHANICAL PROPERTIES * * *							

GRAIN = FINE, GRAIN 6/ 6  
MEETS NAFTA = N

\* \* \* INDUSTRY SPECIFICATIONS \* \* \*  
A.I.S.I.-8620 (OR LATEST REVISIONS), ASTM-A29, ASTM-A322-  
(REAPPROVED 2001) E1, TEAM IND 730009 REV B, UNS#-G86200  
08/18/05 01-44110 AL

|||||

PIN

HEAT: B04106

PIC: FDHD

P/N 92740

END

M. CASTLE & CO.  
*Michelle Adkins* 12/13/05





# SHERRY Laboratories

Testing Today - Protecting Tomorrow®

Materials Testing  
3100 N. Hemlock Circle  
Broken Arrow, OK 74012

Tel: (918) 258-6066  
(800) 324-8378  
Fax: (918) 258-1154

## LABORATORY REPORT

Attn: Bucky Weaver  
The Crosby Group, Inc.  
P.O. Box 3128  
Tulsa, OK 74101

Report No: 2006010146-2  
Date Received: 01/09/2006  
Date Reported: 01/11/2006  
P.O. No: M0600234

Description S/N- 2: (1) 3 1/2 X 8" Thick Barstock API 2C, W/O: 320289, P/N: 2008553, PIC CODE-FDHD

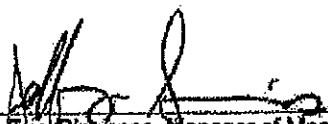
### Room Temperature Tensile Test (ASTM E 8-04)

Parameter	Result
Diameter, in.	0.499
Tensile Strength, psi	105,600
Yield Strength, psi by 0.2% offset	68,900
Elongation In 2", %	18
Reduction of Area, %	38

### Hardness, ASTM E 18-05

Location	Result
Charpy	HRBW 98, 98, 98

Approved by:

  
Jeffrey Simmons, Manager of Mechanical Testing  
Sherry Laboratories

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Materials Testing  
3100 N. Hamlock Circle  
Broken Arrow, OK 74012



Tel: (918) 258-6066  
(800) 324-8378  
Fax: (918) 258-1154

## LABORATORY REPORT

Attn: Bucky Weaver  
The Crosby Group, Inc.  
P.O. Box 3128  
Tulsa, OK 74101

Report No: 2008010146- 2 Additional  
Date Received: 01/09/2008  
Date Reported: 01/16/2008  
Add'l Date: 01/17/2008  
P.O. No: M0800234

Description S/N- 2: (1) 3 1/2 X 8" Thick Barstock API 2C, W/O: 320289, P/N: 2008553, PIC CODE-FDHD

### Impact Test, ASTM A370-05/ASTM E23-05

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: -22 °F

Notch Location:	Base
Impact Values (Ft-Lbs.):	16, 17, 12
Lateral Expansion(Mils):	10, 12, 9
Shear(%):	20, 20, 15

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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# OREGON STEEL MILLS

P.O. BOX 2760, Portland, Oregon 97208 • (503) 286-5651 Fax (503) 240-5203

## REPORT OF CHEMICAL/PHYSICAL TESTS

REPORT NO.	593607	DATE	Feb 22, 2002	PAGE	1
MILL ORDER NO.	137492				
CUSTOMER ORDER NO.	MIS-112150				
JOINED NO.					
SHIPMENT NO.	593607	DATE	02/22/2002		
CARRIER	UNITON PACIFIC				
CUSTOMER NO.	0365096				

METALS USA  
PLATES & SHAPES SOUTHCENTRAL  
ATM-ERIN HOUX  
PO BOX 3528  
ENID, OK 93707-3528

METALS USA  
PLATES & SHAPES SOUTHWEST  
PO BOX 41041  
HOUSTON, TX 77240-1041



THIS MATERIAL HAS BEEN MANUFACTURED, TESTED AND FOUND TO MEET THE SPECIFICATIONS AND PURCHASE ORDER REQUIREMENTS  
OSM CARBON PRESSURE VESSEL QUALITY ASTM A516-80 GRADE 70 ASME SA516 GRADE 70 1998  
NORMALIZED. LOWN 15 FT/LBS AVG @ -40 F; P1 12 F/7LBS MIN. DIN 50649 3.1.2/EN  
10204 3.1 R CERT

### PHYSICAL PROPERTIES

DN	DESCRIPTION	HEAT NO.	SLAB	YIELD PSI X 100	TENSILE PSI X 100	% ELONG # 2"	% RA	HARDNESS BHR	RECO TEST	IMPACTS
1	1.2500 X 96.000M X 480.000 THE FOLLOWING PLATES WERE NORMALIZED AT 1650 DEGS F FOR 63 MINUTES AND AIR COOLED 1 PC 16335 LBS	+ 115526	24	535	745	27		LOVN @ -40 DEGS F 10.0mm 43 48 43 /44 EL/LBS		
4	1.7500 X 96.000M X 480.000 THE FOLLOWING PLATES WERE NORMALIZED AT 1680 DEGS F FOR 80 MINUTES AND AIR COOLED 1 PC 22870 LBS	+ 115524	23	525	760	30		LOVN @ -40 DEGS F		
2	PCS 39295 LBS TOTALS									

PLATE-DE-ADAPTER PIC: CHBL  
HEAT: 115526 P/N 2008032

TEST REPORTS FURNISHED  
BY UNI-STEEL, INC.  
DATE 1-16-02  
CUSTOMER MC Kinley  
CUSTOMER P.O. # M-0208032  
CUSTOMER PART # 2008032

### CHEMICAL ANALYSIS

HEAT NO.	C	Mn	P	S	Si	SE	Cu	Ni	V	Cr	Mg	Ti	B	N	AS	TEST
+115526	.20	1.02	.007	.009	.22		.32	.10	.038	.028	.06	.02				PCS
+115524	.23	1.02	.008	.006	.21		.32	.06	.038	.030	.06	.02				1pc.
HEATS INDICATED WITH (+) WERE MELTED & MANUFACTURED IN THE USA. ALL OTHER HEATS WERE FOLDED IN THE USA.																
END OF REPORT																115526

*Christine Whittle*

CHRISTINE WHITTLE  
Q.C. RECORDS ADMINISTRATOR

I certify the above to be correct as contained in the records of OREGON STEEL MILLS BY





P.O. BOX 3128 TULSA, OK. 74101  
OIL STATES SKAGIT-SMATCO LLC  
1180 MULBERRY RD  
HOUMA, LA 70363



TELEPHONE 918/834-4611  
TELEX 262569 CRSBY UR  
FAX 918/834-9447

## CERTIFICATE OF NONDESTRUCTIVE TESTING

\*\*\*\*\*

INSPECTION PERFORMED ON: 1 PC(S)- M080T18EH 18" 80 TON API 2C CRANE BLOCK  
W/.875" WIRE LINE

TESTING SERIAL NO: 06-329-26

CUSTOMER PURCHASE ORDER NO: 4043036

CROSBY W/O ORDER NO: 639462

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: 8027563

PICS: HOOK - 5GB	HUB - GFCF
WEB - GEBM	SIDE PLATE - CHBF
TRUNNION - FHBX	CENTER PIN - FDHD
PLATE DE-ADAPTER - CHBL	

WE CERTIFY THAT THE INDICATED INSPECTIONS WERE PERFORMED ON THE  
DESCRIBED MATERIAL.

DATE: 04/13/06

BY: Robert D. Shuman FOR  
DION DOUT, INSPECTOR LEVEL II

*products of uncompromising quality . . .*

CROSBY Clips & Fittings, LEBUS Load Binders, McKISSICK Blocks & Sheaves, CROSBY- WESTERN Blocks, NATIONAL Swaging Systems

Plants and facilities in: Jacksonville, Arkansas - Los Angeles, California - Atlanta, Georgia - Chicago, Illinois - Tulsa, Oklahoma - Harrisburg, Pennsylvania  
Dallas, Texas - Longview, Texas - Seattle, Washington - Toronto (Brampton), Ontario - Barnsley, England - Mechelen (Putte), Belgium - Cergy St. Christophe, France





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**Bosnor**

**S. A. DE C. V. / Pemex**

# **Vendor Data Book**

**P.O. # 1550-0268/05-01**

**Serial # 24005C**

**Volume: 1**

## **Nautilus Crane Model 340LA-100**

### **Section 8.0**

### **Overhaul Ball Certificate**



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. \_\_\_\_\_ 590341 Line 1

Customer Purchase Order No. \_\_\_\_\_ 4043036

Crosby Group Order No. \_\_\_\_\_ 590341

**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. 06-319-38	MB10T150E 10 TON API 2C OVERHAUL BALL	1	03/21/06	20,000 Lbs
PART NO. 8011311	PICS: HOOK - 5FD PLATES - EHBD PLUG - EDGJ NUT - EDFL	LARGE & SMALL BOLT - FBFB UPPER EYE - 80C LOWER EYE - 1UX		

(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.

(Date) \_\_\_\_\_ April 17, 2006 (Signature) \_\_\_\_\_ *Catherine Choate*  
**CATHERINE CHOATE**



OB0005.05 1  
Back Order Discounted Order-  
Customer No. 2980 Order Number 590341  
OIL STATES SKAGIT-SMATCO LLC, AHSC

Order Inquiry 4/17/06 8:19:28  
4 % Entered By DOUG CROSBY  
Last maintained by DOUG 12/13/05  
OIL STATES SKAGIT-SMATCO LLC, AHSC

1180 MULBERRY RD  
HOUMA

LA

1180 MULBERRY RD  
HOUMA

LA

70363

70363

Customer PO # Ship Via SCHEDULE Order Date Ship-to PO # Whse SR DR  
4043036 12/05/05 12/05/05 MK 52 - 12

Inv#: 146338 Ship: 3/21/06 Frt Amt:

Pick: MKLTL Acct#:

Inv Date: 3/21/06 Priority: 1 Frt Code: 1

Line #	Qty Ordered	Qty Allocat	Qty Shipped	Prod #.	Ctlg#	Description	Sell Price	C	M
				SH-	JOBS	24005.12.00 LINE ONE			
				SH-		24105.12.00 LINE ONE			
1	2	0	2	8011311	UB500	UTILITY OHB10T 150#			
2	2	0	0	7777777	PART	**** CANCELLED****			
				SH-	383	CRN BLK W/API			
3	2	0	0	8027563	383	CRANE BLK 7/8L SP			
					SE	YELLOW			
					HB	YELLOW			

Records to Roll (1-24): 8 Total Weight

4030.00 Order Total:

F1=End

F3=Fold

F6=New Inquiry

F7=Ship History

F24=More keys



**CERTIFIED MATERIAL TEST REPORT**

**CHAPARRAL STEEL**

300 Ward Rd.  
Midlothian, TX  
76065-9651  
(972) 775-8241



Order Date: 10/26/2004

PO No: 155515\*

Mill Order No: 2833987

Load No: 925256

Manifest No: 11654040

Ship To: 2

LEBUS MANUFACTURING

500 FISHER ROAD

LONGVIEW

75504

Bill To:

LEBUS MANUFACTURING

500 FISHER ROAD

LONGVIEW

75504

PRODUCT  
ROBOS

LENGTH  
19 FT 1 IN / 5.816 M

GRADE  
4130R T

SIZE  
1 3/4 ROUNDS / N/A

SPECIFICATIONS

ASTM A29-99, A322-91

HEAT NO: 1165550

C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	V	Al	Mb
.30	.43	.009	.017	.31	.25	.11	.85	.169	.009	.002	.037	.040

**CHEMICAL ANALYSIS**

**PHYSICAL PROPERTIES**

Grain Size Practices: FINE GRAIN

Normalizing temp: 1650°F 899°C

Quench temp: 1500°F 871°C

J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J11	J12	J13	J14	J15	J16	J17	J18	J19	J20	J21	J22	J23	J24	J25	J26	J27	J28	J29	J30	J31	J32	J33	J34	J35	J36	J37	J38	J39	J40	J41	J42	J43	J44	J45	J46	J47	J48	J49	J50
50	49	45	40	37	32	31	30	28	27	25	25	26	26	24	24	25	25	24	20	23	22	23	23	25	24	27	28	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49		





