CEAW003300

Field Assembly Manual

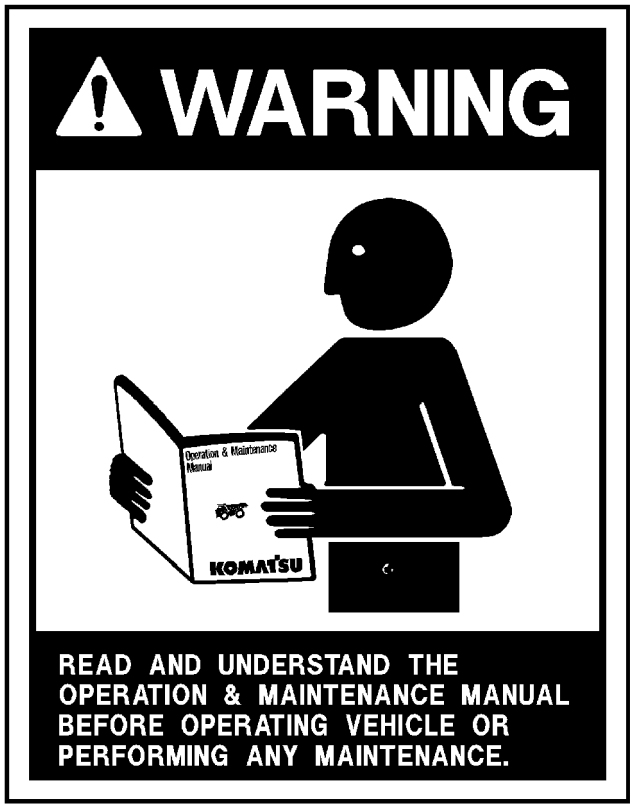
930E-2

DUMP TRUCK

SERIAL NUMBER **A30121 and up**

KOMATSU

www.KomatsuMining.com



Unsafe use of this machine may cause serious injury or death. Operators and maintenance personnel must read and understand this manual before operating or maintaining this machine.
This manual should be kept in or near the machine for reference, and periodically reviewed by all personnel who will come into contact with it.

CALIFORNIA
Proposition 65 Warning

Diesel engine exhaust, some of its constituents, and certain vehicle components contain or emit chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

CALIFORNIA
Proposition 65 Warning

Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.
Wash hands after handling.

NOTES:

FOREWORD

This manual is provided to aid the service technician during field assembly of the standard KOMATSU 930E Dump Truck. Variations of design required for specific truck orders may require some modification of the general procedures outlined in this manual. All safety notices, WARNINGS, and CAUTIONS should be understood and followed when accomplishing assembly of the truck.

The first section covers component descriptions, truck specifications and safe work practices, as well as other general information. The latter portion of the manual pertains to assembly and check-out.

The illustrations used in this manual are, at times, typical of the component shown and do not necessarily refer to any one particular truck model.

This manual shows dimensioning of U.S. standard and metric (SI) units throughout and all location references to “front”, “rear”, “right”, or “left”, are made in respect to the operator's normal seated position.

All maintenance personnel should read and understand the materials in the truck service manual before performing maintenance and/or operational checks on the assembled truck.

This "ALERT" symbol is used with the signal words, "CAUTION", "DANGER", AND "WARNING" in this manual to alert the reader to hazards arising from improper operating and maintenance practices.

DANGER

"DANGER" Identifies a specific potential hazard

WHICH WILL RESULT

in either INJURY OR DEATH

If proper precautions are not taken.

WARNING

"WARNING" Identifies a specific potential hazard

WHICH MAY RESULT

in either INJURY OR DEATH

If proper precautions are not taken.

CAUTION

"CAUTION" is used for general reminders

of proper safety practices

OR

to direct the reader's attention to avoid unsafe

or improper practices which may result

in damage to the equipment.

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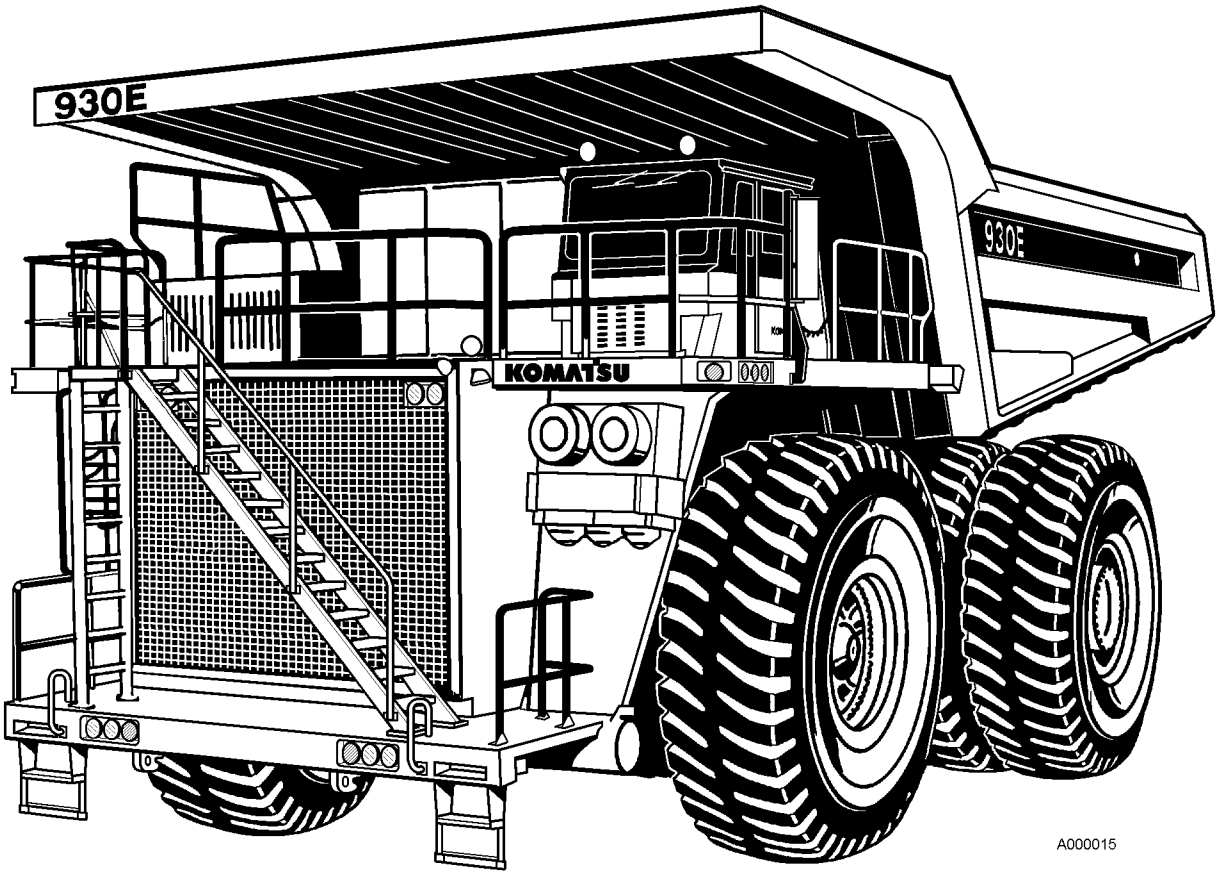


KOMATSU 930E-2

SAFETY RULES DURING ASSEMBLY

The following list of safety practices is intended for use by personnel during field assembly of the 930E Komatsu Truck.

This list of safety rules is not intended to replace local safety rules or regulations, federal, state, or local laws; the safety precautions recommended here are general and should be used in conjunction with all prevailing local rules and regulations.

1. All personnel should be properly trained for the assembly operation.

2. Safety equipment such as safety glasses, hard toe shoes and hard hats should be worn at all times during the assembly procedure.

3. Thoroughly inspect the assembly site. It should be free of weeds, debris or any flammable material.

4. Use only solid hard wood for cribbing. When using metal support stands, place wood blocks between support and frame to prevent metal to metal contact.

5. Inspect all lifting devices. Refer to the manufacturer's manual for correct capacities and safety procedures when lifting components.

6. Make a daily inspection of all lifting cables and chains. Replace any questionable items and insure cables and chains are capable of supporting the load.

7. Never stand beneath a suspended load. Use of guy ropes are recommended for guiding and positioning a suspended load.

8. Always maintain fire control equipment in the immediate area of the assembly. Inspect fire extinguishers regularly to make sure they are fully charged and in good working condition.

9. Capscrews and/or nuts being replaced must be of same grade as originally supplied.

Before doing any welding, read "Special Precautions For Welding On A 930E Truck" in Field Welding Procedures.

10. Never allow welding on the frame or its components unless battery charging alternator lead wire is disconnected and all electrical cabinet plug-in-cards are disconnected.

11. When welding, always make the ground connection to the part being welded. Never allow welding current to pass through bearings, engine, etc.

12. Never allow welding on the transmission unless it has been completely disassembled.

13. Never allow welding on the fuel tank or hydraulic tank, unless tanks have been properly purged and ventilated.

14. Use only the correct tools prescribed for the specific job to be done. Never improvise wrenches, screw drivers, sockets, etc.

15. Lifting eyes and hooks should be fabricated from the proper materials and rated to lift the load being placed on them.

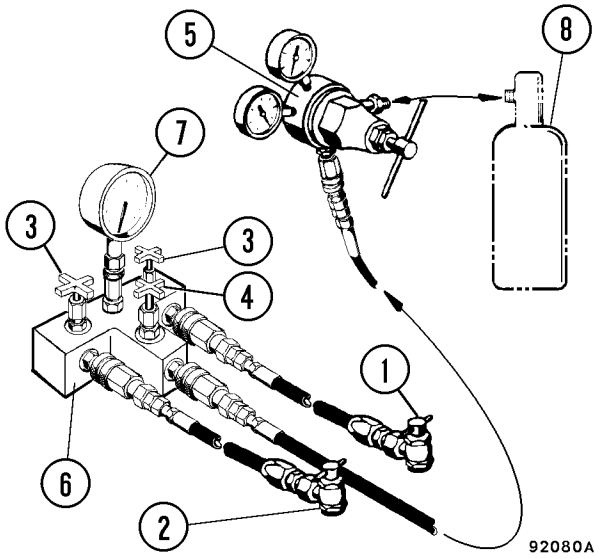
16. When the weight of any component(s) or any assembly procedure is not known or unclear, contact the KMS Area Service Representative for further information.

TOOLS AND EQUIPMENT FOR ASSEMBLY

The following equipment is recommended for field assembly of the Model 930E Komatsu truck.

1. Trailer (40 ft. x 8 ft.) for tool and equipment storage. Should have a lockable door.
2. Cranes
   a. Two, 50 ton cranes to remove chassis from freight trailer and place on cribbing. These cranes can also handle the lifting of the completed body on to the chassis upon completion of the assembly.
   b. One 120-150 ton crane. For the turning of the body on completion of underside body welding, both a 50 ton and preferably, a 120-150 ton crane is required.
3. Fork Lift: One 15,000 lb. capacity, with high lift capability.
4. Welding machines (2), portable, 300 amp. & Oxy-Acetylene cutting set.
5. Portable air compressor with 125 cfm and 100 psi (690 kPa) capacity. Two, 50 ft. x 3/4 in. air hoses.
6. Metal stands or cribbing. Sufficient amount of wood cribbing of sizes from 4 ft. x 12 in. x 12 in. and 4 ft. x 6 in. x 6 in. (railway cross ties)
7. Tire handler - Wiggins/Iowa Mold Tooling.
8. Miscellaneous air tools
9. Ladders - 12 ft., 8 ft., & 6 ft.
10. Chains, lifting cables, slings:
    - two, 4 point slings of 10 ft. length
    - two, 4 point slings of 6 ft. length
    - two, 4 ft., two 6 ft
    - two 10 ft. nylon straps
    - Four lengths of 1 in. x 50 ft. of rope
11. Set of standard master mechanics hand tools.
    - Thread taps and dies of both inch and metric sizes.
    - Metric sockets and open end wrenches from thread sizes 6mm to 36mm.
    - Inch sockets and open end wrenches up to 1 3/4 in. thread sizes.
    - Torque wrenches of 250 ft.lbs. with 18:1 multiplier. Torque wrenches of 600 ft.lbs. with 4:1 multiplier. Hydrotorque of 1 1/2 in. drive with capability of 4100 ft. lbs. or greater.
    - Box wrench 1 3/8 in. (Snap-On P/N X440B) with extension of 12 in. to tighten operators cab ROPS capscrews.
    - Sockets: 2 1/4 in. (Snap-On P/N J15036) and 2 5/8 in. (Snap-On P/N J15042) to tighten front suspension hardware.
12. Heavy duty 3/4 in. & 1 in. square drive impact wrench sets.
13. Impact Sockets for 3/4 in. & 1 in. square drive tools.
14. Special tools (see list, following pages)
15. Two, hydraulic or pneumatic porta-power jacks, (5 ton and 10 ton)
16. Hooks and shackles
17. Miscellaneous: i.e. grinders, rags.
18. Spreader bars for cabs and decks.
19. Two ratchet hoists of 3 ton capacity.
20. Pry bars
21. 10 gal. Varsol, or equal solvent.
22. Paint remover, 5 gal.
23. Grease, rust preventive

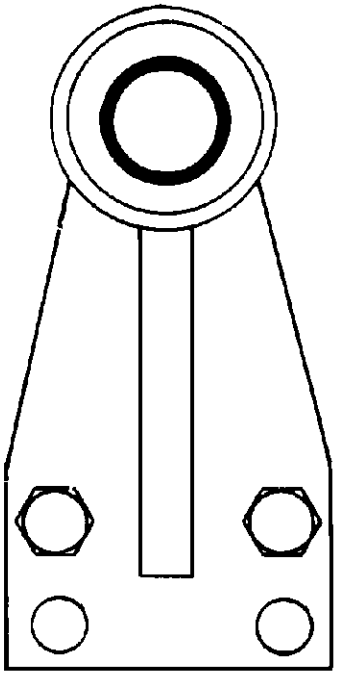
Part Number	Description	Use
EB1759	Nitrogen Charging Kit	Suspension & Accumulator Nitrogen Charging



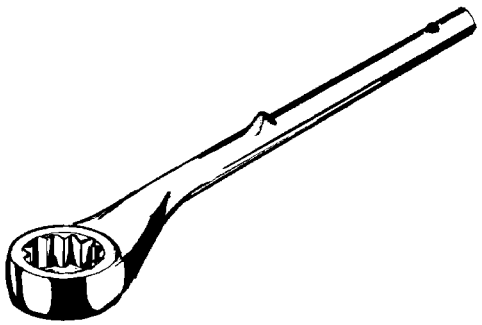
1. “T” Handle Valve
2. Charging Valve Adapter
3. Manifold Outlet Valves (from gauge)
4. Inlet Valve (from regulator)
5. Regulator Valve (Nitrogen Pressure)
6. Manifold
7. Charging Pressure Gauge (Suspensions)
8. Dry Nitrogen Gas

NOTE: Arrangement of parts may vary from illustration shown, depending on Charging Kit P/N.