Materials Testing  
3100 N. Hemlock Circle  
Broken Arrow, OK 74012

## SHERRY Laboratories

Testing Today - Protecting Tomorrow®

Tel: (918) 258-6066  
(800) 324-8878  
Fax: (918) 258-1154

### LABORATORY REPORT

Attn: Bucky Weaver  
The Crosby Group, Inc.  
P.O. Box 3128  
Tulsa, OK 74101

Report No: 2006010433  
Date Received: 01/19/2006  
Date Reported: 01/24/2006  
P.O. No: M0600671

Description: 320-AN, 11 Ton Eye Hook API 2C, W/O: 321628, P/N: 8010401, PIC CODE-5FD

#### Room Temperature Tensile Test (ASTM E 8-04), Longitudinal

<u>Parameter</u>	<u>Result</u>
Diameter, in.	0.503
Tensile Strength, psi	124,600
Yield Strength, psi by 0.2% offset	102,600
Elongation in 2", %	19
Reduction of Area, %	61

#### Hardness, ASTM E 18-05

Location	Result
Charpy	HRC 24, 24, 24

Approved by: \_\_\_\_\_

Jeffrey Simmonds, Manager of Mechanical Testing  
Sherry Laboratories

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Materials Testing  
3100 N. Hemlock Circle  
Broken Arrow, OK 74012

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### LABORATORY REPORT

Attn: Bucky Weaver  
The Crosby Group, Inc.  
P.O. Box 3128  
Tulsa, OK 74101

Report No: 2006010433  
Date Received: 01/19/2006  
Date Reported: 01/24/2006  
P.O. No: M0600671

Description: 320-AN, 11 Ton Eye Hook API 2G, W/O: 321628, P/N: 8010401, PIC CODE-5FD

#### Impact Test, ASTM A370-05/ASTM E23-05

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: -40 °F

Notch Location:	Base
Impact Values (Ft-Lbs.):	34, 45, 55
Lateral Expansion(Mils):	19, 28, 38
Shear(%):	55, 65, 80

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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SIDE PLAT PIC: EHBD  
HEAT: 822B40320 P/N 2008045

(810) 894-8700



ISI EARTH FUND OF PIST, INC.

QUALITY ASSURANCE  
REPORT OF TEST AND ANALYSIS

REPORT NO.	DATE TESTED	DATE OF RECEIPT	INSTRUMENT NO.	PAGE
803-11590	08-12-03	MS-CHGO-UP	IHS 017009	2
METALS USA PLATES & SHAPES S CTL-DI		METALS USA PLATES & SHAPES S CTL IN		
PLATES & SHAPES - MUSKOGEE		TRACK 747		
2800 N 43RD ST E		PORT OF MUSKOGEE		
MUSKOGEE OK 74403		MUSKOGEE OK		

TEST NO.	TEST NAME	TEST NUMBER	NO. PCS	THICKNESS	WIDTH OR DIA	LENGTH	WEIGHT	YIELD POINT	TENSILE STRENGTH	ELONG	RED
				INCHES	INCHES	INCHES	POUNDS	PSI	PSI	IN %	

QUALITY STEEL MELTED & MANUFACTURED IN THE U. S. A.  
PLATES - ASTM A516-90 GR 70 PQV, ASME SA516  
GR 70 PQV 2001 EDITION, CH-Y A208S  
PLT L 15/12 FIELDS AT -50F --- PLT  
NORMALIZED & COOLED IN STILL AIR  
--- TEST CERTIFICATES PREPARED IN  
ACCORD WITH PROCEDURES OUTLINED IN  
DIN 50049 PARA 3.1B  
NO WELD REPAIR WAS PERFORMED ON BELOW PLATE(S)

CO# MUS-213712 GR 841-1721

PLATES HEAT TREATED - TEST SPECIMENS ATTACHED & YIELD STRENGTH & .5% EUL

H030373	822B40320	1	1	96	480	13068	50800	74300	8	31
			N	1650	DEG F -	49 MIN				
H030378	823B72420	1	1	96	480	13068	50100	74600	8	28
			N	1650	DEG F -	49 MIN				
H030384	823B72430	1	.625	96	480	8168	56600	78900	8	25
			N	1650	DEG F -	32 MIN				
H030385	823B72430	1	.5	96	480	6534	55500	80100	8	27
			N	1650	DEG F -	26 MIN				

COOLING TEMPERATURE

TEMPERATURE

TEMPERATURE

WEL TEST REPORTS FURNISHED  
BY UNI-STEEL INC. 9-24

TEST NO.	TEST NAME	TEST NUMBER	THICKNESS	TYPE	SIZE	TEMP	ENERGY	FT LBS	DATE	BY
			INCHES							
H030373	822B40320		1.000	V FULL	L -50	88	86	104		
H030378	823B72420		1.000	V FULL	L -50	142	130	111		
H030384	823B72430		.625	V FULL	L -50	115	70	98		
H030385	823B72430		.500	V FULL	L -50	101	78	76		

CUSTOMER P.O. #11-810063

CUSTOMER PART #2008045

HEAT #822B40320 PCS 1

HEAT # PCS

HEAT NUMBER	C	Mn	P	S	Si	Co	Ni	Cr	Mo	V	Ti	Al	B	Cu	N	OTHER
822B40320	.19	1.13	.017	.006	.360	.008	.01	.15	.057	.003	.003	.027	.0002	.002	.007	
823B72420	.18	1.09	.020	.004	.365	.013	.01	.16	.062	.004	.002	.037	.0003	.002	.006	
823B72430	.17	1.05	.014	.003	.347	.218	.18	.04	.008	.003	.002	.027	.0003	.002	.007	

I certify that the above results are a true and correct copy of actual results furnished to me by the laboratory and that the same have been checked with the requirements of the specification and codes. This test report cannot be altered and must be furnished intact to the party requesting this report. If required, produced under a certified QMS complying with ISO 9001:2008 CERT 830477

SUPV QUALITY ASSURANCE

D. W. ELWOOD PER WNK



# CERTIFICATE OF MATERIAL TEST REPORTS



Castle Metals

## CUSTOMER

MC KISSICK PRODUCTS CO  
2857 DAWSON ROAD  
PO BOX 3128  
TULSA OK 74101-3128 USA

CASTLE METALS CERTIFIES THAT THE FOLLOWING INFORMATION IS TAKEN FROM CHEMICAL AND METALLURGICAL TEST REPORTS FURNISHED TO US BY OUR SUPPLIER AND WHICH ARE ON FILE IN OUR OFFICE.

WE CERTIFY THAT WE HAVE NO KNOWLEDGE OF MERCURY OR RADIOACTIVE MATERIAL USED IN THE MELTING OR PROCESSING OF STEEL SOLD BY OUR COMPANY.

MANUFACTURER (MILL)			CUST. ORDER NO.		CUST. REGISTRATION NO.	
GERDAU AMERISTEEL			M-0506413			
WC	HEAT NO.	ORDER NO.	LINE NO.	SHIP QTY.	SHIP DATE	
2148	M10518 H5875	219122	1	170.0		

## DESCRIPTION

1.6250 RD A4140 CP HT A193-B7 10/13 PART NO. 2008059

## CHEMICAL ELEMENTS

C	MN	P	S	SI	NI	CR	MO	AL
.41	.87	.008	.032	.28	.11	1.01	.22	.027
CU	V	PB	TI	CO	N	CB		
.12	.006	.00/.00	.003	.006	.0055	.002		

## MECHANICAL PROPERTIES

TENSILE 145000 PSI, YIELD 130000 PSI, ELONG 18.0, R.A. 57.5  
HARDNS RC 32/ 33, GRAIN = FINE, GRAIN 5/ 8, MACRO - S1 R1 C1, R.R. 16.1  
MEETS NAFTA = Y

## JOMINY

1	2	3	4	5	6	7	8	12	16	20	24	28	32
57	57	57	57	57	57	57	57	50	48	47	46	44	40

## INDUSTRY SPECIFICATIONS

A.I.S.I.-4140 (OR LATEST REVISIONS), ASTM A434-BC, ASTM-A193-03B-GRADE-B7  
ASTM-A29-99-E1, ASTM-A331-95 (REAPPROVED 2000), UNS#-G41400  
VACUUM DEGASSED CAL/AL TREATED ALUMINUM KILLED MEETS OR EXCEEDS JOHN DEERE Q1  
2 CLEANLINESS REQUIREMENTS RD# 2358/2371 3/7/04 QUENCHED & TEM PERED STRESS F  
REE TENSILE #2 145,000 PSI / YIELD: 130,000 PSI / ELON: 20.0 / R.A. 57.2 / RC  
@ MID-RAD = 32/31 / ADST: 1500 F 45 MIN / QUENCH: WATER / TEMPER: 1150 F 62  
MIN \*\* T&P @ HA IND \*\* FROM IAC 16588 03/30/04

|||||

Bar Stock  
HEAT: M10518 H5875

PIC: FBFB  
P/N 2015012

END

A.M. CASTLE & CO.

Michelle Adkins 7/13/05





## SHERRY Laboratories

Testing Today - Protecting Tomorrow®

Materials Testing  
3100 N. Hamlock Circle  
Broken Arrow, OK 74012

Tel: (918) 258-6066  
(800) 324-8378  
Fax: (918) 258-1154

### LABORATORY REPORT

Attn: Bucky Weaver  
The Crosby Group, Inc.  
P.O. Box 3128  
Tulsa, OK 74101

Report No: 2005080575- 2  
Date Received: 08/19/2005  
Date Reported: 08/22/2005  
P.O. No: M0508034

Description S/N- 2: P10 Code-FBFB, 1 5/8" x 8" Barstock for API 2C, W/O: 313853, P/N: 2016012


#### Room Temperature Tensile Test (ASTM E 8-04), Longitudinal

Parameter	Result
Diameter, in.	0.354
Tensile Strength, psi	150,400
Yield Strength, psi by 0.2% offset	135,700
Elongation in 1.4", %	19
Reduction of Area, %	60

#### Hardness, ASTM E 18-05

Location	Result
Charpy	HRC 30, 31, 31

Approved by:

  
Carol Judd, 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.





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Broken Arrow, OK 74012

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(800) 324-8378  
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### LABORATORY REPORT

Attn: Bucky Weaver  
The Crosby Group, Inc.  
P.O. Box 3128  
Tulsa, OK 74101

Report No: 2005080575- 2  
Date Received: 08/19/2005  
Date Reported: 08/22/2005  
P.O. No: M0508034

Description S/N- 2: Pic Code-FBFB, 1 5/8" x 8" Barstock for API 2C, W/O: 313853, P/N: 2015012

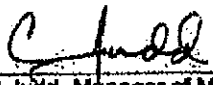
#### Impact Test, ASTM A370-05/ASTM E23-05

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.):	64, 51, 52
Lateral Expansion(Mils):	38, 29, 29
Shear(%):	100, 100, 100

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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**GOLTRA CASTINGS COMPANY, INC.**

501 McIntyre STREET  
Golden, Colorado 80401  
PHONE 303-279-7818

DATE: 11/1/05

## ASTM SPECIFICATION

ASTM-A487 GRADE 4 CLASS B

## CUSTOMER DESCRIPTION

MCKISSICK  
P/N: 12-S-4

## TENSILE TEST PER ASTM E 8

HEAT CODE	YIELD PSI	TENSILE PSI	ELONGATION %	REDUCTION IN AREA %
80C	104,000	122,000	17	36.0

Brinell: 248

## QUENCH AND TEMPERED

## CHEMICAL COMPOSITION

Element	Carbon	Manganese	Phosphorous	Sulfur
Units	%	%	%	%
Average	0.3131	0.7282	0.0175	0.0127
	Silicon	Copper	Nickel	Chromium
	%	%	%	%
	0.4791	0.1871	0.4898	0.4934
	Molybdenum	Aluminum	Vanadium	Base
	%	%	%	%
	0.1851	<.0000	0.0064	

## CHARPY IMPACT TEST PER ASTM A370 FIG. 1

TYPE OF SPECIMEN: CHARPY V NOTCH

SPECIMEN	#1	#2	#3
IMPACT VALUE	15	21	15

METHOD OF TEST ASTM E 23

TEST TEMPERATURE -25 DEG F

MADE AND MELTED IN THE USA

I HEREBY CERTIFY THAT THE ABOVE INFORMATION IS CORRECT.