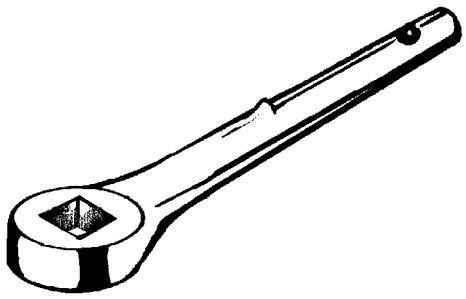
Part Number	Description	Use
EJ2626 (No longer available as complete unit)	Roller Assy.	Power Module Remove & Install
EJ2271	Roller Mount	
PC0706	Bearing	
TH9449	Bearing Retainer Ring	
TG1680	Roller Retainer Ring	
C1645	Capscrew 0.75 -10 NC x 2 1/4 in.	
C1542	Lockwasher 0.75 in.	
EH8686	Roller Ring	



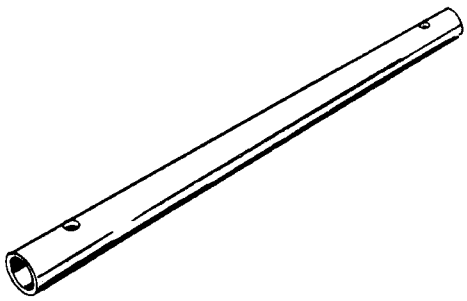
Part Number	Description	Use
PB8326	Offset Box End Wrench, 1, 7/16 in.	Miscellaneous



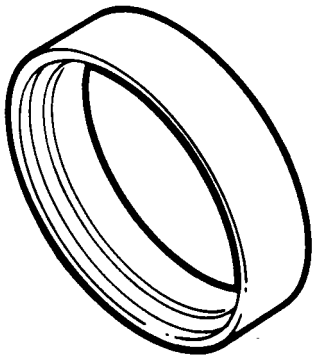
Part Number	Description	Use
TZ2734	3/4 in. Torque Adapter	Miscellaneous



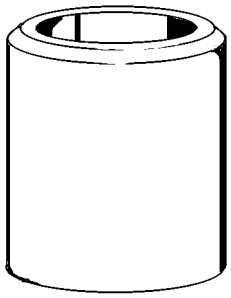
Part Number	Description	Use
TZ2733	Tubular Handle	Use with PB8326 & TZ2734



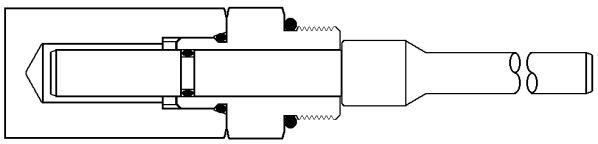
Part Number	Description	Use
BF4117	Seal Installation Tool	Front & Rear Disc Brake Floating Ring Seal Installation
ED3347	Seal Installation Tool	Rear Axle/Hub Adaptor Floating Ring Seal Installation



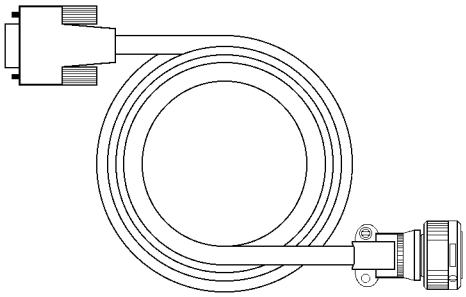
Part Number	Description	Use
EH4638	Sleeve Alignment Tool	Steering Linkage and Tie Rod Assembly, Refer to Section “G”



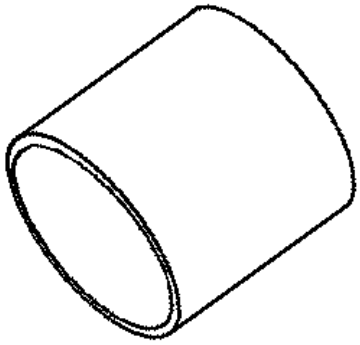
Part Number	Description	Use
EF9302	Wear Indicator	Brake Disc Wear, Refer to Section “J”
EB1723	Cap, Indicator	
EF9301	Pin, Indicator	
WA0010	O-ring, Indicator Pin	
TL3995	O-ring, Indicator Cap	
EB4813	Housing, Indicator	
SV9812	O-ring, Housing	



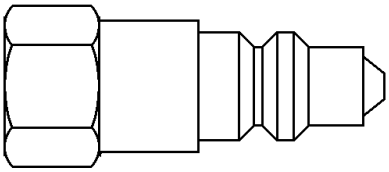
Part Number	Description	Use
EF9160	Harness	Payload Meter Download, Refer to Section “M”, Payload Meter



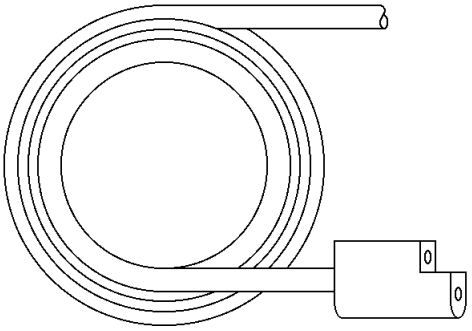
Part Number	Description	Use
EH7817	Alignment Tool	Upper Hoist Pin



Part Number	Description	Use
PB4684	Hydraulic Coupling	Miscellaneous



Part Number	Description	Use
PB9067	Bulkhead Connector	Battery Jumper



MAJOR COMPONENT DESCRIPTION

Truck And Engine

The 930E-2 Dump Truck is an off-highway, rear dump truck with AC Electric Drive. The gross vehicle weight is 1,100,000 lbs. (498 957 kg). The engine is a Komatsu SSDA16V160 rated @ 2700 HP (2014 kW).

Alternator (GE-GTA34)

The diesel engine drives an in-line alternator at engine speed. The alternator produces AC current which is rectified to DC within the main control cabinet. The rectified DC power is converted back to AC by groups of devices called “inverters”, also within the main control cabinet. Each inverter consists of six “phase modules” under the control of a “gate drive unit” (GDU). The GDU controls the operation of each phase module.

Each phase module contains an air-cooled solid-state switch referred to as a “gate turn-off thyristor” (GTO). The GTO cycles on and off at varying frequencies to create an AC power signal from the DC supply.

The AC power signal produced by each inverter is a variable-voltage, variable-frequency signal (VVVF). Frequency and voltage are changed to suit the operating conditions.

AC Induction Traction Motorized Wheels

The alternator output supplies electrical energy to the two wheel motors attached to the rear axle housing. The motorized wheels use three-phase AC induction motors with full-wave AC power.

The two wheel motors convert electrical energy back to mechanical energy through built-in geartrains within the wheel motor assembly. The direction of the wheel motors is controlled by a forward or reverse hand selector switch located on a console to the right side of the operator.

Blower

Both the inverters and the wheel motors produce heat while in operation and must be cooled. Cooling air is provided by a separate AC drive blower using rectified DC as its power source. Cooling air flow volume is modulated based on thermal requirements.

Suspension

HYDRAIR®II suspension cylinders located at each wheel provide a smooth and comfortable ride for the operator and dampens shock loads to the chassis during loading and operation.

Operator's Cab

The Operator's Cab has been engineered for operator comfort and to allow for efficient and safe operation of the truck. The cab provides for wide visibility, with an integral 4-post ROPS/FOPS structure, and an advanced analog operator environment. It includes a tinted safety-glass windshield, power-operated side windows, a deluxe interior with a fully adjustable seat and lumbar support, a fully adjustable/tilt steering wheel, controls mounted within easy reach of the operator, and an analog instrument panel which provides the operator with all instruments and gauges which are necessary to control and/or monitor the truck's operating systems.

Power Steering

The truck is equipped with a full time power steering system which provides positive steering control with minimum operator effort. The system includes nitrogen-charged accumulators which automatically provide emergency power if the steering hydraulic pressure is reduced below an established minimum.

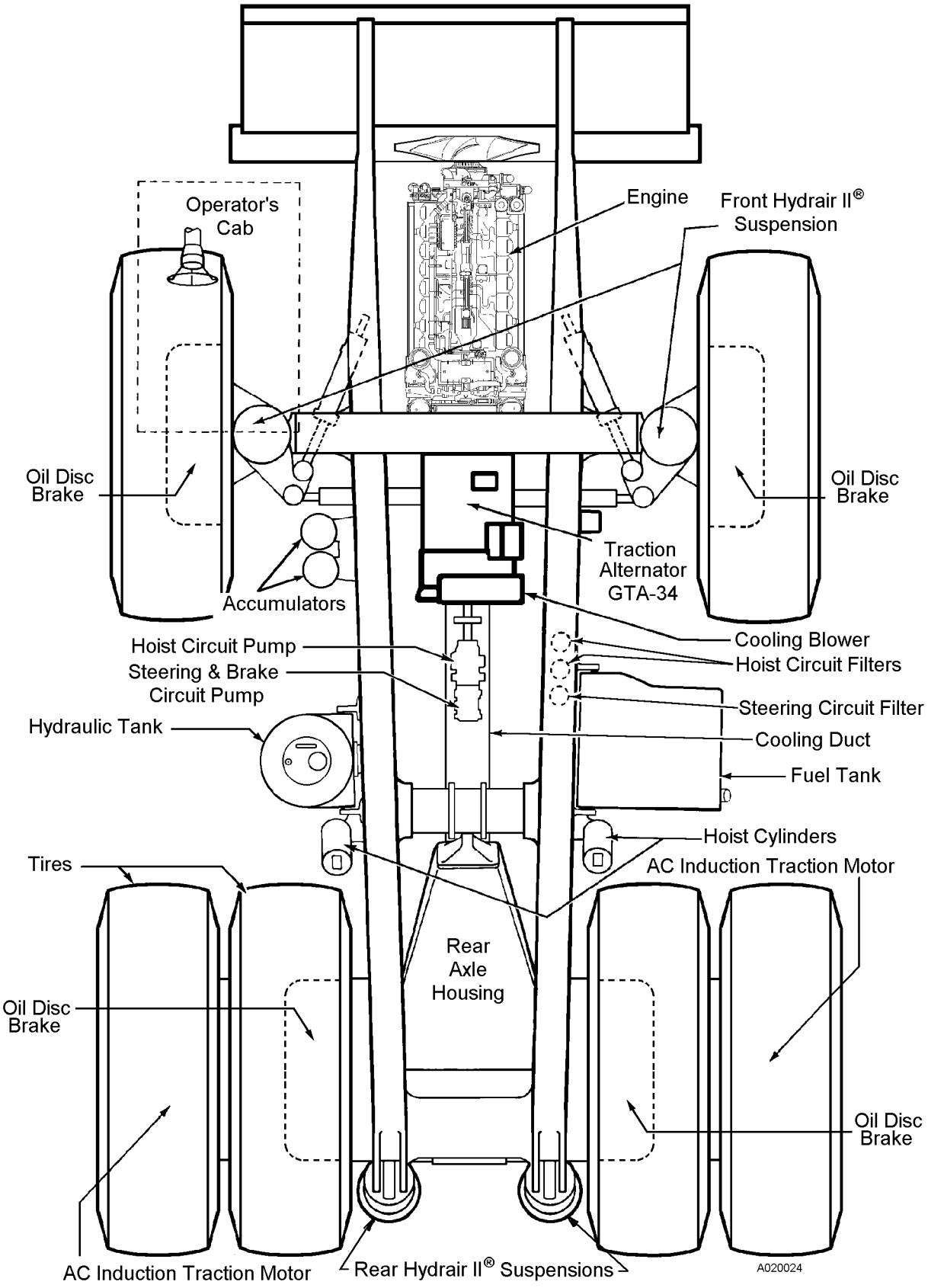
Dynamic Retarding

The dynamic retarding is used to slow the truck during normal operation or control speed coming down a grade. The dynamic retarding ability of the electric system is controlled by the operator through the activation of the retarder pedal (or by operating a lever on the steering column) in the operators cab and by setting the RSC (Retarder Speed Control). Dynamic retarding is automatically activated, if the truck speed goes to a preset overspeed setting.

Brake System

Service brakes at each wheel are oil-cooled multiple disc brakes applied by an all-hydraulic actuation system. Depressing the brake pedal actuates both front and rear brakes, after first applying the retarder. All wheel brakes will be applied automatically, if system pressure decreases below a preset minimum.