GOLTRA CASTINGS COMPANY, INC.  
Larry Draper, General Manager

SWIVEL LOWER EYE  
HEAT CODE: 80C  
P/N 2009245



# CERTIFICATE OF MATERIAL TEST REPORTS



**Castle Metals**

**CUSTOMER**

**MC KISSICK PRODUCTS CO**  
**2857 DAWSON ROAD**  
**PO BOX 3128**  
**TULSA OK 74101-3128 USA**

CATTLE METALS CERTIFIES THAT THE FOLLOWING INFORMATION IS TAKEN FROM CHEMICAL AND METALLURGICAL TEST REPORTS FURNISHED TO US BY OUR SUPPLIER AND WHICH ARE ON FILE IN OUR OFFICE.

WE CERTIFY THAT WE HAVE NO KNOWLEDGE OF MERCURY OR RADIOACTIVE MATERIAL USED IN THE MELTING OR PROCESSING OF STEEL SOLD BY OUR COMPANY.

MANUFACTURER (MILL) <b>CASTLE (H A INDUSTRIES)</b>			CUST. ORDER NO. <b>N-0408889</b>		CUST. REQUISITION NO.	
WC <b>41417</b>	HEAT NO. <b>7482365Q9020</b>	ORDER NO. <b>193000</b>	LINE NO. <b>1</b>	SHIP QTY. <b>1,365.0</b>	SHIP DATE	

## DESCRIPTION

**5.0000 RD A4140 HR QTSP 193B7/434BC/285-321BHN 20/24 PART NO.**

* * * CHEMICAL ELEMENTS * * *								
C	MN	P	S	SI	NI	CR	MO	AL
.41	.90	.015	.026	.26	.06	1.01	.21	.032
CU	V							
.03	.005							

\* \* \* MECHANICAL PROPERTIES \* \* \*

**TENSILE 133000 PSI, YIELD 108000 PSI, ELONG 18.8, R.A. 52.4**  
**HARDNESS BHN 290/ 306, GRAIN = FINE, GRAIN 7/ 7, MACRO - 82 R2 C2**  
**MEETS NAPTA = Y**

* J O M I N Y *												
1	2	3	4	5	6	7	8	12	16	20	24	28
58	57	57	57	57	57	57	56	53	51	49	46	44

\* \* \* INDUSTRY SPECIFICATIONS \* \* \*

**ASTM-A-434-04 (REAPPROVED 2000), ASTM-A193-03-GRADE-B7 (THRU 7"), ASTM-A29-99**  
**ASTM-A322-91 (REAPPROVED 2001), ASTM-A304-02, UNS#-G41400**  
**(OR LATEST REVISIONS)**  
**REPUBLIC**

**BAR STOCK**                      **PIC: EDGJ**  
**HEAT: 7482365Q9020**      **P/N 92884**

A.M. CASTLE & CO.

*Michelle Adkins 1/5/04*





## SHERRY Laboratories

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Materials Testing  
3100 N. Hemlock Circle  
Broken Arrow, OK 74012

Tel: (918) 258-6066  
(800) 324-8378  
Fax: (918) 258-1154

### LABORATORY REPORT

Attn: Bucky Weaver  
The Crosby Group, Inc.  
P.O. Box 3128  
Tulsa, OK 74101

Report No: 2004110288  
Date Received: 11/10/2004  
Date Reported: 11/12/2004  
P.O. No: M0408230

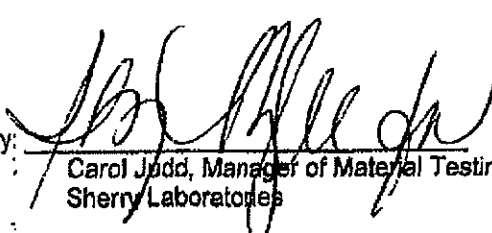
Description: Plc Code-EDGJ, 5" x 8" Bar API 2C, WO #300669, P/N: 2015015 (For Testing at Mld Radius)

#### Room Temperature Tensile Test (ASTM E 8-04)

Parameter	Result
Diameter, in.	0.500
Tensile Strength, psi	142,400
Yield Strength, psi by 0.2% offset	118,400
Elongation in 2", %	17
Reduction of Area, %	57

#### Hardness, ASTM E 18-03

Location	Result
Charpy	HRC 32, 32, 32

Approved by:   
Carol Judd, Manager of Material Testing  
Sherry Laboratories

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Tel: (918) 258-6066  
(800) 324-8378  
Fax: (918) 258-1154

### LABORATORY REPORT

Attn: Bucky Weaver  
The Crosby Group, Inc.  
P.O. Box 3128  
Tulsa, OK 74101

Report No: 2004110288  
Date Received: 11/10/2004  
Date Reported: 11/12/2004  
P.O. No: M0408230

Description: Plc Code-EDGJ, 5" x 8" Bar API 2C, WO #300669, P/N: 2015015 (For Testing at Mid Radius)

#### Impact Test, ASTM A370-03a/ASTM E23-02a

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.):	48, 50, 48
Lateral Expansion(Mils):	25, 29, 25
Shear(%):	90, 100, 90

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 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 01

Certification Date  
17-NOV-2004

## CUSTOMER ORDER NUMBER

M-409057

7311 E. PINE STREET  
TULSA OK 74115

Invoice Number  
T468507

## CUSTOMER PART NUMBER

2002746

Ship# T431517

SOLD TO: MCKISSICK PRODUCTS CO  
P O BOX 3128  
TULSA OK 741013128

SHIP TO: MCKISSICK PRODUCTS CO  
2801 DAWSON RD GATE 5  
TULSA OK 74110

Description: 8620 COLD FINISH ASTM A331  
1 RD X 12' R/L  
HEAT: 495505

ITEM: 506940

Line Total: 3168 IN

Specifications:  
ASTM A331 95

ASTM A304 96

### CHEMICAL ANALYSIS

C	MN	P	S	SI	NI	CR	MO
0.21	0.9	0.011	0.031	0.22	0.45	0.51	0.16
CU	AL	V	NB				
0.12	0.041	0.008	0.003				

RCPT: R140770

MILL: NIAGARA LASALLE CORPORATION

COUNTRY OF ORIGIN: USA

END-QUENCH HARDENABILITY (JOMINY - RC) IN

1	2	3	4	5	6	8	10	12	14	16
47	46	43	35	30	28	24	23	21	20	20

GRAIN SIZE : 5 - 8

STRAND CAST REDUCTION RATIO 55.2 TO 1  
MATERIAL IS FREE FROM MERCURY CONTAMINATION  
NO WELD REPAIR PERFORMED ON MATERIAL

SWIVEL NUT  
HEAT: 495505

PIC: EBFL  
P/N 2002746

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.

Material did not come in contact with mercury while in our possession.

MARVIN FOSTER

*Marvin Foster*



15T1201  
3/08/05

Michigan Steel, Inc.  
CHEMICAL AND PHYSICAL ANALYSIS

Page 1  
15:32:44

Product# . . . : M241397  
Customer Part#: 230397  
Pattern Number: 10-T-EB  
Customer . . . : THE CROSSBY GROUP INC  
MCKISSICK DIVISION  
P O BOX 3128  
TULSA OK 74101-3128

Order/Item# . : 29413 / 1  
Customer P.O.#: M-0409419

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: \_\_\_\_\_ DATE: 3-8-05 P.O.: M-050411 S.O.: 30108  
of 10 pcs shipped. BHN: 1229

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 10204-3.1.B & DIN 50049-3.1.B

Melt#	Quantity	Date	Heat Treat	Heat Code	Specification
AAL06		2/04/05	1UX	- -	ASTM A487-98 4B ( B627 )

..... C H E M I C A L S .....  
C : .2600      MN : .8010      SI : .5150      P : .0240  
S : .0290      NI : .5610      CR : .5570      MO : .2680  
CU : .0780      V : .0150      CE : .6060

..... P H Y S I C A L S .....  
Brinell (HBW) 217-269      Yield (PSI) 96000  
Tensile (PSI) 112500      %El (in 2") 18  
%Red of Area 48.1

WET MAG. PER ASTM E709,  
MT DATE & STATEMENT BY: 

Barrel  
HEAT CODE: 1UX  
P/N 230397  
Charpy test temp: - 25





# SHERRY Laboratories

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Tulsa Materials  
3100 North Hemlock Circle  
Broken Arrow, OK 74012-1115 USA

Tel: 918-258-8066  
800-982-8378  
Fax: 918-258-1154

## LABORATORY REPORT

Attn: Bucky Weaver  
Crosby Group, Inc.  
P.O. Box 3128  
Tulsa, OK 74101

Report No.: 06020077-003-v1  
Date Received: 2/2/2006  
Date Reported: 2/7/2006  
P.O. No.: M0601198

Sample Description: Work Order No. 322715, Part No. 2009243, PIC Code 1UX, 10 Ton Swivel Barrel, API 2C

### Tensile Test (Round) per ASTM E8-04

Parameter	Result
Orientation	Longitudinal
Diameter, Inch	0.351
Tensile Strength, psi	125,000
Yield Strength, psi at 0.2% offset	98,000
Elongation in 1.4 inch, %	10
Reduction of Area, %	28

### Impact Test per ASTM A370-05/ASTM E23-05

Testing Machine Capacity, lbs: 284  
Specimen Type: Charpy V Notch  
Specimen Location: ASTM A370-05  
Notch Orientation: Perpendicular to Surface  
Specimen Orientation: Longitudinal  
Specimen Size: 10mm X 10mm  
Test Temperature °F: -25


Notch Location	Impact Values (Ft.-Lbs)	Lateral Expansion (Mils)	Shear (%)
Base	25, 31, 15	18, 22, 12	55, 54, 40

Comments: Absorbed energy values above 80% of the scale range are approximate.

### Rockwell Hardness Test per ASTM E18-05

Parameter	Result
Location	Charpy
Reading 1	HRC 25
Reading 2	HRC 25
Reading 3	HRC 24

Approved by:

  
Jeffrey Simmons, Manager of Mechanical Testing  
Sherry Laboratories

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P.O. BOX 3128 TULSA, OK. 74101  
OIL STATES SKAGIT-SMATCO LLC  
1180 MULBERRY RD  
HOUMA, LA 70363



TELEPHONE 918/834-4611  
TELEX 262569 CRSBY UR  
FAX 918/834-9447

## CERTIFICATE OF NONDESTRUCTIVE TESTING

\*\*\*\*\*

INSPECTION PERFORMED ON: 1 PC(S)- MB10T150E 10 TON API 2C OVERHAUL BALL

TESTING SERIAL NO: 06-319-38

CUSTOMER PURCHASE ORDER NO: 4043036

CROSBY W/O ORDER NO: 637289

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: 8011311

PICS: HOOK - 5FD	LARGE & SMALL BOLT - FBFB
PLATES - EHBD	UPPER EYE - 80C
PLUG - EDGJ	LOWER EYE - 1UX
NUT - EDFL	

WE CERTIFY THAT THE INDICATED INSPECTIONS WERE PERFORMED ON THE DESCRIBED MATERIAL.