The parking brake is a dry disc type, mounted inboard on each rear wheel motor, and is spring-applied and hydraulically-released with wheel speed application protection (will not apply with truck moving).



930E MAJOR COMPONENTS

SPECIFICATIONS

These specifications are for the standard 930E Truck. Customer Options may change this listing.

ENGINE

Komatsu SSDA16V160

Number of Cylinder 16
Operating Cycle 4-Stroke
Rated Brake HP. .2700HP(2014kW)@1900RPM
Flywheel HP. . . . . 2550HP (1879 kW)
Weight (Wet)***** . . . . . 21,182 lbs (9608 kg)

*** Weight does not include Radiator, Sub-frame, or Alternator**

AC ELECTRIC DRIVE SYSTEM

AC/DC Current

Alternator . . . . . General Electric GTA - 34
Integral Cooling Fan . . . . .2500 cfm (71 m³/min)
AC Thermally Mod. Dual Fan
. . . . . 12,000 cfm (340 m³/min)
Motorized Wheels AC Induction Traction Motors
. . . . . Wheel Slip/Slide Control
Standard Gear Ratio***** 31.50:1
Maximum Speed . . . . . 40 MPH (64.5 km/h)

*******NOTE: Wheel motor application depends upon GVW, haul road grade, haul road length, rolling resistance, and other parameters. Komatsu & G.E. must analyze each job condition to assure proper application.*

DYNAMIC RETARDING

Electric Dynamic Retarding . . . . . Standard
Maximum Retarding. . . . . .5400 HP (4026 kW)
Continuous . . . . . .3300 HP (2460 kW)

- Continuously Rated High-density Blown Grids with Retard at Engine Idle & Retard in Reverse Propulsion.

BATTERY ELECTRIC SYSTEM

Batteries . . . . . bumper-mounted
4, 8D & 2, 30H 12Volt Batteries (Series/Parallel)
. . . . . .220 Ampere-Hour Capacity
. . . . . .With Disconnect Switch
Alternator . . . . . 24 Volt, 240 Ampere Output
Lighting . . . . . 24 Volt
Starters (2). . . . . 24 Volt

SERVICE CAPACITIES

	U.S. Gallons	Liters
Crankcase (Includes lube oil filters)		
SSDA16V160.	74	280
Cooling System	157.	594
Fuel	1200	4542
Hydraulic System.	350	1325
Wheel Motor Gear Box .	20/Wheel. . .	76/Wheel

HYDRAULIC SYSTEM

Hoist & Brake Cooling Pump . . . . .Tandem Gear
Output . . . . . 246 GPM (931 l/min)
. . . . . @ 1900 RPM & 2750 psi (17. 2 MPa)
Steering/Brake Pump
. . . . . .Pressure Compensated Piston Type
Output . . . . . 66 GPM (250 l/min)
. . . . . @ 1900 RPM & 2750 psi (18. 9 MPa)
Relief Pressure - Hoist. . . . 2500 psi (17.2 MPa)
Relief Pressure / Steering & Brake Pump
. . . . . 4000 psi (27.6 MPa)
Hoist. . . . . Two, 3-Stage Hydraulic Cylinders
Tank. . . . Vertical / Cylindrical, Non-Pressurized
Tank Capacity . . . . . 250 US Gal. (947 Liters)
Filtration. . . . . In-line Replaceable Elements
Suction. . . . . .Single, Full Flow, 100 Mesh
Hoist & Steering Filters . . .Beta 12 Rating = 200
. . . . . Dual, In-Line, High Pressure

SERVICE BRAKES

All Hydraulic Actuation . . . with Traction System
. . . . . Wheel Slip/Slide Control
Front & Rear Oil-Cooled Multiple Discs
. . . . . at Each Wheel.

SERVICE BRAKES (CONTINUED)

Total Friction Area /Brake . . . . . .15,038 in² (97 019 cm²)

Maximum Apply Pressure . . . . . .2500 psi (17 238 kPa)

STEERING

Turning Circle (SAE). . . . . 98 ft. 1 in. (29.67 m)

- Twin hydraulic cylinders with accumulator assist to provide constant rate steering.
- Emergency power steering automatically provided by accumulators

STANDARD DUMP BODY*

Capacity:. . . . . .

Struck	224 yds³	171 m³
Heaped @ 2:1 (SAE)	276 yds³	211 m³
Width (Inside)	26 ft. 9 in.	(8.15 m)
Depth	10 ft. 3 in.	(3.1 m)
Loading Height	23 ft.	(7.01 m)
Dumping Angle	45°	

* OPTIONAL capacity dump bodies are available.

TIRES

Radial Tires (standard) 53/80 R63

Rock Service, Deep Tread . . . . . Tubeless

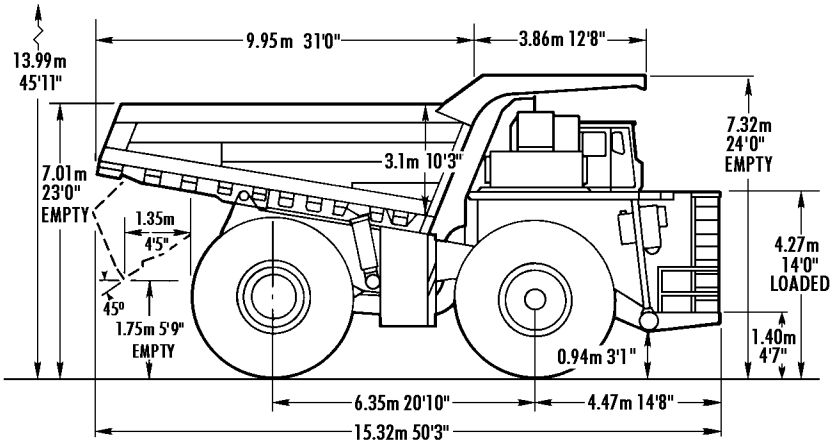
Rims . . . . . .(patented Phase II New Generation™ rims)

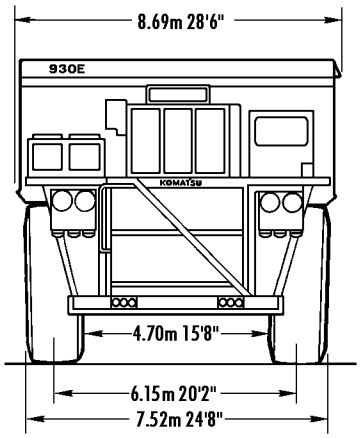
WEIGHT DISTRIBUTION

EMPTY	**Pounds**	**Kilograms**
Front Axle (49.3%)	220,319	999 351
Rear Axle (50.7%)	225,527	102 297
Total (50% Fuel)	445,846	202 232
LOADED		
Front Axle (33.9%)	372,900	169 147
Rear Axle (66.1%)	727,100	329 813
Total	1,100,000	498 960

Not to exceed 1,100,000 lbs. (498 960 kg), including options, fuel, and payload. Weights in excess of this amount require factory approval.

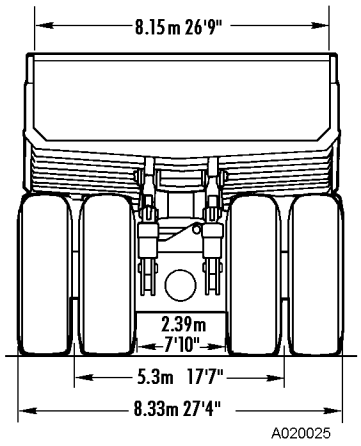
OVERALL TRUCK DIMENSIONS





All Dimensions with 171/211m³ 224/276 yd³ Body

BODIES	Struck		2:1 Heap		Loading Height	
	M³	Yd³	M³	Yd³	M	Feet
Standard	171	**224**	211	**276**	7.01	**23'0"**



NOTES

930E-2 MAJOR COMPONENT WEIGHTS

⚠WARNING ***Slings, chains, and/or cables used for lifting components must be inspected for serviceable condition and be rated to supply a safety factor of approximately 2X the weight being lifted.***

ITEM	POUNDS	KILOGRAMS
CHASSIS		
Wheel Rim Str.	3,104	1,408
Tire 53/80 R63 (148" OD)	9,480	4,300
Wheel & Tire Assy.	14,285	6,480
Main Frame Str.	47,790	21,677
Horsecollar	13,103	5,944
Fuel Tank (1200 gal.)	3,725	1,690
BODY (Weights are for complete body)		
Standard Body (276 yd^3)	66,268	30,059
NOTE: Body liners, if used, will add considerable weight to body. These weights are not included here.		
POWER MODULE		
Engine Oil	460	210
Duct Str. R.H.	175	79
Duct Str.	160	73
Duct Str. Alternator	205	93
Duct Str.	77	35
Duct Str. Control Cabinet	33	15
Plenum Str.	267	121
Grille Str.	886	402
Engine Sub-Frame	1,900	862
Auxiliary Box Assy.	445	202
Engine Sub-Module (less Grille)	36,500	16,556

ITEM	POUNDS	KILOGRAMS

POWER MODULE (Continued)

Air Cleaner Assy.	330	150
Retard Grid Assy.	6,045	2,742
Main Elect. Control Cabinet Assy.	6,714	3,045
Traction Alternator	8,200	3,720
GE Blower Assy.	2,271	1,030
Fan (Engine)	148	67
Heat Exchanger	200	90
Engine (Komatsu SSDA16V160)	20,514	9,305
Radiator & Shroud Assy.	5,732	2,600

NOTE: Optional equipment may add to weights listed above.

DECK AND DECK SUPPORT COMPONENTS

RH Deck Str.	385	175
LH Deck Str.	385	175
Center Deck Str.	550	250
Front Susp. Assy. (1)	6,150	2,790
Left Deck Support Str.	1,270	576
Right Deck Support Str.	1,306	593
Support Str.	1,284	583
LH Upright Str.	1,600	726
RH Upright Str.	1,274	578
LH Diagonal Beam Str. (ROPS)	344	156
RH Diagonal Beam Str.	150	68

ITEM	POUNDS	KILOGRAMS
HYDRAULIC COMPONENTS		
Steering Accumulator (1)	465	211
Hoist Cylinder (1)	2,120	962
Steering Cylinder (1)	320	145
Hydraulic Tank	1,508	684
Tandem Pump	310	141
Hoist Valve	415	188
FRONT AXLE COMPONENTS		
Front Brake Assy.	3,300	1,496
Spindle And Brake Assy. (1)	10,670	4,840
LH Steering Arm	734	333
RH Steering Arm	734	333
Front Susp. Assy. (1)	6,150	2,790
REAR AXLE COMPONENTS		
Rear Suspension Assy. (1)	2,470	1,120
Parking Brake Assy.	350	159
Duct Str. Wheelmotor	174	79
Pivot Eye Assy.	818	371
Final Drive Case W/Pivot Eye	14,114	6,402
Anti-Sway Bar Assy.	385	175
Wheelmotor & Service Brake Assembly	41,105	18,645
Wheel Ring Adaptor	940	426

NOTE: Optional equipment may add to weights listed above.

NOTES

Field Welding for Assembly or Repair

The large size of Trucks & Loaders which are produced by Komatsu Mining Systems, Inc. often makes extensive field welding procedures necessary when machines are assembled after shipment. Repairs during normal maintenance may also require welding to prolong the useful life of components and reduce costs of operation.

The field welding information contained here is general information and is not intended to give detailed instructions on specific repairs. The publications listed in the bibliography at the end of this document will give more specific details for most welding procedures. For more specific information or details, contact the KMS Area Service Manager.

WELDER QUALIFICATION AND TRAINING

The welding technique must be of the highest standard to produce the soundest weld possible. Only welders who have been trained and qualified for structural steel welding in all positions, in conformance with the American Welding Society (AWS) D1.1 or (AWS) D14.3 only, are allowed to perform the welding. The welding instructions for field assembly of KMS components are normally provided by engineering drawings. Additional detailed welding instructions for field repairs are provided in the field repair manuals SEBD14001 and SEBD15002. A full understanding of the AWS standard welding symbols is necessary to perform and inspect such field welds. Weld sizes specified on the drawings are intended to reflect minimum requirements.

WELD PROCESSES

Electric arc welding, either the semi-automatic “MIG” (GMAW), Flux Core (FCAW), or “Stick” electrode welding (SMAW), are approved processes for field installation and maintenance welding. Welding of highly stressed structural members such as castings, torque tubes, top and bottom plates on the frame rails, and the curved intersection points of frames should be done with the specific detailed instructions from KMS Product Service. See Annex A for repair procedures. These repair procedures are detailed instructions for most high stressed structural members.

Approved Consumables Are: GMAW, ER70S-6; FCAW, E70T-5, E71T-8, E71T8-Ni1; and SMAW, E7018 or E8018.

⚠CAUTION

Always disconnect the positive and negative battery cables of the vehicle before doing any welding on the unit. Failure to do so may seriously damage the battery and electrical equipment.

If truck/loader is equipped with an electronically controlled transmission or engine, be certain to follow all disconnect procedures detailed in the manufacturer's and/or the truck/loader service manual.

DO NOT DISCONNECT OR REMOVE any control circuit cards on electric drive trucks or any of the “AID” circuit control cards.

Always fasten the welding machine ground lead to the piece being welded; grounding clamp must be attached as near as possible to the weld area.

Never allow welding current to pass through ball bearings, roller bearings, suspensions, or hydraulic cylinders.

Always avoid laying welding cables over or near the vehicle electrical harnesses. Welding voltage could be induced into the electrical harness and possibly cause damage to components.

WELD QUALITY

1. Each weld must be homogeneous with low porosity, and free from cracks or slag inclusions.
2. Each weld must have complete fusion between the base metal and weld metal added by the electrode.
3. All welds must be reasonably smooth without excessive deformity. All craters must be filled. No cracks are permitted.
4. The toe of a weld to a high stress member must have smooth transition. Excessive convexity in multi-pass fillet welds is undesirable. Excessive convexity produces high residual stress in the throat of the weld, and is not permitted.
5. Undercut in excess of 0.03 in. (0.76 mm) on critical welds must be reworked by the application of a covering weld pass. It is important that the covering weld pass blend with the existing weld.
6. When welding in the vertical position, always weld using the vertical up technique. Large wash weld weaves should not be used when welding on truck frames. Properly applied multiple pass welding is the required procedure on truck frames.
7. Slag is to be removed from all weld beads, and must be completely removed before each pass in a multiple pass procedure. It is also required that all slag is removed and tie in all areas. Grind all welds where a weld crosses or intersects with another weld.

MATERIALS, CONTROLS AND PRECAUTIONS

The steel used in the fabrication of KMS trucks and loaders is of high strength low alloy (HSLA) material of different grades. The standard dump body main plates are made from abrasion resistant materials. These materials offer themselves very well to welding during fabrication, and repair.

The welding consumables are often supplied by the KMS Truck and Loader division with the new equipment as part of the field welding / assembly package. For field welding and repairs, the APPROVED consumables as detailed, should be procured from a local, reliable supplier. Other highly specialized welding consumables are available but have limited use on KMS structural components. Approval is required from your Area Service Manager.

Other highly specialized welding materials are available, but have limited use on KMS products.

Control of the welding area environment is essential for producing proper welds. Essentially, five areas require attention and control.

1. **Air Movement** - Air movement caused by wind, drafts, or blowers should be avoided, especially when a shielding gas is being used as part of the welding process.
2. **Low Ambient Temperature** - Welding should not be done at temperatures below 10°C (50°F). For certain low temperature conditions, preheating of the work may be necessary before welds can be made. Refer to Annex A.
3. **Weld Cooling** - Provisions should be made to protect the weld from a rapid cooling rate. Heat retardation may be accomplished through the use of heat lamps, torches, insulating blankets, etc. Certain materials may require post heat also as part of the welding procedure.
4. **Moisture** - Moisture on the steel surfaces to be welded must be removed before attempting to make welds. Electrodes must be stored in sealed containers until needed, and then must be kept in a warming oven at the work location until used to prevent any moisture absorption which might affect weld quality.
5. **Foreign Materials** - Any foreign substances such as dirt, paint, oil, rust, scale, carbon deposits from cutting must be removed prior to making any welds. All surfaces to be welded should be cleaned with a grinder to insure all foreign materials have been removed.

WELD INSPECTION

All welding repairs are subject to inspection by a KMS appointed inspector or laboratory to insure quality. After the weld has been made it can be inspected by a number of non-destructive evaluation techniques. The inspections can include any of the methods listed below. All assembly welds and weld repairs that are deemed unacceptable by the inspector must be corrected at no additional cost to KMS. All weld repairs are also subject to additional inspection.

1. **Visual Inspection** - This is the process of looking for potential defects such as undersized welds that can be checked with weld gauges. Defects include surface cracks, surface porosity, craters, and undercuts.

2. **Dye Penetrant Inspection** - This is an easily applied process which indicates cracks or surface conditions. The process is relatively inexpensive, but does not produce a permanent record except by normal photography.
3. **Fluorescent Penetrant Inspection** - Similar to dye penetrant inspection. This process uses a black (ultraviolet) light for increased efficiency and accuracy.
4. **Magnetic Particle Inspection** - This process requires special equipment that is usually more costly than the dye penetrant inspections. This process does not provide a permanent record except by normal photography.
5. **Ultrasonic Inspection** - This is a popular method of examining weld discontinuities. Specialized equipment and operator certification is required. With some equipment, printed data of the test can be created for a permanent record. Operator records with equipment settings and test results are also, normally recorded.
6. **X-Ray Inspection** - This process provides a view of the weld and base materials but it is highly specialized. This procedure provides a permanent visual record, but is more expensive than most other inspection techniques.

RECORDS

Record keeping of welding work may be of value if personnel and job conditions change frequently. Forms and recording codes are provided in several welding books, and using a systematic approach will help to provide continuity of welding work done. These records, along with photographs of the area before, during, and after repairs, can be of help when similar jobs arise, and must be accomplished by a different welder at a different location. The Service Department at Komatsu Mining Systems, Inc., Peoria Operations, should be provided with reports and photographs whenever welding repairs are made on Komatsu Trucks.

ANNEX A

The following are general repair procedures which should be used for all frame repair and rework.

1. The repair or rework area must be protected from wind and moisture during the entire procedure. Welding should be done at an ambient temperature of 50° F (10° C) or above.
2. Clean and grind the entire repair area to remove all rust, grease, oils, paint, and any other foreign materials likely to contaminate the weld.
3. Air arc out all cracks in the form of a “V” shape. The depth of the “V” is determined by the depth of the crack; the width to depth ratio should be approximately 1.25:1, and never less than 1:1. Cracks through the parent material will require a “V” with a root width slightly wider than the thickness of the 0.25 in. (6 mm) backup strip material. Backup strips are required for all cracks which have gone through the parent metal and cannot be welded from both sides.
4. Use dye penetrant to insure cracks are completely removed.
5. After air arcing and inspections (steps 3 & 4), all areas cut by the air arc should be cleaned thoroughly with a grinder to remove all possible carbon deposits and dye penetrant.
6. Fill gouges with weld and grind all surfaces smooth to avoid defects in new welds.
7. Grind all surfaces to be welded so they are free of slag, rust, or other foreign material.
8. Preheat the entire weld joint area until the surrounding surface area reaches 300° F (150° C) at a distance of 3 in. (7.6 cm) from all areas to be welded.
9. All welds are to be made with approved consumables only. The SMAW (Stick) welding rod must be used within four hours after being removed from a new sealed container or from a 125° F (32° C) minimum drying oven. Any rod that exceeds this exposure time must be re-dried for one hour at 800° F (427° C) before being used. Keep all weld starts and stops to a minimum.
10. When welding is complete, immediately (before weldment cools) post-heat welded area to 300° F (150° C). Maintain temperature for 15 minutes, and allow to cool slowly.
11. Grind, as necessary, using 36 or finer grit grinding material. Grinding should be parallel to the direction of primary stress, when possible.
12. Hammer peen welds as outlined in ANNEX B. Repaired area should be relatively smooth and free of rough areas which may lead to stresses.
13. Inspect repaired areas for surface defects using magnetic particle inspection procedures or dye penetrant method.

14. If surface defects are found, remove defects by grinding to a maximum depth of 0.060 in. (1.5 mm). Larger defects must be removed per aforementioned procedures. Spot welding requires preheating and postheating.

ANNEX B

TOE HAMMER PEENING

EQUIPMENT:

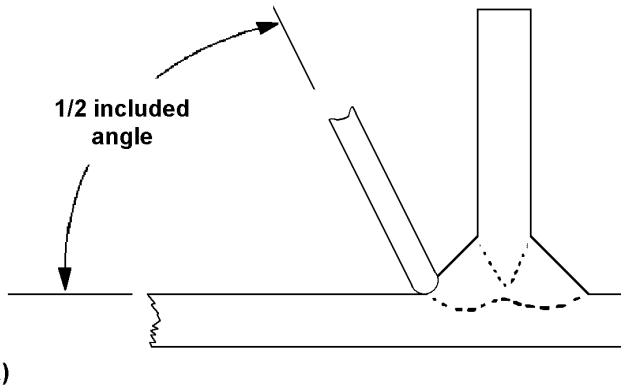
- Hand held pneumatic hammer
- Adequate air supply
- Adequate lighting
- 0.25 in. (6 mm) diameter spherical tip bit
- Protective clothing, gloves, including eye, face, and ear protection.

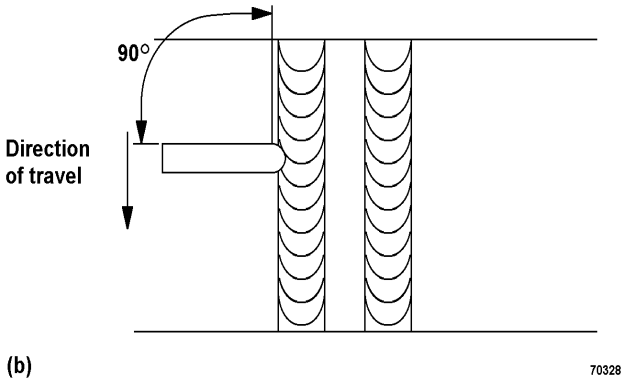
NOTE: Peening shall only be performed after weld acceptance by visual inspection.

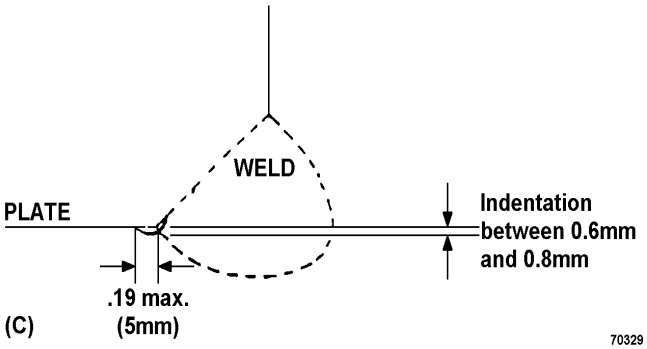
1. The toe of the weld should serve as a guide for the peening tool resulting in the area of deformation being approximately equally divided between the base material and the weld metal face to the specified depth and not to exceed 0.19 in. (5 mm) in width.

NOTE: Only the top layer of welds should be peened in multiple pass welds.

2. Welds must have a smooth profile and the toe must have a good transition to parent material (no overlap) before peening operation is performed. Grinding weld face and toe area is permitted to correct unacceptable conditions. Visual inspection/acceptance is to be done after peening with appropriate radius and depth gauge.
3. The hammer tool should be held at approximately one half the included angle between the weld face and the parent material and perpendicular to the direction of travel. This will normally require approximately four passes of the peening tool with the pressure of near full operator weight being applied. The depth of the indentation must be between 0.20 in. to 0.030 in. (0.6 mm to 0.8 mm).



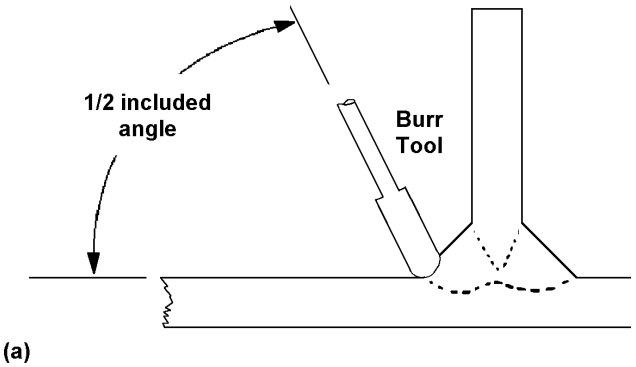




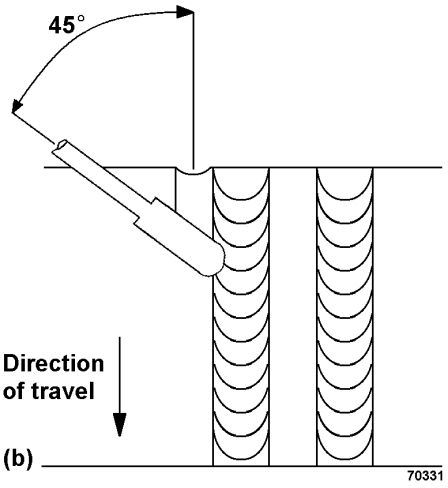
TOE GRINDING WITH ROTARY BURR

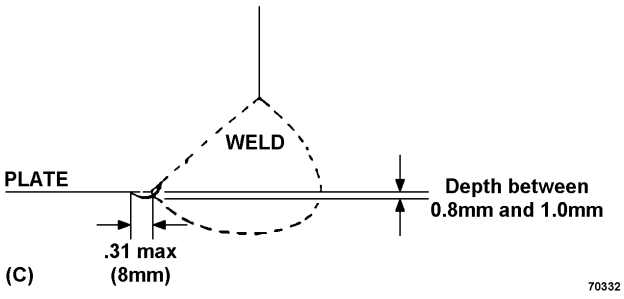
EQUIPMENT:

- High speed rotary air tool (15,000-20,000 rpm)
- Tungsten carbide rotary burr 0.50 in. (12 mm) diameter with 0.50 in. (12 mm) spherical tip
- Adequate air supply
- Adequate lighting
- Protective clothing, gloves, includes eye, face, and ear protection



1. The toe of the weld should serve as a guide for the burr tool resulting in the material removed being approximately equally divided between the base material and the weld metal face to the specified depth and not exceed 0.31 in. (8 mm) in width.
2. The weld must have a smooth profile and the toe must have a good transition to the parent material (no overlap) before the grinding operation is performed. Grinding the weld face and toe area is permitted to correct unacceptable conditions. Visual inspection/acceptance to be done after grinding with the appropriate radius and depth gauge.
3. The axis of the tool should be maintained at about 45° to the parent plate and inclined at about 45° to the direction of travel. The depth of the grinding must be between 0.030 in. to 0.040 in. (0.8 mm to 1.0 mm). The final surface should be clean, smooth and free of all traces of undercut or slag.





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“Metals and How to Weld Them”, James F. Lincoln Arc Welding Foundation, Cleveland, Ohio

Lincoln Electric Company, Cleveland, Ohio “Procedure Handbook of Arc Welding”

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Special Precautions for Welding on a 930E Truck

Preliminary Procedures before Welding or Performing Maintenance

Prior to welding and/or repairing the 930E Truck, maintenance personnel should notify a KMS factory representative. Only qualified personnel, specifically trained for servicing the AC Drive System, should perform this service.