DATE: 03/07/06

BY: Robert D. Shuman  
DION DOUT, INSPECTOR LEVEL II

*products of uncompromising quality . . .*

CROSBY Clips & Fittings, LEBUS Load Binders, McKISSICK Blocks & Sheaves, CROSBY- WESTERN Blocks, NATIONAL Swaging Systems

Plants and facilities in: Jacksonville, Arkansas - Los Angeles, California - Atlanta, Georgia - Chicago, Illinois - Tulsa, Oklahoma - Harrisburg, Pennsylvania  
Dallas, Texas - Longview, Texas - Seattle, Washington - Toronto (Brampton), Ontario - Barnsley, England - Mechelen (Putte), Belgium - Cergy St. Christophe, France





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**Bosnor**

**S. A. DE C. V. / Pemex**

# **Vendor Data Book**

**P.O. # 1550-0268/05-01**

**Serial # 24005C**

**Volume: 1**

## **Nautilus Crane Model 340LA-100**

### **Section 9.0**

### **Backlash Reports**



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA







## BACKLASH REPORT

### PINION/BALLRING

*left*

CRANE SERIAL NUMBER: 24005

BACKLASH TOP: .028 BOTTOM: .028

#### ALIGNMENT

X1 1<sup>14</sup>/<sub>32</sub>", X2 1<sup>14</sup>/<sub>32</sub>" L 11<sup>1</sup>/<sub>4</sub>" SLOPE X =  $\frac{X2-X1}{L} = \underline{0}$   
Y1 1<sup>14</sup>/<sub>32</sub>", Y2 1<sup>14</sup>/<sub>32</sub>" L 11<sup>1</sup>/<sub>4</sub>" SLOPE Y =  $\frac{Y2-Y1}{L} = \underline{0}$

ARE BOLTS (TURRET OR UPPERSTRUCTURE/ BALLRING) IN PLACE? ☒ YES ☐ NO

DATE: 3/27/06

ACCEPTABLE:

*Terrell J. Moller*

NOT ACCEPTABLE: \_\_\_\_\_





## BACKLASH REPORT

### PINION/BALLRING

*right*

CRANE SERIAL NUMBER: 24005

BACKLASH TOP: .029 BOTTOM: .029

ALIGNMENT

X1	$1\frac{13}{32}$ "	X2	$1\frac{13}{32}$ "	L	$1\frac{1}{4}$ "	SLOPE X =	$\frac{X2-X1}{L}$	=	<u>0</u>
Y1	$1\frac{13}{32}$ "	Y2	$1\frac{13}{32}$ "	L	$1\frac{1}{4}$ "	SLOPE Y =	$\frac{Y2-Y1}{L}$	=	<u>0</u>

ARE BOLTS (TURRET OR UPPERSTRUCTURE/ BALLRING) IN PLACE? ☒ YES ☐ NO

DATE: 3/27/06

ACCEPTABLE:

Jeff. Muller

NOT ACCEPTABLE: \_\_\_\_\_





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**Bosnor S. A. DE  
C. V. / Pemex**

**PB-KU-H Platform**

**Vendor Data Book**

P.O. # 1550-0268/05-01

Serial # 24005C

Volume: 1

## **Nautilus Crane Model 340LA-100**

### **Section 10.0 Miscellaneous**

- Certificate of Leak Test**
- Straightness Check**
- Paint Logs**
- Grating Information**
- ABS Statement of Fact**
- Technical Data Sheets**
- Crane Acceptance Test Procedure and Report**



SKAGIT SMATCO  
1180 MULBERRY ROAD  
HOUMA, LA 70363  
USA





# Certificate of Leak Test

Vessel Description:

*Power Unit*

Oil States Industries, Inc. Work Order Number:

*24005*

Test Pressure (PSIG):

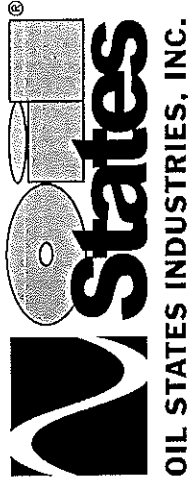
*2 1/2 lbs.*

Test Date:

*4/10/04*

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.



*Timothy J. Mollard*  
Quality Inspector



# Certificate of Leak Test

Oil States Industries, Inc. Work Order Number: 24005

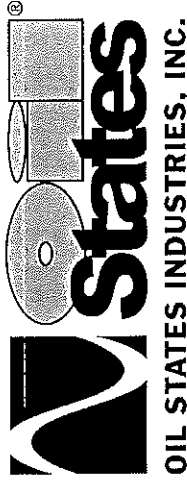
Vessel Description: Injection Lines 5" - 6"

Test Pressure (PSIG): 2 1/2 lbs.

Test Date: 3/27/06

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.



*James J. Miller*  
Quality Inspector



# Certificate of Leak Test

Vessel Description: Return manifold

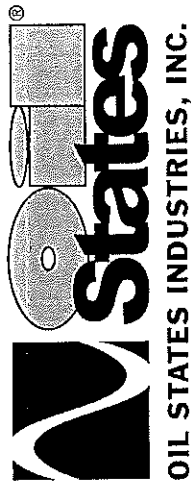
Oil States Industries, Inc. Work Order Number: 24005

Test Pressure (PSIG): 45 lbs.

Test Date: 4/17/06

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.



*James J. Moller*  
Quality Inspector



# Certificate of Leak Test

Vessel Description: RETURNS MANIFOLD #2

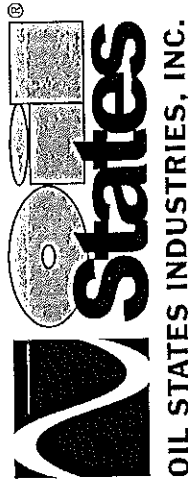
Oil States Industries, Inc. Work Order Number: 24005

Test Pressure (PSIG): 45

Test Date: 5-22-06

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.



*Ronald M. Miller*

Quality Inspector



# Certificate of Leak Test

Vessel Description: RETURN AIRDRY

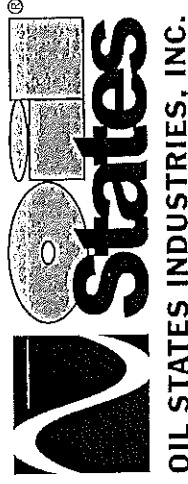
Oil States Industries, Inc. Work Order Number: 24005

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*Randal Moller*

Quality Inspector



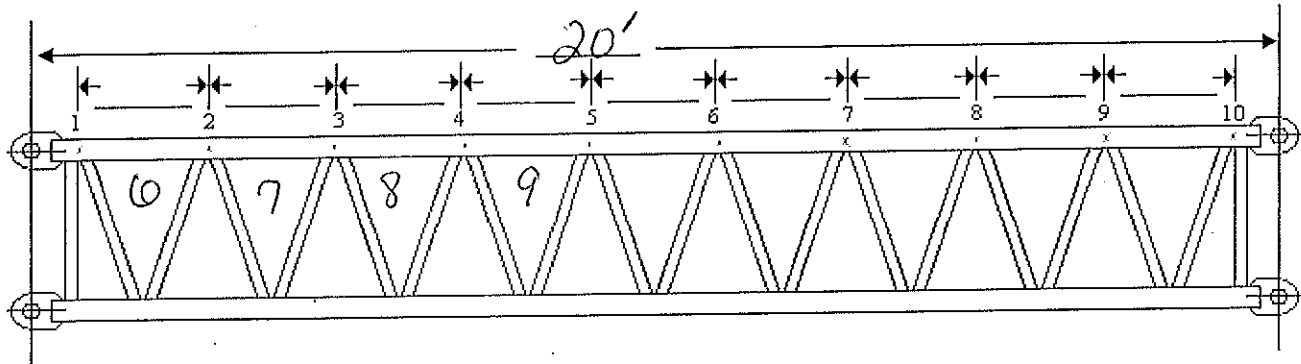


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## MAIN CHORD STRAIGHTNESS CHECK



		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
TOP RIGHT	A	0	0	1/64"	0	0	0	0	0	0							
	B	0	0	0	0	0	0	0	0	0							
TOP LEFT	A	0	0	0	0	0	0	1/64"	0	0							
	B	0	1/32"	1/32"	0	0	1/32"	1/32"	1/32"	0							
BOTTOM RIGHT	A	0	0	0	0	0	0	0	0	0							
	B	0	0	0	1/32"	0	0	1/32"	1/32"	0							
BOTTOM LEFT	A	0	0	0	0	0	0	1/64"	0	0							
	B	0	0	0	1/32"	0	0	0	1/32"	0							

BOOM  
CONSTRUCTION

1 	2 
3 	4 OTHER:

Weldment Type: Boom Point

Weldment Serial Number: 05 333-01

Crane Serial Number: 24005.05

Crane Model Number: 340

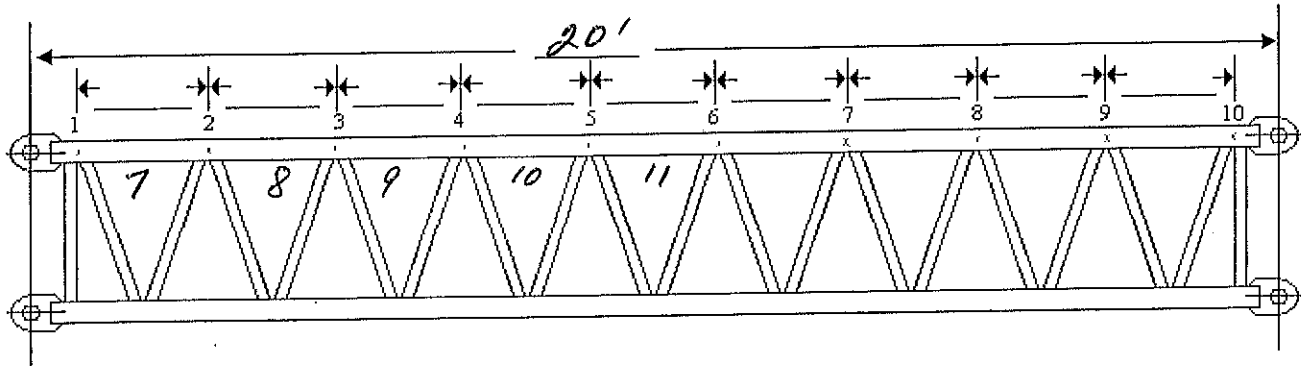
Inspected by: [Signature]

Date Inspected: 2/10/06





## MAIN CHORD STRAIGHTNESS CHECK



		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
TOP RIGHT	A	0	1/32	1/32	1/16	1/32	0	0	1/32	1/32	3/64	0					
	B	0	0	0	1/64	1/32	0	0	1/64	0	1/64	0					
TOP LEFT	A	0	1/32	1/32	1/32	1/32	0	1/32	1/32	1/16	1/16	0					
	B	0	0	0	0	0	0	0	1/32	1/32	1/64	0					
BOTTOM RIGHT	A	0	1/32	1/32	1/32	0	0	0	1/32	1/32	0	0					
	B	0	1/64	0	0	0	0	0	1/64	0	1/64	0					
BOTTOM LEFT	A	0	1/32	1/32	1/32	0	0	1/32	1/32	1/32	1/32	0					
	B	0	0	1/64	0	1/64	0	0	1/64	1/32	0	0					

BOOM  
CONSTRUCTION

<p>1</p>	<p>2</p>
<p>3</p>	<p>4 OTHER:</p>

Weldment Type: Boom Base

Weldment Serial Number: 05333-03

Crane Serial Number: 24005

Crane Model Number: 340L

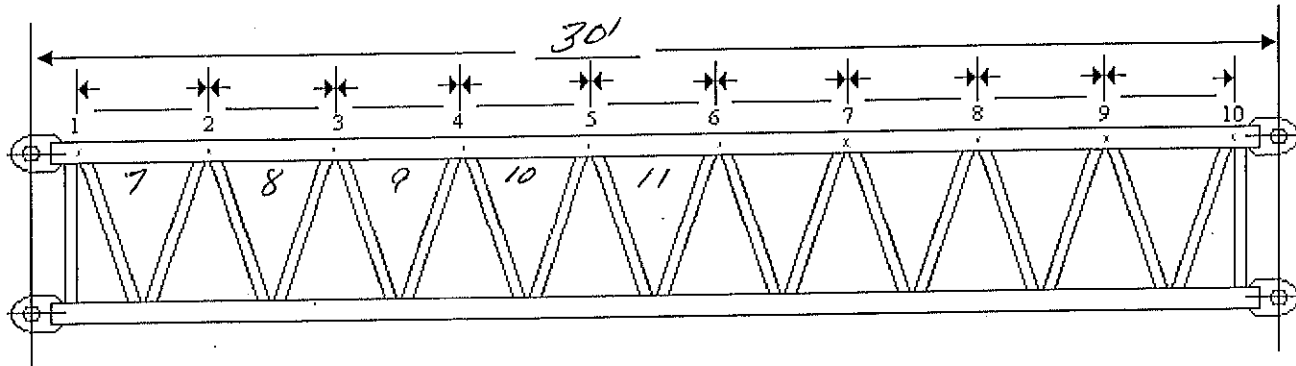
Inspected by: Daniel J. M...

Date Inspected: 2/18/06





## MAIN CHORD STRAIGHTNESS CHECK



		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
TOP RIGHT	A	0	$\frac{3}{64}$	$\frac{1}{32}$	$\frac{1}{32}$	$\frac{1}{32}$	0	$\frac{1}{32}$	$\frac{1}{32}$	$\frac{1}{32}$	0	0					
	B	0	0	0	$\frac{1}{32}$	0	0	$\frac{1}{32}$	$\frac{1}{64}$	$\frac{1}{32}$	$\frac{1}{32}$	$\frac{1}{64}$					
TOP LEFT	A	0	$\frac{1}{32}$	$\frac{1}{32}$	$\frac{1}{32}$	$\frac{1}{32}$	0	$\frac{1}{32}$	$\frac{1}{32}$	$\frac{1}{16}$	$\frac{1}{32}$	$\frac{3}{64}$					
	B	0	$\frac{3}{64}$	$\frac{3}{64}$	$\frac{1}{32}$	$\frac{1}{32}$	0	0	$\frac{3}{64}$	$\frac{1}{64}$	$\frac{1}{32}$	$\frac{1}{32}$					
BOTTOM RIGHT	A	0	$\frac{1}{32}$	0	0	0	0	$\frac{1}{32}$	0	0	$\frac{1}{64}$	0					
	B	0	0	$\frac{1}{32}$	$\frac{1}{32}$	$\frac{1}{32}$	0	$\frac{1}{32}$	$\frac{1}{64}$	$\frac{1}{32}$	$\frac{1}{32}$	0					
BOTTOM LEFT	A	0	$\frac{1}{64}$	0	0	$\frac{1}{64}$	0	$\frac{1}{32}$	$\frac{1}{32}$	$\frac{1}{32}$	$\frac{1}{32}$	$\frac{1}{64}$					
	B	0	$\frac{1}{32}$	$\frac{1}{32}$	$\frac{1}{32}$	$\frac{1}{32}$	0	$\frac{1}{16}$	$\frac{1}{64}$	$\frac{3}{64}$	$\frac{1}{32}$	$\frac{1}{32}$					

BOOM  
CONSTRUCTION

<p style="text-align: center;">1</p> <div style="text-align: center;"> </div>	<p style="text-align: center;">2</p> <div style="text-align: center;"> </div>
<p style="text-align: center;">3</p> <div style="text-align: center;"> </div>	<p style="text-align: center;">4 OTHER:</p>

Weldment Type: Boom Mid #1

Weldment Serial Number: 05333-05

Crane Serial Number: 24005

Crane Model Number: 340L

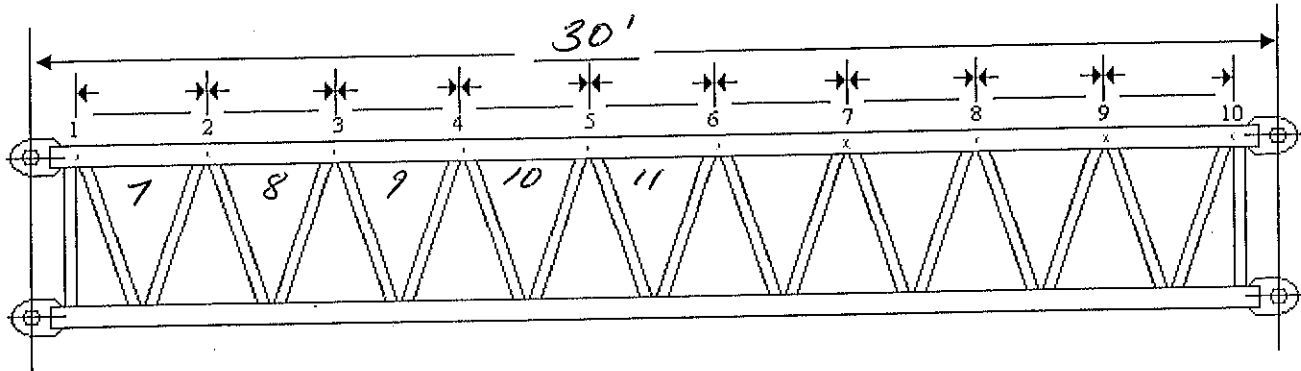
Inspected by: Timothy M. Miller

Date Inspected: 1/24/04





## MAIN CHORD STRAIGHTNESS CHECK



		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
TOP RIGHT	A	0	1/64	0	0	1/64	0	1/32	1/32	3/64	1/64	1/64					
	B	0	0	0	0	0	0	1/32	1/32	1/32	1/64	1/32					
TOP LEFT	A	0	1/16	1/32	1/32	1/32	0	1/32	1/32	1/32	1/64	1/32					
	B	0	5/64	1/32	5/64	1/16	0	3/64	1/32	3/64	3/64	3/64					
BOTTOM RIGHT	A	0	3/64	1/64	1/64	0	0	1/32	1/64	1/64	0	0					
	B	0	1/32	3/64	3/64	1/16	0	0	1/32	1/32	3/64	3/64					
BOTTOM LEFT	A	0	0	1/64	1/64	1/32	0	1/64	1/64	1/32	1/32	1/32					
	B	0	0	3/64	1/32	1/32	0	1/64	3/64	3/64	1/32	1/64					

BOOM  
CONSTRUCTION

<p>1</p>	<p>2</p>
<p>3</p>	<p>4 OTHER:</p>

Weldment Type: Boom Mid #2

Weldment Serial Number: 05333-06

Crane Serial Number: 24005

Crane Model Number: 340L

Inspected by: Timothy Moll

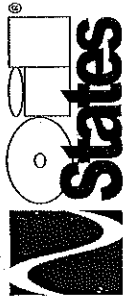
Date Inspected: 1/30/06





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# Purchased Component Paint Inspection Log

Work Order:

24005.20

Approved: HB

2/17/06 15:12

Second Coat													

Coat 1 Amerlock 2

Coat 2 Amercoat 450 HS

Coat 3 N/A

Coat 4 N/A

Color

YE314

DFT 4 - 8 Mils

2 - 3 Mils

N/A

N/A

Surface Prep: SP 1, 2, 3

Profile: A/R

Total Millage: 6 - 11 MILS

NOTE: All items which are chromed and/or stainless steel (other than diesel and hydraulic reservoirs) will not be blasted or coated

Coat 5

\* Load Block & Ball 4504 INTERNATIONAL ORANGE

Form No: SS3R-0081

Date 3/1/05

Page 1 of 2





2/17/06 15:12

**NOTE:** All items which are chromed and/or stainless steel (other than diesel and hydraulic reservoirs) will not be blasted or coated





2/17/06 15:12

**PRESS-O-FILM™** **TESTEX**  
NEWARK, DE 19715  
USA  
No. 3.0  
Reading 3.0  
Gage less 2.0 mils  
or 50  $\mu$ m  
X COARSE (1.5 to 4.5 mils) or (40 to 115  $\mu$ m)

Coat 4 N/A

N/A

**Total Millage:** 3 mil

Q38  
11  
5-16-06





2/17/06 15:12

Coat 1 Amercoat 878		Coat 2 Amercoat 878		Coat 3 N/A		Coat 4 N/A	
<u>Color</u>	0	0				0	0
<u>DFT</u>	1.5 mil	1.5 mil					N/A
Surface Prep: SP 10		Profile: 1 - 1.5 mil		Total Millage: 3 mil			

Form No: SS3R-0081  
Date 3/1/05





**PRESS-O-FILM™ 10-2**  
TESTEX  
NEWARK, DE 19715  
USA  
No. 3.0  
Reading 3.0  
Gage less 2.0 mils  
or 50 µm  
X COARSE (1.5 to 4.5 mils) or (40 to 115 µm)

**PRESS-O-FILM™ 8**  
TESTEX  
NEWARK, DE 19715  
USA  
No. 2.6  
Reading 2.6  
Gage less 2.0 mils  
or 50 µm  
X COARSE (1.5 to 4.5 mils) or (40 to 115 µm)

**PRESS-O-FILM™ P.P.**  
TESTEX  
NEWARK, DE 19715  
USA  
No. 2.7  
Reading 2.7  
Gage less 2.0 mils  
or 50 µm  
X COARSE (1.5 to 4.5 mils) or (40 to 115 µm)

## Structural Paint Inspection Log

Work Order:

24005.20

Approved: HB

2/17/06 15:12

First Coat														
Blast														
Weldment	Date	Time	Air Temp	Surf. Temp	Dew Point	Hum	Profile	Date	Time	Air Temp	Surf. Temp	Dew Point	Hum	DFT
PERESTAL	2-18	11:30A	62°	68°	53°	74%	3.3	2-18	4:00PM	86°	84°	72°	63%	2-3
GASTRA STOP	3-30	2:15PM	82°	81°	57°	42%	3.0	3-30	5:15PM	82°	81°	57°	42°	2-3
<del>TURRET</del>	<del>4-12</del>	<del>3:50PM</del>	<del>80°</del>	<del>79°</del>	<del>50°</del>	<del>35%</del>	<del>2.8</del>	<del>4-12</del>	<del>5:15PM</del>	<del>78°</del>	<del>76°</del>	<del>49°</del>	<del>36°</del>	
POWERUNIT	4-12	3:50PM	80°	79°	50°	35%	2.8	4-12	5:15PM	78°	76°	49°	36°	3-4
CONCRETE STATION	4-17	2:30PM	78°	76°	51°	39%	2.7	4-17	4:00PM	82°	80°	57°	42°	3-4
WALKWAYS SUPPORT	4-17	2:30PM	78°	76°	51°	39%	3.2	4-17	4:00PM	82°	80°	57°	42°	3-4
CAB	4-17	2:30PM	78°	76°	51°	39%	3.2	4-17	4:00PM	82°	80°	57°	42°	3-4
TURRET	4-13	2:15PM	83°	82°	52°	36%	2.9	4-13	4:25PM	83°	82°	52°	36°	3-4
PALLET PARTS	4-18	3:30PM	86°	84°	58°	39%	2.7	4-19	2:00PM	73°	72°	51°	46°	2-3
TOILER	5-1	4:00PM	84°	84°	55°	37%	3.0	5-1	5:35PM	84°	84°	55°	37°	3-4
BRIDLE	5-1	4:00PM	84°	84°	55°	37%	2.9	5-1	5:35PM	84°	84°	55°	37°	3-4
PRESS-O-FILM™ GAUTAY														
PRESS-O-FILM™ TESTEX NEWARK, DE 19715														
No. 3.0 Reading 3.0														
Gage less 2.0 mils or 50 um														
PRESS-O-FILM™ 200000														
PRESS-O-FILM™ TESTEX NEWARK, DE 19715														
No. 3.3 Reading 3.3														
Gage less 2.0 mils or 50 um														
PRESS-O-FILM™ 742000														
PRESS-O-FILM™ TESTEX NEWARK, DE 19715														
No. 2.8 Reading 2.8														
Gage less 2.0 mils or 50 um														
PRESS-O-FILM™ 742000														
PRESS-O-FILM™ TESTEX NEWARK, DE 19715														
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PRESS-O-FILM™ TESTEX NEWARK, DE 19715														
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Gage less 2.0 mils or 50 um														
PRESS-O-FILM™ 742000														
PRESS-O-FILM™ TESTEX NEWARK, DE 19715														
No.														