If it is necessary to perform welding or repair to the truck without a field engineer present, the following procedures should be followed to ensure that the truck is safe for maintenance personnel to work on and to reduce the chance for damage to equipment.

Anytime the 930E engine is running:

- ***Do not open any of the cabinet doors or remove any covers.***
- ***Do not use any of the power cables for hand holds or foot steps.***
- ***Do not touch the retarder grid elements.***

Before opening any cabinets or touching a grid element or a power cable, the engine must be shutdown and all warning lights "OFF".

Normal Engine Shutdown Procedure

1. Stop the truck out of the way of other traffic on a level surface (dry, if possible), and free of overhead power lines, or other obstructions (in case dump body should need to be raised).
   a. Reduce engine speed to idle. Allow engine to cool gradually by running at low idle for 3 to 5 minutes.
   b. Place the F-N-R selector switch in "Neutral".
   c. Apply the parking brake switch. Be sure the "Parking Brake Applied" indicator light in the overhead display panel is illuminated.
2. Place REST switch in "ON" position to put AC Drive System in "REST" mode of operation. Be sure the "REST" indicator light in the overhead panel is illuminated.
3. With engine cooled down, turn keyswitch counterclockwise to "OFF" position for normal shutdown of engine.

If engine does not shutdown with keyswitch, use engine shutdown switch on operator cab center console, and hold this switch down until engine stops.

4. With keyswitch "OFF", and engine stopped, wait at least 90 seconds. Insure steering circuit is completely bled down by turning steering wheel back and forth several times. No front wheel movement will occur when hydraulic pressure is relieved. If the vehicle continues to steer after shutdown, notify maintenance personnel.
5. Verify that all the LINK VOLTAGE lights are "OFF" (one on back wall of operator cab, and two on deck control cabinets). Notify maintenance personnel if any light remains illuminated longer than five minutes after engine shutdown.
6. Close and lock all windows, remove key from keyswitch, and lock cab to prevent possible unauthorized truck operation. Dismount truck properly. Put wheel chocks in place.

Engine Shutdown Procedure before Welding or Performing Maintenance

Normal operation of the drive system at shutdown should leave the system safe to maintain. However, in the event of a system failure, performing the following procedure prior to any maintenance activities will ensure that no hazardous voltages are present in the AC Drive System.

1. Before shutting down the engine, verify the status of all the drive system warning lights on the overhead display panel. Use the lamp test switch to verify that all lamps are functioning properly.

If any of the RED Drive System warning lights remain ON, do not attempt to open any cabinets, disconnect any cables, or reach inside the retarder grid cabinet without a trained drive system technician present even if engine is shut down.

Only qualified personnel, specifically trained for servicing the AC Drive System, should perform this service.

2. If all red drive system warning lights are “OFF”, follow the “Normal Engine Shutdown Procedure”.
3. After the engine has been stopped for at least five minutes, inspect the LINK VOLTAGE lights on the exterior of the main control cabinet and back wall of the operator's cab (DID panel). If all lights are OFF, the retard grids, wheel motors, alternator, and power cables connecting these devices are safe to work on.
4. Locate the “GF” Cut-out switch in the access panel on the left side of the main control cabinet. Place the switch in the “Alternator Cutout” position. This will prevent the alternator from re-energizing and creating system voltage, until the switch is returned to its former position.
5. The blower motors, control cabinet, and power cables connecting these devices are still unsafe. To establish that these devices are safe, open the top control cabinet cover and inspect the red lights on the blower control panel.

If these lights are “OFF”, the blower system, blower power cables, and remainder of the control cabinet is safe to work on.

If these lights are ON, refer to steps 11 & 12.

6. DO NOT weld on the rear of the control cabinet! The metal panels on the back of the cabinet are part of capacitors and cannot be heated.
7. DO NOT weld on the retard grid exhaust louvers; they are made of stainless steel. Any welding done here must be done by qualified welders, using the appropriate equipment and materials. Some power cable panels throughout the truck are also made of aluminum, or stainless steel. They must be repaired with the same material, or the power cables may be damaged.
8. Power cables must be cleated in wood or other non-ferrous materials. Do not repair cable cleats by encircling the power cables with metal clamps or hardware. Always inspect power cable insulation prior to servicing the cables and prior to returning the truck to service. Discard cables with broken insulation.
10. Power cables and wiring harnesses must be protected from weld spatter and heat.

Always fasten the welding machine ground (-) lead to the piece being welded; the grounding clamp **MUST BE ATTACHED AS NEAR AS POSSIBLE** to the weld area.

Always avoid laying welding cables over or near the vehicle electrical harnesses. Welding voltage may be induced into the electrical harness and cause damage to components.

Before welding on the truck, open the battery disconnect switches and disconnect the battery charging alternator lead wire.

Never allow welding current to pass through ball bearings, roller bearings, suspensions, or hydraulic cylinders.

11. If the red lights on the exterior of the control cabinet and/or the back wall of the operator's cab continue to be illuminated after following the above procedure, a fault has occurred.

Leave all cabinet doors in place. Do not touch the retard grid elements; do not disconnect any power cables, or use them as hand or foot holds.

Notify a KMS factory representative, immediately. Only qualified personnel, specifically trained for servicing the AC Drive System, should perform this service.

12. If the red lights on the blower control panel are illuminated after following the above procedure, a fault has occurred. Reinstall the control cabinet panel. Do not perform maintenance on the blower control panel, or blower motor power cables.

Notify a KMS factory representative immediately. Only qualified personnel, specifically trained for servicing the AC Drive System, should perform this service.

13. Replace all covers and doors and place the “GF” cutout switch and battery disconnect switches in their original positions. Re-connect all harnesses prior to restarting the truck.

Leave the drive system in the REST position until the truck is to be moved.

RECEIVING

1. Inspect all components for possible shipping damages. Note any damages found, and report to shipper.

2. Spread out all parts shipped loose and inventory parts. Check for any short-shipped parts.
   a. Report serial numbers of all components.
   b. Inspect rear suspension spherical bearings to assure pin fit and movement.

3. Place front of chassis on 33 in. (84 cm) high (minimum) cribbing.

4. Place four, 12 in. (30 cm) cribbing under axle box (spread out in line with inner supports, and approximately 1.5 - 2 in. (38 - 51 mm) from wheel motor mount edge.)

NOTE: Cab and deck assemblies should be matched to the correct chassis.

5. Clean all component mount surfaces free of foreign material.

6. Check all cables for shipping damage, including cooling air intake, axle box, and cabinet blower hoses.

7. Ensure that deck mounting bolts are tightened to the proper torque before grid boxes, etc. are installed.

8. Check all electrical connectors are free from paint and/or corrosion. Clean any connector whose electrical continuity is questionable.

9. Before installing cab components to substructure, tap all threaded holes to remove paint (installation of inner bolts beside brake cabinet will be necessary).

10. Verify correct hook-up of all wiring.

11. Recheck the torque on factory installed capscrews:
    a. Steering Arms
    b. Nose Cone Pin
    c. Engine Mounts

12. Steering accumulators are normally NOT charged when shipped from the factory. Use proper precautions when checking nitrogen ($N_{2)}$ and oil level in cylinder.

13. Brake accumulators are normally charged with nitrogen when shipped from the factory. Use proper precautions when checking pressures.

NOTES

CHASSIS ASSEMBLY

NOTE: Due to differences in machine configurations and shipping restrictions/requirements throughout the world, the shipping and packaging of large machines will vary. Photographs or illustrations used in the following procedures are provided as general guidelines only. Actual assembly may be different, but this general procedure outline should provide a basis for assembly.

Recommended Assembly Data

1. Acknowledgment of Receipt Form*
2. Service Report Form*
3. Receiving Inspection Report Form*
4. Field Assembly Inspection Report Form*
5. List of Assembly Drawings*

*** supplied from factory**

6. Fluid Specifications (available in shop manual, Section "P")
7. Front Suspension Oiling & Charging Procedure (available in shop manual, Section “H”)
8. Rear Suspension Oiling & Charging Procedure (available in shop manual, Section “H”)
9. Fan Drive Checkout Procedure (available in Engine service manual)
10. Toe-In Checkout Procedure (available in shop manual, Section “G”)
11. Electrical Propulsion Checkout Procedure (available in shop manual, Section “E”, or refer to GE manual.)
12. Hydraulic Checkout Procedure (available in shop manual, Section “L”)
13. Steering & Brake Schematic (See schematic Section “R”, of shop manual)
14. Hydraulic Brake Checkout Procedure (available in shop manual, Section “J”)
15. Cab Module Hydraulic Piping Schematic (See schematic Section “R”, of shop manual)
16. Instrument Panel w/wire reference (See schematic Section “R”, of shop manual)
17. Filter List (available in Parts Catalog)
18. Lubrication & Service PM Forms (available in shop manual, Section “P”)
19. Park Brake Installation & Adjustment Procedure (available in shop manual, Section “J”)
20. Component Weight Chart (for crane reference, available in this manual)
21. Standard Torque Chart (available in this manual)

FOLLOW ALL SAFETY RECOMMENDATIONS IN THIS MANUAL, AS WELL AS LOCAL, STATE, AND FEDERAL REGULATIONS.

WHEN WELDING:

⚠CAUTION

Always disconnect the truck battery cables before doing any welding on the truck. Failure to do so may seriously damage the batteries and electrical equipment. Never allow welding on the frame or its components unless battery charging alternator lead wire is disconnected.

Always fasten the welding machine's ground to the piece being welded, or as close as possible.

Never allow welding current to pass through bearings.

Avoid laying welding cables over truck electrical cables and harnesses; welding voltages could possibly induce voltages in truck wiring and cause damage to components.

Always maintain fire control equipment in the immediate area of the assembly. Inspect fire extinguishers regularly to make sure they are fully charged and in good working condition.

Never allow welding on the fuel tank or hydraulic tank, unless tanks have been properly purged and ventilated.

BASIC ASSEMBLY PROCEDURE

1. SITE PREPARATION
2. UNLOAD TRAILERS OR RAIL CARS
3. ASSEMBLE CHASSIS *
4. WELD BODY *

** NOTE: These activities may be done in either order, or simultaneously, depending on available resources (cranes, welders, technicians, etc.).*

5. STATIC Checkout (Electrical & Mechanical)
6. MOUNT BODY TO CHASSIS
7. DYNAMIC Checkout (Electrical & Mechanical)
8. SITE CLEAN-UP

ORDER OF ASSEMBLY

The assembly procedure is organized in levels. Generally, the tasks to be done at a given level may be performed in any convenient order or simultaneously, but all the identified tasks in that level must be completed before proceeding to the next higher level. Each level depends on the components from the previous level having been installed.

NOTE: Due to differences in machine configurations and shipping restrictions/requirements throughout the world, the shipping and packaging of large machines will vary. Some of these steps may change due to different shipping configurations and/or truck options. However, the following outline should provide general guidelines.

Level 1

1. CHASSIS - Unload and crib for assembly.
2. TEMPORARY PLACEMENT OF AUXILIARY CONTROL CABINET; Refer to step 3, “930E Chassis Assembly Procedure”
3. DECK SUPPORT STRUCTURES (on horsecollar over suspension).

NOTE: It is easier to install and weld the deck support structures before the front suspensions are installed. However, do not install the deck support structures first, unless there is a suitable means of installing the suspension with the deck support structures in place.

4. REAR SUSPENSION UPPER MOUNTS
5. HYDRAULIC TANK
6. FUEL TANK
7. FRONT SUSPENSIONS (See “DECK SUPPORT STRUCTURE”)
8. DIAGONAL LADDER
9. AIR CLEANER / UPRIGHTS
10. DIAGONAL SUPPORT STRUCTURES (leave loose until left deck is bolted in place)

NOTE: Do not weld the air cleaner / uprights until all decks and the operator cab are installed. Ratchet hoists may be required to help tie all the structures together for a proper fit.

Level 2

1. AIR CLEANER PIPING
2. CENTER DECK
3. CONTROL CABINET
4. AUXILIARY CONTROL CABINET

Level 3

1. SPINDLES / HUBS
2. STEERING CYLINDERS
3. TIE RODS

Level 4

1. L. H. DECK STRUCTURE
2. R. H. DECK STRUCTURE (GRID BOX)
3. OPERATOR CAB

Level 5

1. EXHAUST PIPES
2. WELD UPRIGHT TORQUE TUBES
3. BLOWER - AIR INTAKE DUCTWORK
4. WHEEL MOTORS

Level 6

1. FRONT TIRES
2. REAR TIRES
3. INSTALL HOIST CYLINDERS

Level 7.

1. CLEARANCE LIGHTS
2. BODY PADS / SHIMS / GUIDES
3. INSTALL FRONT MUD FLAPS

Level 8

1. MOUNT BODY
2. HINGE PINS

Level 9

1. CONNECT HOIST CYLINDERS TO BODY
2. INSTALL ROCK EJECTORS
3. INSTALL REAR MUD FLAPS

LEVEL 10

1. CLEAN TRUCK
2. INSTALL DECALS
3. INSTALL LIGHT WIRING
4. CHECK NITROGEN CHARGE ON SUSPENSIONS
5. CHARGE STEERING ACCUMULATOR
6. ADD FLUIDS (ANTI-FREEZE, HYDRAULIC OIL, WHEEL MOTOR OIL)
7. CHARGE A/C SYSTEM

NOTE: Prior to starting the engine, make sure the steering pump case is full of oil.