**PRESS-O-FILM™ GASTRA**  
TESTEX  
NEWARK, DE 19715  
USA  
No. 3.0  
Reading 3.0  
Gage less 2.0 mils  
or 50 µm  
X COARSE (1.5 to 4.5 mils) or (40 to 115 µm)

**PRESS-O-FILM™ 1**  
TESTEX  
NEWARK, DE 19715  
USA  
No. 2.7  
Reading 2.7  
Gage less 2.0 mils  
or 50 µm  
X COARSE (1.5 to 4.5 mils) or (40 to 115 µm)

**PRESS-O-FILM™ 7.23**  
TESTEX  
NEWARK, DE 19715  
USA  
No. 2.8  
Reading 2.8  
Gage less 2.0 mils  
or 50 µm  
X COARSE (1.5 to 4.5 mils) or (40 to 115 µm)

Coat 1 Dimetecote 9

Coat 2 Amercoat 385

Coat 3 Amercoat 450 HS

Coat 4 N/A

Color

White

YE 314 Offshore Yellow

NA

DFT 2.5 Mils

4 - 6 Mils

2 - 3 Mils

NA

Surface Prep: SP 10

Profile: 1 - 2 Mils

Total Millage: 8.5 - 12 MILS

NA

**PRESS-O-FILM™ CAO**  
TESTEX  
NEWARK, DE 19715  
USA  
No. 4.2  
Reading 4.2  
Gage less 2.0 mils  
or 50 µm  
X COARSE (1.5 to 4.5 mils) or (40 to 115 µm)

**PRESS-O-FILM™ C.S**  
TESTEX  
NEWARK, DE 19715  
USA  
No. 2.7  
Reading 2.7  
Gage less 2.0 mils  
or 50 µm  
X COARSE (1.5 to 4.5 mils) or (40 to 115 µm)

**PRESS-O-FILM™ W.S.**  
TESTEX  
NEWARK, DE 19715  
USA  
No. 2.2  
Reading 2.2  
Gage less 2.0 mils  
or 50 µm  
X COARSE (1.5 to 4.5 mils) or (40 to 115 µm)

NOTE: All ite

feel (other than dies

tested or coated





# Structural Paint Inspection Log

Work Order: 24005.20

Approved: HB

2/17/06 15:12

Weldment		Second Coat						Third Coat							
		Date	Time	Air Temp	Surf. Temp	Dew Point	Hum	DFT	Date	Time	Air Temp	Surf. Temp	Dew Point	Hum	DFT
PEDESTAL		2-21	4:30PM	84°	80°	68°	59°	8-9	2-22	10:55AM	82°	82°	67°	61°	10-11
Gantry & stops		4-1	11:25AM	72°	73°	50°	45°	7-9	4-4	2:00PM	60°	61°	29°	30°	9-11
Power unit		4-18	6:20PM	86°	84°	58°	39°	8-9	4-19	11:20AM	68°	68°	49°	50°	10-12
CONTROL STATION		4-18	6:20PM	86°	84°	58°	39°	7-8	4-19	11:20AM	68°	68°	49°	50°	10-11
WALKWAY SUPPORT		4-18	6:20PM	86°	84°	58°	39°	7-8	4-19	11:20AM	68°	68°	49°	50°	11-12
CAB		4-18	6:20PM	86°	84°	58°	39°	7-9	4-19	11:20AM	68°	68°	49°	50°	10-11
TARGET		4-18	6:20PM	86°	84°	58°	39°	8-9	4-19	11:20AM	68°	68°	49°	50°	10-12
PALLET PARTS		4-20	11:55AM	80°	89°	72°	75°	8-9	4-21	11:15AM	82°	88°	72°	72°	12-13
IDLER		5-4	10:35AM	79°	86°	78°	96°	8-9	5-6	2:30PM	81°	88°	72°	72°	8-12
BRIDGER		5-4	10:55AM	79°	86°	78°	96°	8-9	5-6	2:30PM	81°	88°	72°	72°	9-12

Coat 1 Dimetecote 9

Coat 2 Amercoat 385

Coat 3

Amercoat 450 HS

Coat 4 N/A

Color

White

YE 314 Offshore Yellow

DFT 2.5 Mils

4 - 6 Mils

2 - 3 Mils

Surface Prep: SP 10

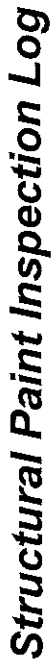
Profile:

1 - 2 Mils

Total Millage: 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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**Total Millage: 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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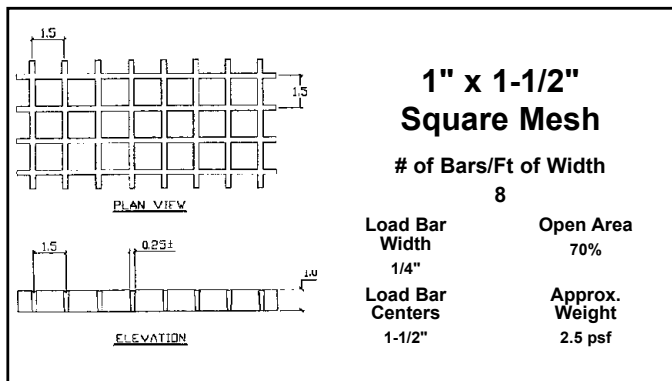


# Molded Grating Selection and Details

## Fibergrate® and Chemgrate® Molded Grating

Brand	Depth	Mesh	Standard Panel Sizes	Wt. Per Sq. Ft.	Open Area
Fibergrate	1"	1-1/2" x 1-1/2" square	3' x 10', 4' x 8', 4' x 12'	2.5 lb	70%

## Fibergrate® Grating Details





# Molded Grating Resins

## Resin Systems

Corrosion in the workplace negatively impacts your bottom line. Each year, industrial plant executives eliminate expensive corrosion-related maintenance problems by switching to Fibergrate molded grating. Various applications present different requirements so Fibergrate has more than ten standard resin systems (the most in the industry) including the new FGI-AM (food grade isophthalic polyester antimicrobial) available in both Fibergrate and Chemgrate Resins.

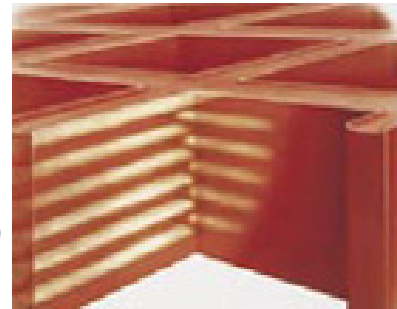
## Fibergrate® Resins

- **CORVEX®** - An economy polyester grating, Corvex outperforms a number of competitive fiberglass and metal products and meets the requirements for corrosion resistance found in light industrial and water/wastewater applications. **Color:** yellow, dark gray or dark green. **Flame Spread:** ASTM E84 rating of 25 or less. **Certifications:** DNV Type Approval No. F-16856.

## Slip-resistant Surfaces

Slips and falls are the second leading cause of industrial accidents. According to the National Safety Council, each injury related lost work day can cost \$50,000 to \$100,000. That is why Fibergrate developed three slip-resistant surfaces for flooring and stair solutions. These surfaces include meniscus and applied grit tops in the Fibergrate resins and integral grit in the Chemgrate resins.

### Meniscus Top











# AMERICAN BUREAU OF SHIPPING

ABS Plaza – 16855 Northchase Drive  
Houston, TX 77060-6008

Page 1 of 2

Report No.: MC720240-A

Date: 07 June 2006

Port: Morgan City, La.

**THIS IS TO CERTIFY** That The Undersigned Surveyor To This Bureau Did At The Request Of Oil States Of Houma, Louisiana Attend Their Facility On 07 June 2006 In Order To Carry Out An Statement Of Fact Survey Upon The Following Crane Manufactured At Their Facility To Customer Requirements:

## CRANE PARTICULARS

### MANUFACTURER – OIL STATES

A). MODEL – NAUTILUS 340LA-100

B). SERIAL NO. – 24005

C). TAG NO. – ZZZ-7550

D). DIESEL ENGINE POWERED

E). PEDESTAL MOUNTED

F). HYDRAULICALLY DRIVEN

### LOAD TEST

#### SIX PART LINE BLOCK @ LOW SPEED

<u>TEST</u>	<u>RADIUS</u>	<u>STATIC RATED LOAD</u>	<u>PROOF LOAD</u>	<u>PERCENT OF RATED LOAD</u>
NO. 1	10 M	45,803 kg.	45,839 kg.	100%
NO. 2	10 M	45,803 kg.	60,831 kg.	133%

#### SIX PART LINE BLOCK @ HIGH SPEED

<u>TEST</u>	<u>RADIUS.</u>	<u>STATIC RATED LOAD</u>	<u>PROOF LOAD</u>	<u>PERCENT OF RATED LOAD</u>
NO. 3	16 M	28,002 kg.	27,980 kg.	100%
NO. 4	23 M	18,715 kg.	18,693 kg.	100%

### Auxiliary Hoist

#### SINGLE PART LINE BLOCK

<u>TEST</u>	<u>RADIUS.</u>	<u>STATIC RATED LOAD</u>	<u>PROOF LOAD</u>	<u>PERCENT OF RATED LOAD</u>
NO. 5	15 m	4,632 kg.	4,680 kg.	101%

Note: This Report evidences compliance with one or more of the Rules, guides, standards or other criteria of American Bureau of Shipping and is issued solely for the use of the Bureau, its committees, its clients or other authorized entities. This Report is a representation only that the structure, item of material, equipment, machinery or any other item covered by this Report has met one or more of the Rules, guides, standards or other criteria of American Bureau of Shipping as of the date of issue. Parties are advised to review the Rules for the scope and conditions of classification and to review the survey records for a fuller description of any restrictions or limitation on the vessel's service or surveys. The validity, applicability and interpretation of this Report is governed by the Rules and standards of American Bureau of Shipping who shall remain the sole judge thereof. Nothing contained in this Report or in any notation made in contemplation of this Report shall be deemed to relieve any designer, builder, owner, manufacturer, seller, supplier, repairer, operator or other entity of any warranty express or implied.





# AMERICAN BUREAU OF SHIPPING

ABS Plaza – 16855 Northchase Drive  
Houston, TX 77060-6008

Page 2 of 2

Report No.: MC720240-A

Date: 07 June 2006

Port: Morgan City, La.

The Above Noted Load Tests Were Carried Out By Suspending Certified Live Weights In Which The Loads As Stated Were Lifted One Foot Off The Ground, At The Boom Radius As Indicated And Held In That Position For A Period Of Not Less Than Five Minutes.

Crane Function And Operational Tests Were Carried Out At This Time In Which The Following Were Also Examined/Tested:

## The Following Gauges Were Found

Hydraulic Pressure (*Main Hoist*)  
Hydraulic Pressure (*Aux. Hoist*)  
Hydraulic Pressure (*Boom*)  
Hydraulic Pressure (*Swing*)  
Hydraulic Pressure (*Return*)  
Engine Oil Pressure  
Accumulator Pressure  
Engine Water Temp.  
Hydraulic Oil Temp.  
Engine Tachometer  
Hydraulic Oil Level  
Diesel Fuel Level  
Hydraulic Load Indicator System (Main)  
Hydraulic Load Indicator System (Aux.)  
Fire Extinguisher

## Electrical Items

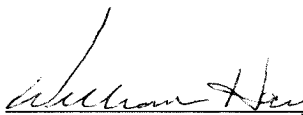
Boom Floodlights (2)  
Boom Tip Beacon Light (1)  
Gantry Beacon Light (1)  
Power On Light  
Cab Light (2)  
Circuit Breaker

## Tested the Following:

Engine Start  
Engine Throttle  
Engine Shutdown  
Engine Air Intake / Over speed Shutdown  
Low Oil Pressure/High Water Temperature Shutdown  
Main Line Anti-Two Block  
Auxiliary Line Anti-Two Block  
Swing Park Brake  
Dynamic Swing Brake  
Free Swing Capability  
Mechanical Swing Lock  
360° Continuous Rotation  
High Angle Kick Out  
Low Angle Kick Out  
Low Boom Angle Kick Out Override  
Manual Recharge Pump  
Pneumatic Windshield Wiper  
Attention Horn (Pneumatic)  
High Speed Manual Reset Valve

## Electrical Items

Instrument Light (1)  
Air conditioner  
Gaitronics System with Speaker  
115 VAC / 60 Hz Outlet (2)

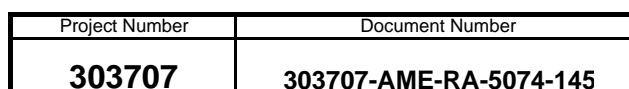
  
William Haynie - Surveyor











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Project Number	Document Number
<b>303707</b>	<b>303707-AME-RA-5074-145</b>

TAG NUMBER		TECHNICAL QUESTIONNAIRE	REV	DATE	ISSUED FOR	BY	CHECKED	APPROVED	PAGE	37 / 47	REVISION
ZZZ-7550			A	9/1/2003	IDC	SM					
SERVICE: West Pedestal Crane			B	9/23/2003	COMMENTS	SM	RM	KCS			
CLIENT: PEMEX			C	10/21/2003	APPROVAL	SM	RM	KCS			
PROJECT: PB-Ku-H Prod.Platform			0	12/2/2003	APPROVED FOR FINAL DESIGN						
LOCATION: Bay of Campeche											

DESIGN INFORMATION	REQUIREMENTS	SUPPLIER'S PROPOSAL	ALTERNATIVES
<b>West Pedestal Crane</b>	<b>ZZZ-7550</b>	<b>ZZZ-7550</b>	
<b>Pedestal Adapter Data</b>			
Pedestal Adapter Included	Required	Provided	Confirmed
Pedestal Adapter Diameter TOP	*		
Pedestal Adapter Diameter BOTTOM	2032 mm	2032 mm.	Confirmed
Pedestal Adapter Material Grade	SA-516-70	API 2H Grade 50	Confirmed
Pedestal Adapter Wall Thickness	*	25.4 mm.	Confirmed
Pedestal Adapter Height	*	1.22 meters	Confirmed
Pedestal Adapter Bottom Bevel	30 Degrees	45 degrees	Confirmed
Jack Pad Supports	Required	Provided	Confirmed
Internal Floor Grating	Required	Provided	Confirmed
Internal Drain Baffle Plate	Required	Provided	Confirmed
Drain Connection	1" FNPT	Provided	Confirmed
Manway	One - 24" Required	Provided	Confirmed
Stabbing Guide	Required	Provided	Confirmed
<b>Hook / Swing / Luffing Speed Data</b>			
Main Hoist Hook Speed	*	40 FPM	Confirmed
Aux. Hoist Hook Speed	*	195 FPM	Confirmed
Boom Luffing Speed	*	120 seconds	Confirmed
Min. Swing Speed	*	0 RPM	Confirmed
Max. Swing Speed	1.5 RPM	1.5 RPM	Confirmed
<b>Swing Mechanism Data</b>			
Swing Assembly	Swing Bearing / Kingpost	Slew Bearing	Confirmed
Swing Type	Free Swing Required	Provided	Confirmed
Drive System	Gear	Provided	Confirmed
Number of Swing Drives	*	Two	Confirmed
Swing Lock	Mechanical Required	Provided	Confirmed
Swing Brake(s)	Required	Provided	Confirmed
Parking Brake	Required	Provided	Confirmed
Dynamic Brake	Required	Provided	Confirmed
Slewing Bearing Assembly	Bolted	Provided	Confirmed
360 degree Rotation	Required	Provided	Confirmed
<b>Power Unit &amp; Fuel System</b>			
Prime Mover	Caterpillar Diesel Engine Req'd. or Equal	Caterpillar	Confirmed
Model and HP Rating	*	3126DITA / 250HP	Confirmed
HP Rating to Cover Combined Operation of all Crane Motions	Per Specification	Triple Function Full Speed at Reduced Load Provided	Confirmed

**NOTES:**

\* - Denotes information to be provided by SUPPLIER



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CLIENT: PEMEX			C	10/21/2003	APPROVAL	SM	RM	KCS		
PROJECT: PB-Ku-H Prod.Platform			0	12/2/2003	APPROVED FOR FINAL DESIGN					
LOCATION: Bay of Campeche										
DESIGN INFORMATION		REQUIREMENTS	SUPPLIER'S PROPOSAL		ALTERNATIVES					
West Pedestal Crane		ZZZ-7550	ZZZ-7550							
Self-Contained Cooling System		Required	Provided		Confirmed					
Anti-Corrosion Coating on Engine Radiator		Required	Epoxy Coating		Confirmed					
Spark Arresting Exhaust Silencer		Required	Provided		Confirmed					
Insulated Exhaust System		Required	Provided		Confirmed					
Combustion Air and Fuel Shutoff Valves		"Rig-Saver" Type or equal	Provided		Confirmed					
Weather-Proof Engine Enclosure		Required	Hood and Side Panels		Confirmed					
Starting System		220VAC / 24VDC Bat. Syst. Req'd.	Hydraulic Start Provided		Confirmed					
Diesel Day Fuel Tank		6 mm Thick Carbon Steel Tank Required	Provided		Confirmed					
Diesel Day Fuel Tank Capacity		12 Hour Min. Run Time Req'd.	Provided		1,041 liters					
Diesel Day Fuel Tank Appurtenances Included per Spec.		Required	Per Oil States Standard		Level Gauge, Filler/Vent					
Fuel Tank Full Perimeter Drip Pan		Required	Provided		Confirmed					
Hydraulic System										
Type of System		Open Loop Required	Provided		Confirmed					
Crane Motions Covered		Simultaneous Full Load, Full	Triple Function Simultaneous		Confirmed					
		Speed Operation of Boom	operation Full Speed at		Confirmed					
		Luffing, Swing Drives & Main or Fast Line Hoist Required	reduced load provided		Confirmed					
Number of Hydraulic Pumps		Minimum of Three (3) Req'd.	Provided		5					
Pump(s) Manufacturer		*								
Hydraulic Fluid Reservoir		6 mm Thick Carbon Steel Tank Required	Provided		Confirmed					
Hydraulic Fluid Reservoir Capacity			2,081.98 liters		2,081.98 liters					
			Per Oil States Standard		Level Gauge, Filler/Vent, Suction Strainers, Return Filter					
Reservoir Appurtenances Included per Spec.		Required	Provided		Confirmed					
Hydraulic Fluid Reservoir Full Perimeter Drip Pan		Required	Not Required		Not Required					
Air-to-Oil Heat Exchanger		Required								
All Tubing in Compliance with Spec. (Molybdenum content, etc.)		Required	Hoses will be used for Hydraulic plumbing		Hoses will be used for Hydraulic plumbing					
Hydraulic Fluid		Required	Provided		Confirmed					
Hydraulic System Hoses, Tubing, Fittings, Relief Valves		Required	Hoses , Tubings, Fitting and Relief Valves Provided		Confirmed					
Included Per Spec										
NOTES:										
* - Denotes information to be provided by SUPPLIER										





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ZZZ-7550		A	9/1/2003	IDC	SM					39 / 47
SERVICE: West Pedestal Crane		B	9/23/2003	COMMENTS	SM	RM	KCS			
CLIENT: PEMEX		C	10/21/2003	APPROVAL	SM	RM	KCS			
PROJECT: PB-Ku-H Prod.Platform		0	12/2/2003	APPROVED FOR FINAL DESIGN						
LOCATION: Bay of Campeche										


  

DESIGN INFORMATION	REQUIREMENTS	SUPPLIER'S PROPOSAL	ALTERNATIVES
<b>West Pedestal Crane</b>	<b>ZZZ-7550</b>	<b>ZZZ-7550</b>	
<b>Hoists / Wire Ropes / Load Blocks</b>			
Boom Luffing Hoist Type	Rope Hoist	Wire Rope Provided	Confirmed
Main Hoist Type	Eq. Wire Rope Drum	Braden	Confirmed
Main Hoist Wire Rope Description	*	Bridon	Confirmed
Main Hoist Wire Rope Type	Non-Rotating, Non-Galvanized Type Required	Dyform 18-HSLR	Confirmed
Main Hoist Wire Rope Diameter	29 mm Required (min.)	22.23 mm.	22.23 mm.
Main Hoist Wire Rope Capacity	No less than five (5) full wraps of rope	583.08 m. Total Rope Provided.	583 m
Main Hoist Load Block Manufacturer	Crosby or Johnson or equal	Provided	Crosby
Main Hoist Load Block Type	*	Safety Latch Type	Confirmed
Main Hoist Load Block Weight	*	907.18 kg.	492 kg
Main Hoist Hook Drop Available	*	76.2 meters	Confirmed
Aux. Hoist Type	Braden or Eq. Wire Rope Drum	Braden	Confirmed
Aux. Hoist Wire Rope Description	*	Bridon	Confirmed
Aux. Hoist Wire Rope Type	Non-Rotating, Non-Galvanized Type Required	Dyform 18-HSLR	Confirmed
Aux. Hoist Wire Rope Diameter	> 29 mm Required	19.05 mm.	19.05 mm.
Aux. Hoist Wire Rope Capacity	*	135.03 m. Total Rope Provided.	135 m
Aux. Hoist Load Block Manufacturer	Crosby or Johnson or equal	Provided	Crosby
Aux. Hoist Load Block Type	*	Safety Latch Type	Confirmed
Aux. Hoist Load Block Weight	*	97.98 kg.	98 kg
Aux. Hoist Hook Drop Available	*	76.2 meters	Confirmed
Manual Emergency Load Lowering for Boom and Main Hoist	Required	Manual Emergency Load Lowering Kit for hoist ONLY provided.	Confirmed - boom, main, and aux hoist
Main and Aux. Hoists Anti-Two Block System	Required	Provided	Confirmed
Load Line Guides w/ Rollers	Required	Provided	Confirmed
All Lifting Equipment Certified for Personnel Handling	Required	Provided	Confirmed
<b>Operators Cab</b>			
Fully Enclosed, all Welded Carbon Steel Construction	Required	Provided	Confirmed
Cab Bolted to Crane Main Platform w/ Vibration Isolators	Required	Provided	Confirmed
Cab Orientation	RHS Looking Down Boom	Provided	Confirmed
Tinted Opening Safety Glass on All Sides	Required	Provided	Confirmed
Two Interior Dome Lights	Required	Provided	Confirmed
<b>NOTES:</b>			
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PROJECT: PB-Ku-H Prod.Platform			0	12/2/2003	APPROVED FOR FINAL DESIGN						
LOCATION: Bay of Campeche											
DESIGN INFORMATION			REQUIREMENTS		SUPPLIER'S PROPOSAL		ALTERNATIVES				
<b>West Pedestal Crane</b>			<b>ZZZ-7550</b>		<b>ZZZ-7550</b>						
Interior Dimmable Lights and Instrumentation			Required		Provided		Confirmed				
Horn			Required		Air Horn Provided		Confirmed				
Windshield Wipers			Required		Pneumatic Wipers Provided		Confirmed				
Fire Extinguisher			Required		Provided		Confirmed				
Adjustable Sun Visor			Required		Provided		Confirmed				
SS Load Chart			Required		Provided		Confirmed				
Air Conditioning			Required		Provided		Confirmed				
Tool Box			Required		Provided		Confirmed				
Two Spare 115VAC/60 Hz Outlets			Required		Provided		Confirmed				
All Required Alarms and Indicators per Spec.			Required		Per Oil States Standard		Oil States Standard				
All Required Crane Controls per Spec.			Required		Per Oil States Standard		Oil States Standard				
<b>Controls and Instrumentation</b>											
SS Boom Angle Indicator			Required		Provided		Confirmed				
Main Line Hydraulic Load and Load Radius Indicator			Required		Provided		Confirmed				
Aux. Line Hydraulic Load and Load Radius Indicator			Required		Provided		Confirmed				
Hydraulic System Pressure Gauges per Spec.			Required		Per Oil States Standard		Oil States Standard				
Diesel Engine Gauges per Spec.			Required		Per Oil States Standard		Oil States Standard				
Cab Controls per Spec. (in addition to Operating Controls)			Required		Per Oil States Standard		Oil States Standard				
Main & Aux. Line "Dead Man" Type Operating Controls			Required		Provided		Confirmed				
Crane Swing "Dead Man" Type Opererating Control			Required		Provided		Confirmed				
Crane Boom Luffing "Dead Man" Type Operating Control			Required		Provided		Confirmed				
Crane Operating Brakes per Spec.			Required		Per Oil States Standard		Dynamic Foot, Parking, Storm Lock				
<b>Electrical and Lighting Requirements</b>											
Explosion Proof Electrical Swivel in Crane Base			Required		Provided		Confirmed				
Spare Slip Rings in accordance with Spec.			Required		Can be offered as option		(7) 10amp provided				
Connection for 220VAC, 3 Ph., 60 Hz COMPANY Power Supply			Required		Provided		Confirmed				
All Required Wiring to Electrical Swivel			Required		Provided		Confirmed				
NOTES:											
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**OIL STATES SKAGIT SMATCO, LLC**



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<b>303707</b>	<b>303707-AME-RA-5074-145</b>


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PROJECT: PB-Ku-H Prod.Platform			0	12/2/2003	APPROVED FOR FINAL DESIGN						
LOCATION: Bay of Campeche											