LEVEL 11

1. CHECK OUT SYSTEMS (ELECTRICAL, HYDRAULIC, BRAKES, AND STEERING)
2. EXHAUST BLANKETS
3. CLEAN ASSEMBLY AREA
4. TOUCH-UP PAINT
5. TRAIN OPERATOR
6. OPTIONAL - INSTALL FIRE SUPPRESSION SYSTEM PRIOR TO RELEASE TO SERVICE.

930E Chassis Assembly Procedure

The following information is intended to provide basic guidelines for the assembly of the 930E Dump Truck. Due to differences in machine configurations and shipping restrictions/requirements throughout the world, the shipping and packaging of large machines will vary.

Items like the hydraulic tank and accumulator(s) may have been removed for shipping. Photographs may show the rear axle and rear suspensions already installed on the chassis; however, shipping restrictions may prevent this in some areas, and these components will have to be locally installed. Each shipment may be different, depending on the truck configuration and destination.

This outline is meant to provide a general basis for assembly, in spite of any differences in how the truck was delivered.

⚠WARNING

In the procedures that follow, many very heavy components will be required to be lifted into place and secured.

Inspect all lifting devices. Slings, chains, and/or cables used for lifting components must be inspected daily for serviceable condition. Refer to the manufacturer's manual for correct capacities and safety procedures when lifting components. Replace any questionable items.

Slings, chains, and/or cables used for lifting components must be rated to supply a safety factor of approximately 2X the weight being lifted.

When in doubt as to the weight of components or any assembly procedure, contact the area representative for further information.

Lifting eyes and hooks should be fabricated from the proper materials and rated to lift the load being placed on them.

Never stand beneath a suspended load. Use of guy ropes are recommended for guiding and positioning a suspended load.

NOTE: Throughout this assembly process, when hardware is tightened to a specified torque, the capscrews and nuts should be marked with paint or ink to show verification that the correct final torque has been achieved.

⚠IMPORTANT⚠

It is important not to interchange crucial components such as deck supports and cabs when assembling several trucks simultaneously. Major components such as deck supports, cabs, grid boxes, etc. have a paint stencilled “unit number” located on the component for identification. Use the stencilled unit number for proper assembly of trucks.

NOTE: At times, components such as deck supports may also come with a metal stamped unit number, in addition to the paint stencil. These numbers may not correspond with each other and the paint stencilled number should always take precedent. The machine serial number may also be used for proper identification.

NOTES

1. Lift the chassis off the truck/trailer (Figure 6-1) or rail car using two cranes with a minimum capacity of 50 tons each and place on adequate cribbing in a level position. The weight of the chassis, as shipped, is approximately **133,000 lbs. (60 382 kg)**.

   Cribbing should be approximately 33 in. (84 cm) high at the front, and approximately 12 in. (30 cm) high under the rear axle housing (Figure 6-2). Placement of the chassis at this height will allow easy installation of truck components.

   Thoroughly clean the chassis.

FIGURE 6-1.

FIGURE 6-2.

2. Remove the auxiliary control cabinet (Figure 6-3) from the LH frame rail where it is supported and tack welded for shipment. The weight of the auxiliary control cabinet is approximately **445 lbs. (202 kg)**.

NOTE: The electrical wiring for the auxiliary control cabinet has already been connected to the truck and cannot easily be disconnected. The cabinet should be temporarily placed on the control cabinet support structure to allow the LH deck support to be placed into position and welded to the horsecollar (Figure 6-4).

FIGURE 6-3.

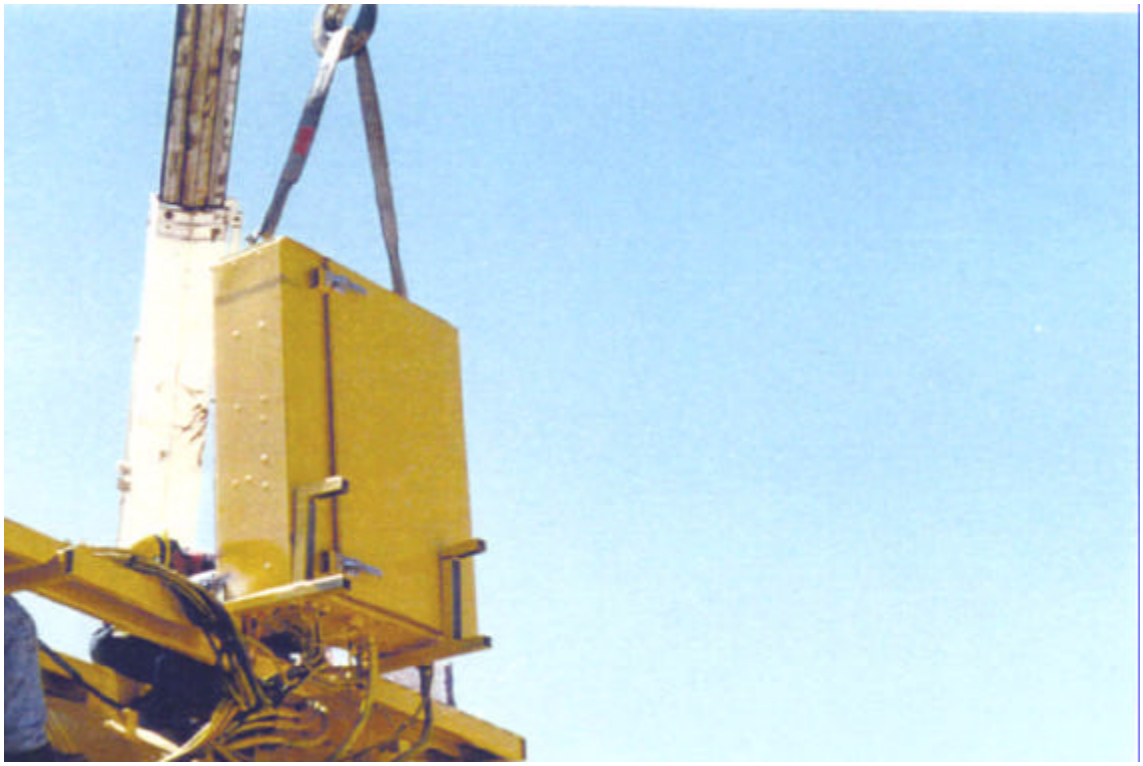


FIGURE 6-4.

3. Lift the LH deck support into position. The weight of each deck support is approximately **1270 lbs. (576 kg)**.

   Bolt the structure into place using the four tapped pads, and weld all around the support.

   The four tapped pads on each support and the corresponding blocks on the horsecollar need to be removed to allow for a complete weld around the joint.

   Grind all areas, and clean. Paint after welding is complete.

   Refer to Figures 6-5 thru 6-10.

   Repeat for the RH deck support.

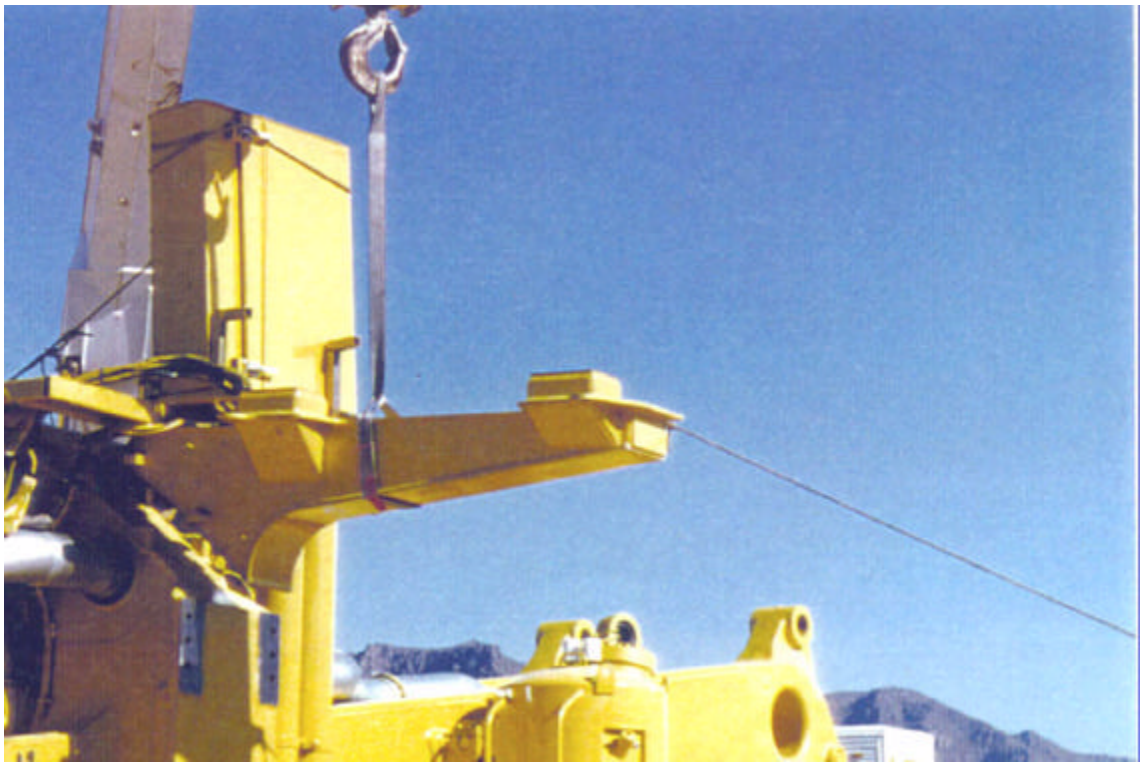


FIGURE 6-5.

FIGURE 6-6.

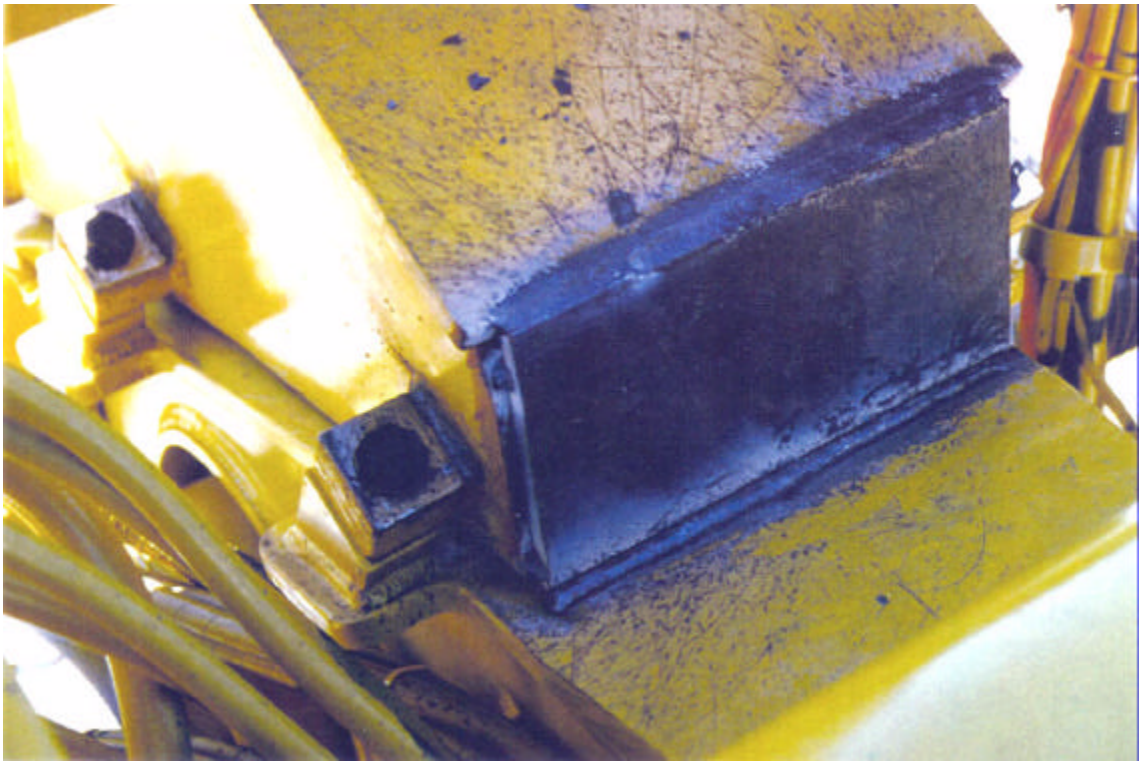


FIGURE 6-7.

FIGURE 6-8.

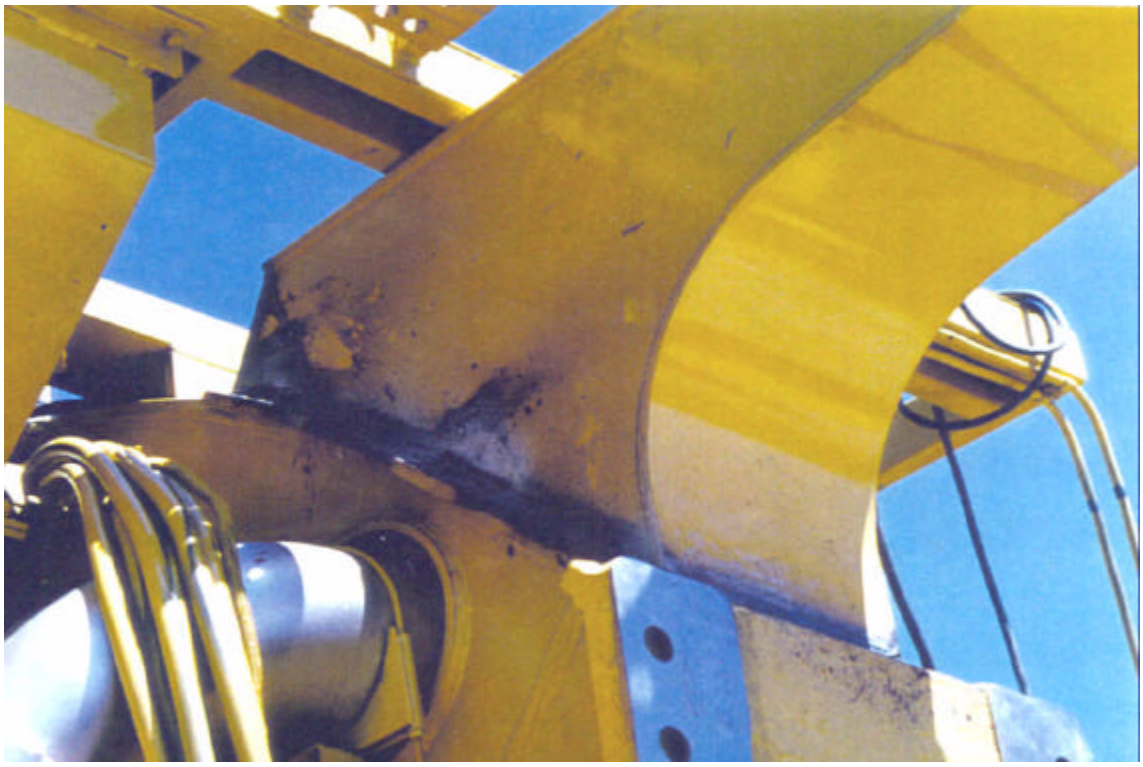


FIGURE 6-9.

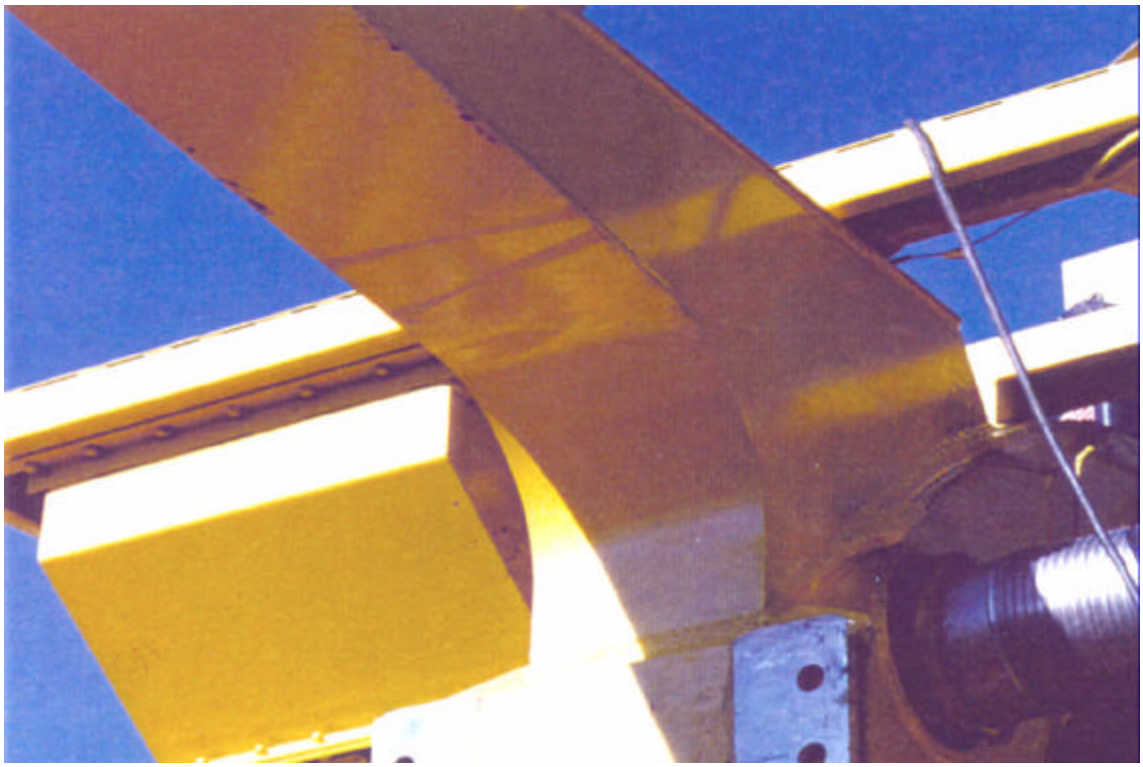


FIGURE 6-10.

4. Position the top rear suspension eye with its spherical bearing between the ears on the frame as shown in Figure 6-11.
5. Lubricate pin (1), align the retaining capscrew hole with the hole in the mounting bore, and drive in far enough to hold the pin in position.
6. Insert spacer (4) and continue to drive the pin in through the spherical bearing. Insert the remaining spacer and continue to drive the pin in until the retaining capscrew hole is aligned with the hole in the pin.
7. Install capscrew (2) and locknut (3). Tighten to **343 ft. lbs. (465 N.m)** torque.

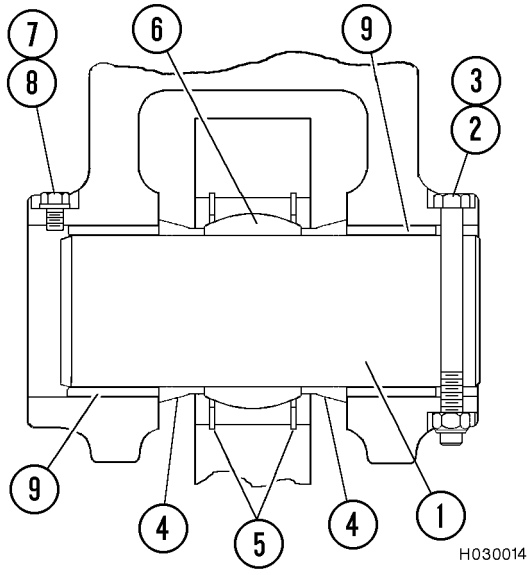


FIGURE 6-11. REAR SUSPENSION MOUNTING PIN
(Typical, Top and Bottom)

1. Pin
2. Retainer Capscrew
3. Locknut
4. Bearing Spacer
5. Retainer Ring
6. Bearing
7. Capscrew
8. Washer
9. Sleeve

8. Clean the mounts for the hydraulic tank and lift the tank into position. (Figure 6-12)

   The weight of the hydraulic tank is approximately **1508 lbs. (684 kg)**.

   Tighten the four mounting capscrews (1.0 in. UNC G5) near the top of the tank to a torque of **459 ± 45 ft. lbs. (622 ± 62 N.m)**.

   Tighten the two mounting capscrews (M24) near the bottom of the tank to a torque of **590 ± 59 ft. lbs. (800 ± 80 N.m)**.

9. Clean the mounts for the fuel tank and lift the tank into position. (Figure 6-13)

   The weight of the fuel tank is approximately **3725 lbs. (1690 kg)**.

   Tighten the four mounting capscrews (1.000 in. UNC G5) near the top of the tank to **459 ± 45 ft. lbs. (622 ± 62 N.m)** torque.

   Tighten the four mounting capscrews (0.750 in. UNC G8) near the bottom of the tank to **310 ± 31 ft. lbs. (420 ± 42 N.m)** torque.

FIGURE 6-12.

FIGURE 6-13.

10. Connect the piping to the hydraulic tank and properly tighten all fittings.

    Refer to Figures 6-14 and 6-15.

NOTE: When the machine is ready for operation, the hydraulic tank shut-off valves must be opened. The valves are open when the handles are parallel with the hoses.

FIGURE 6-14.

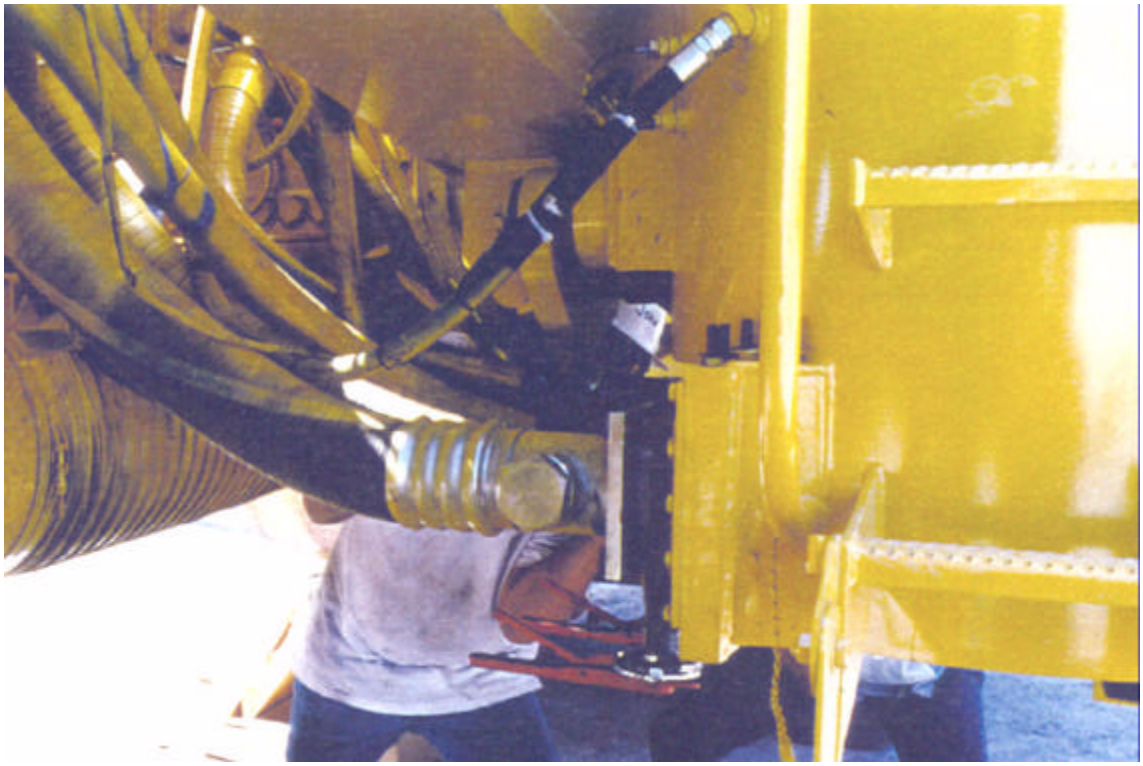


FIGURE 6-15.

11. Install the two hoist filter assemblies onto the bracket provided on the inner side of the fuel tank. Connect fuel supply and return lines to the fuel tank.

    Refer to Figure 6-16.

12. Clean the front suspension mounting surfaces. Refer to Figure 6-17.

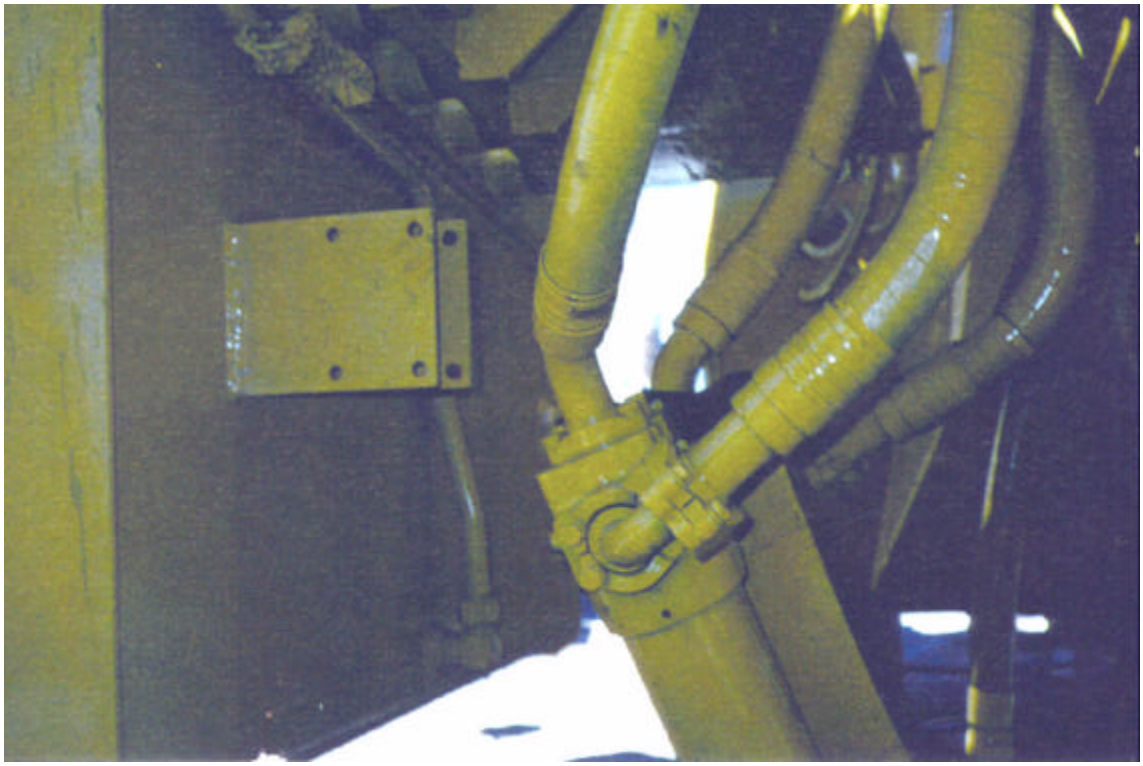


FIGURE 6-16.