DESIGN INFORMATION	REQUIREMENTS	SUPPLIER'S PROPOSAL	ALTERNATIVES
<b>West Pedestal Crane</b>	<b>ZZZ-7550</b>	ZZZ-7550	
All Electrical Cable Armored Shipboard with PVC Sheath	Required	Provided	Confirmed
All Electrical Terminations and Fittings PVC Coated	Required	Per Oil States Standard	
All Electrical Insallation & Components for CI 1, Div. 2, Grp C & D	Required	Provided	Confirmed
Complete Self-Contained Lighting System for Night Ops.	Required	Provided	Confirmed
Two Aircraft Warning Lights	Required	Provided	Confirmed
Main Platform and Boom Access and Inspection Lights	Required	Provided	Confirmed
Main E-Stop Switch per Spec.	Required	Provided	E-Stop pull Cable
Main Circuit Breaker with Disconnect Switches per Spec.	Required	Per Oil States Standard	(2) 20a Circuit Breakers
<b>Construction and Misc.</b>			
All Welded Construction per API 2C	Required	Per API 2C and AWS D1.1	Confirmed
All Components Seal Welded	Required	Per API 2C and AWS D1.1	Confirmed
Lifting Lugs Supplied on all Crane Components	Required	Provided	Confirmed
Main Platform with Hand/Toe Rails and FRP Grating	Required	Steel Grating Provided	1-1/2" Square Fiberglass Grating
Function and Load Testing	Required	Provided	Confirmed
All Welded Construction per API 2C	Required	Provided	Confirmed
All Components Seal Welded	Required	Per API 2C and AWS D1.1	Confirmed
Lifting Lugs Supplied on all Crane Components	Required	Provided	Confirmed
Main Platform with Hand/Toe Rails and FRP Grating	Required	Steel Grating Provided	1-1/2" Square Fiberglass Grating
Galvanized and Painted Handrails	Required	Provided	Confirmed
Galvanized and Painted Access Ladder	Required	Provided	Confirmed
Maintenance Jib	Required	Can be offered as option	Option Not Purchased
External Coating per Spec.	Required	Per Oil States Standard	Oil States Standard
API 2C Nameplate	Required	Provided	Confirmed
Existing Pedestal / Structural Design meets imposed loads	Required	Oil States Pedestal Reactions provided.	As Per Oil States Pedestal Reactions
Function and Load Testing	Required	Provided	Confirmed

<b>NOTES:</b>
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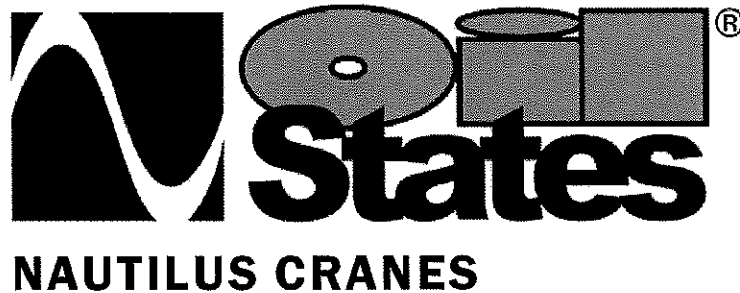
**OIL STATES**  
OIL STATES SKAGIT SMATCO, LLC







# CRANE ACCEPTANCE TEST PROCEDURE AND REPORT



**Nautilus Model 340LA-100 Marine Crane**

*for*

**Bosnor S.A. DE C.V.**

**PB-KU-H Platform**


**Serial Number: 24005**


**Tag Number: ZZZ-7550**

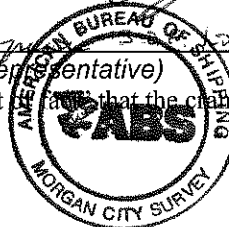
**Purchase Order: 1550-0268/05-1**

**Date: June 7, 2006**

  
(Oil States Industries, Inc. Representative)

  
(Bosnor, S.A DE C.V. Representative)

  
William Wayne (ABS Representative)  
ABS will witness the FAT, and will issue "statement of fact" that the crane testing has been witnessed by ABS.



Crane Serial Number: 24005



**PRIOR TO START OF FAT:**

The crane will run an endurance test consisting of a normal duty cycle for a minimum of two hours.

Start time: 2:30 pm End time: 4:30 pm

**SECTION 1 – Gauges:**

Accept	Not Accept	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Pressure (Main Hoist)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Pressure (Aux. Hoist)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Pressure (Boom)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Pressure (Swing)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Pressure (Return)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engine Oil Pressure
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Accumulator Pressure
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engine Water Temp.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Oil Temp.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engine Tachometer
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Oil Level
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Diesel Fuel Level
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydraulic Load Indicator System (Main)
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Hydraulic Load Indicator System (Aux.)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Fire Extinguisher

**SECTION 2 – Function Test the Following:**

Accept	Not Accept	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engine Start
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engine Throttle
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engine Shutdown
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engine Air Intake / Over speed Shutdown (Chalmatic)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Low Oil Pressure/High Water Temperature Shutdown
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Main Line Anti-Two Block
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Auxiliary Line Anti-Two Block
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Swing Park Brake
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Dynamic Swing Brake
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Free Swing Capability
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Mechanical Swing Lock
<input checked="" type="checkbox"/>	<input type="checkbox"/>	360° Continuous Rotation
<input checked="" type="checkbox"/>	<input type="checkbox"/>	*High Angle Kick Out
<input checked="" type="checkbox"/>	<input type="checkbox"/>	*Low Angle Kick Out
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Low Boom Angle Kick Out Override
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Manual Recharge Pump
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Pneumatic Windshield Wiper (Pneumatic)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Attention Horn (Pneumatic)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	High Speed Manual Reset Valve

\* The boom high and low angle kickouts will be tested at a reduced speed

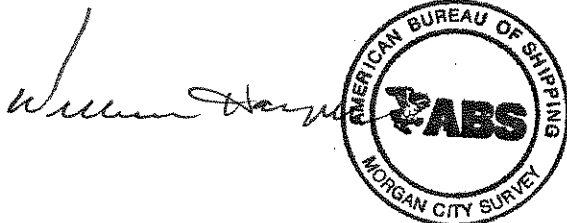
**SECTION 3 – Electrical:**

Accept	Not Accept	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Boom Floodlights (2)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Boom Tip Beacon Light (1)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Gantry Beacon Light (1)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Power On Light
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Cab Light (2)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Circuit Breaker

Accept	Not Accept	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Instrument Light (1)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Air conditioner
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Gaitronics System with Speaker
<input checked="" type="checkbox"/>	<input type="checkbox"/>	115 VAC / 60 Hz Outlet (2)

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

FUNCTION	BOOM ANGLE (Degrees)	CRACKING PRESSURE NO LOAD (PSI)	FULL SPEED PRESSURE NO LOAD (PSI)
Boom Up:	60	500	1,100
Boom Down:	60	700	1,900
Main Hoist Up:	60	100	700
Main Hoist Down:	60	600	1,400
Aux. Hoist Up:	60	100	500
Aux. Hoist Down:	60	600	1,300
Swing CW:	60	100	500
Swing CCW:	60	100	500



Crane Serial Number: 24005



## SECTION 5: Load Test

Note: Load testing will be performed in increments close to 6m, however the low elevation of the test stand at the OSI facility restrict load testing to a maximum radius 23m due to insufficient hook height.

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

Lift No.	Static Rated Load (Kg)	Test Load (Kg)	Percent of Rated Load	Main Hoist Cracking Pressure (PSI) Up	Main Hoist Cracking Pressure (PSI) Down	Main Hoist Full Speed Pressure (PSI) Up	Main Hoist Full Speed Pressure (PSI) Down	Swing Cracking Pressure (PSI) CCW	Swing Cracking Pressure (PSI) CW	Boom Cracking Pressure (PSI) Up	Boom Cracking Pressure (PSI) Down	Load Cell (lbs)	3.05 m Speed Chain (sec)	Speed Chain Average (sec)	Hook Speed (mpm)
1	45,803	45,839	100%	200	600	2,200	900	200	200	2,000	700	45,000	1. 25.31		
* 2	45,803	60,831	133%							2,500	600		2. 24.87	24.96	7.33
													3. 24.71		

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

Lift No.	Static Rated Load (Kg)	Test Load (Kg)	Percent of Rated Load	Main Hoist Cracking Pressure (PSI) Up	Main Hoist Cracking Pressure (PSI) Down	Main Hoist Full Speed Pressure (PSI) Up	Main Hoist Full Speed Pressure (PSI) Down	Swing Cracking Pressure (PSI) CCW	Swing Cracking Pressure (PSI) CW	Boom Cracking Pressure (PSI) Up	Boom Cracking Pressure (PSI) Down	Load Cell (lbs)	3.05 m Speed Chain (sec)	Speed Chain Average (sec)	Hook Speed (mpm)
3	28,002	27,980	100%	1,300	700	1,700	1,200	200	500	1,700	700	28,000	1. 13.16		
4	18,715	18,693	100%	1,000	600	1,500	1,200	200	700	1,700	700	18,000	2. 13.32	13.30	13.75
													3. 13.43		

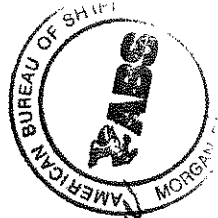
### Auxiliary Hoist: 1 - Part Reeving

Lift No.	Static Rated Load (Kg)	Test Load (Kg)	Percent of Rated Load	Aux. Hoist Cracking Pressure (PSI) Up	Aux. Hoist Cracking Pressure (PSI) Down	Aux. Hoist Full Speed Pressure (PSI) Up	Aux. Hoist Full Speed Pressure (PSI) Down	Swing Cracking Pressure (PSI) CCW	Swing Cracking Pressure (PSI) CW	Boom Cracking Pressure (PSI) Up	Boom Cracking Pressure (PSI) Down	Load Cell (lbs)	3.05 m Speed Chain (sec)	Speed Chain Average (sec)	Hook Speed (mpm)
5	4,632	4,680	101%	2,400	600	2,800	1,200	100	300	600	700	0	1. 2.18		
													2. 2.20	2.17	84.15
													3. 2.14		

### CERTIFIED TEST WEIGHTS (Kg)

1	45,839	=	Slings	A	D	E	H	I											
			544	+	1,043	+	8,287	+	17,123	+	6,586	+	12,256						
* 2	60,831	=	Slings	A	D	E	H	I	G	B	C								
			544	+	1,043	+	8,287	+	17,123	+	6,586	+	12,256	+	6,822	+	4,119	+	4,051
3	27,980	=	Slings	I	G	B	C	1 rd wt											
			544	+	12,256	+	6,822	+	4,119	+	4,051	+	188						
4	18,693	=	Slings	G	B	C	3" plate	A	4 rd wts										
			544	+	6,822	+	4,119	+	4,051	+	1,361	+	1,043	+	753				
5	4,680	=	Slings	C	3 rd wts														
			64	+	4,051	+	565												

\* This is a 33% overload lift that will be conducted at a 10m radius. This will be done by lifting the load slightly off the ground, utilizing boom luffing only.



*William H. Hays*

Crane Serial Number: 24005





### SPECIAL NOTES:

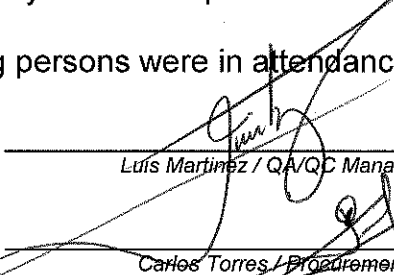
- All welding has been subjected to 100% NDT, which includes ultrasonic testing (all full penetration welds), wet magnetic particle examination (all fillet welds), and radiography (long seam on pedestal barrel), whichever is applicable to the type of weld connection, and comply with AWS D1.1.
- Oil States used the strain gage testing method for design verification; therefore heavy load lift testing of two times the static load is not required. Testing results are available at our facility for review.
- A two hour endurance test was conducted concurrent to the FAT. The joint testing of the crane was 5 hours, with a start time of 2:30pm and an ending time of 7:30pm.

### COMMENTS

1. Complete general paint touch up
2. Replace aux load cell gauge and function test
3. Adjust swing mechanical and function test

This is to verify that Nautilus Model 340LA-100 Marine Crane, Serial Number 24005, for PB-KU-H Platform has met all API 2C specification 6<sup>th</sup> edition, Bosnor, S.A DE C.V. and Oil States Industries, Inc. requirements and inspections which were performed by Oil States Industries, Inc. prior to installation of the API Monogram and has been satisfactorily accepted by QA/QC Department and Bosnor, S.A DE C.V. representative.

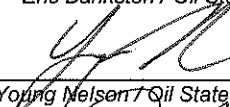
The following persons were in attendance and witnessed FAT:

  
Luis Martinez / QA/QC Manager Bosnor


  
Carlos Torres / Procurement Bosnor

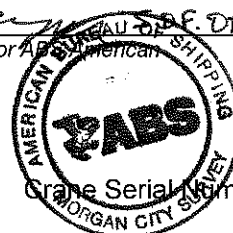
  
Tony G. Reyes / Penco Group, Logistics

  
Eric Bankston / Oil States, Project Manager

  
Young Nelson / Oil States, New Equipment Sales

  
Dwayne Bourgeois / Oil States, QA/QC

  
William Haynie / Senior Surveyor



S.F. DP's - Load Test

Crane Serial Number: 24005