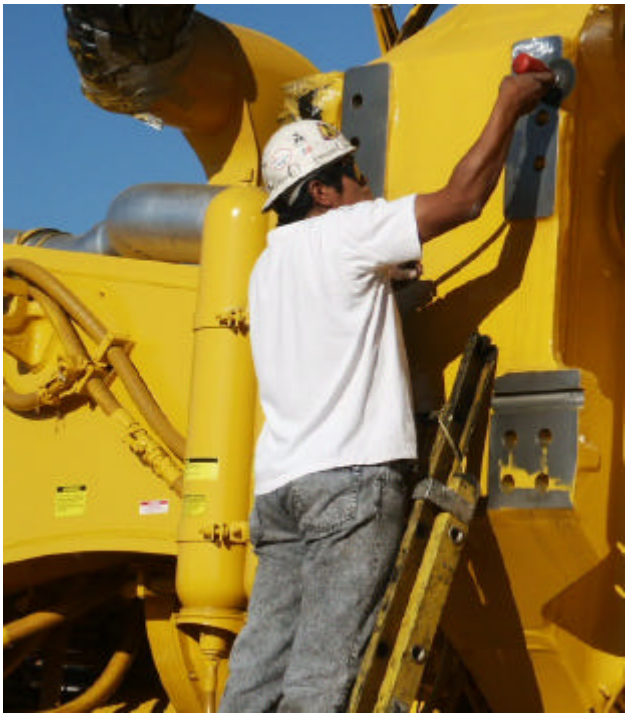


FIGURE 6-17.

13. Lift the front suspension assembly into position. Refer to Figure 6-18. The weight of each front suspension assembly is approximately **6150 lbs. (2790 kg)**. The hardware for the front suspension should be tightened according to the "Turn-of-the-Nut" method as described below.

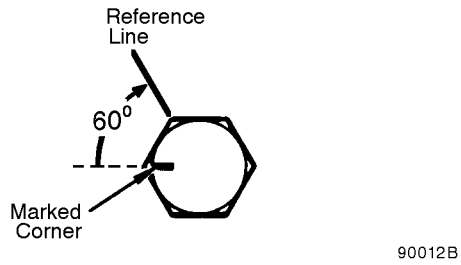
"TURN-OF-THE-NUT" Tightening Procedure

a. Tighten all fourteen capscrews (1, 6, 8, Figure 6-19) to **400 ± 40 ft .lbs. (542 ± 5 N.m)** torque.

b. Maintain this torque on the top two corner capscrews and the bottom outer four capscrews (item 8, (the 4 bottom capscrews with nuts).

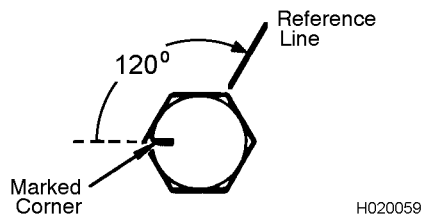
c. Loosen the 8 remaining capscrews and then tighten again using "turn-of-the-nut" tightening procedure as follows:

d. For the four, 6.0 in. (15 cm) long capscrews (1) at the upper mount, tighten capscrews initially to **70 ft. lbs. (95 N.m)** torque; then advance capscrew head 60° using steps (d-1) thru (d-3). Refer to the diagram below.



REFERENCE MARKS FOR 60 DEGREE ADVANCE
(6.0 in. (15 cm) Capscrews)

For the four inner, 14.0 in. (36 cm) long capscrews (6, Figure 6-19), tighten capscrews initially to **100 ft. lbs. (136 N.m)** torque; then advance capscrew head 120° using steps (d-1) through (d-3). Refer to the diagram below.



REFERENCE MARKS FOR 120 DEGREE ADVANCE
14.0 in. (36 mm) Capscrews

1.) Mark a reference line on a corner of the hexagonal capscrew head or nut and the mounting surface opposite this corner as shown. Then mark the position located 60° or 120° clockwise relative to the first reference line on the mounting surface.

2.) To insure that the opposite end of the turning member, either the capscrew head or nut remains stationary, scribe a reference mark for this check.

3.) Each corner of a hexagon represents 60°. The turning member, either the capscrew head or nut, is turned until the marked corner is adjacent with the marked reference line. Check to make sure that the opposite end of the turning member has NOT turned during the tightening procedure.

NOTE: Do not exceed 4 RPM tightening speed. Do not hammer or jerk wrench during the tightening procedure.

e. Loosen the top two corner capscrews (1) and the bottom outer four capscrews (8, the 4 bottom capscrews with nuts).

1.) Tighten the top, two corner 6.0 in. (15 cm) capscrews to **70 ft. lbs. (95 N.m)** torque, then use "turn-of-the-nut" method to advance capscrew heads 60°.

2.) Tighten the bottom, outer four 14.0 in. (36 cm) capscrews to **200 ft. lbs. (271 N.m)** torque, then use "turn-of-the-nut" method to advance capscrew heads 120°.

NOTE: If for any reason, these fasteners need to be checked for tightness after completing the above procedure; loosen and inspect all 14 capscrews and repeat entire process, starting with cleaning and lubricating capscrews, washers, and nuts. In addition, the capscrew head will need to be appropriately marked to show an additional use.

FIGURE 6-18.

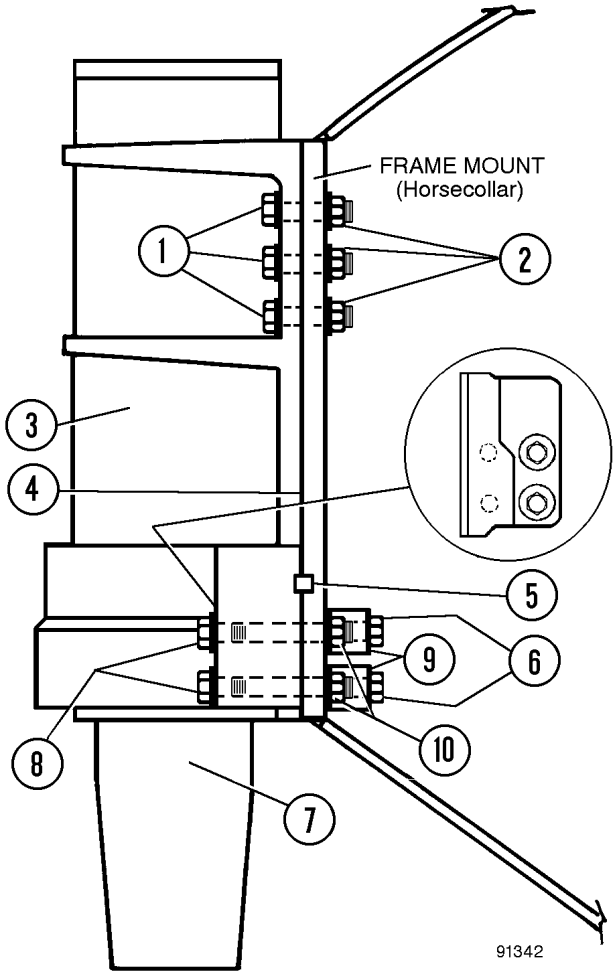


FIGURE 6-19. SUSPENSION INSTALLATION

1. Capscrews, Washers
2. Nuts, Washers
3. Housing
4. Mounting Surface
5. Shear Bar
6. Capscrews, Washers
7. Piston
8. Capscrews, Washers
9. Spacer
10. Nuts, Washers

14. The diagonal ladder and railing can now be installed and all capscrews tightened.

    Refer to Figure 6-20.

    Tighten capscrews to standard torque. Refer to section FAM1003 for Torque Charts and Tables.

FIGURE 6-20.

15. Lift LH & RH uprights into position and install the four capscrews (M20) to each upright. Tighten the nuts to **343 ± 34 ft. lbs. (465 ± 47 N.m)**.

    The weight of the LH upright is approximately **1600 lbs. (726 kg)**. The weight of the RH upright is approximately **1274 lbs. (578 kg)**.

    Refer to Figures 6-21 and 6-22.

NOTE: DO NOT weld the torque tubes on the uprights until the decking is in place.

FIGURE 6-21.

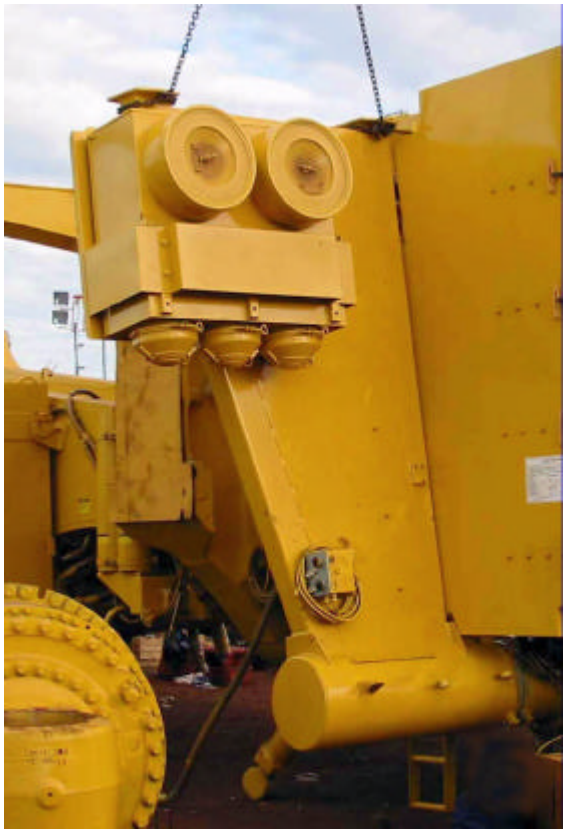


FIGURE 6-22.

16. If installed (some trucks are shipped with the center deck not installed), the center deck should be removed to enable easy installation of air intake tubing and the two diagonal cross tubes.

    Refer to Figure 6-23.

    The weight of the center deck is approximately **550 lbs. (249 kg)**.

17. Lift the LH diagonal tube into position (Figure 6-25). The weight of the LH diagonal tube is approximately **344 lbs. (156 kg)**.

    Loosely install the capscrews until the deck and cab is in place. After installation of the deck and cab, tighten the sixteen capscrews (M24) to **590 ± 59 ft.lbs. (800 ± 80 N.m)** torque.

FIGURE 6-23.

FIGURE 6-24.

18. Lift the RH diagonal tube into position (Figure 6-26). The weight of the tube is **150 lbs. (68 kg)**. Loosely install the capscrews until the decking is in place.

    After installation of the deck, tighten the twelve capscrews (M16) to **177 ± 17 ft.lbs. (240 ± 24 N.m)** torque.

19. Lift the four air intake tubes and hump hoses into place. Ensure that all the clamps are properly tightened.

    Refer to Figure 6-24.

FIGURE 6-25.

FIGURE 6-26.

20. Place the center deck into position. (Figure 6-27). Tighten the four capscrews (M20) to **343 ± 34 ft.lbs. (465 ± 47 N.m)**.

FIGURE 6-27.

21. Lift the electrical control cabinet into position. The weight of the cabinet is approximately **6714 lbs. (3045 kg)**.

    Tighten the ten capscrews (M30) to a torque of **1180 ± 118 ft.lbs. (1600 ± 160 N.m)**.

    Refer to Figures 6-28 and 6-29.

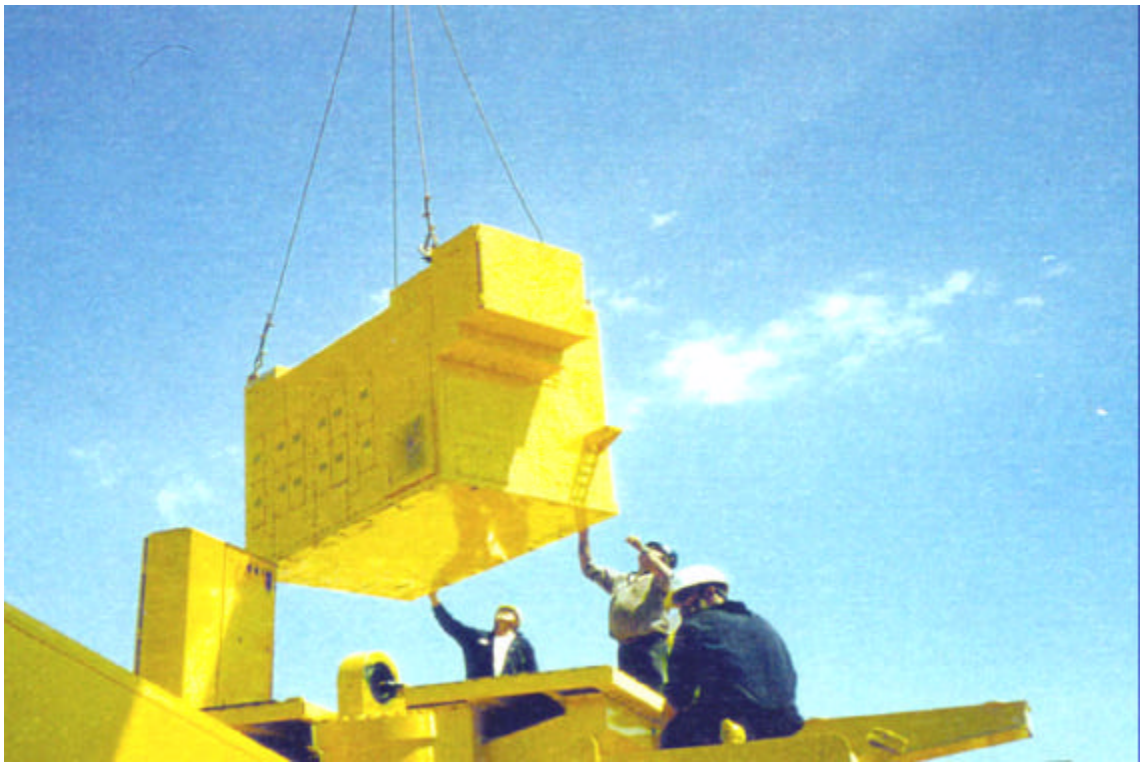


FIGURE 6-28.

FIGURE 6-29.

22. Apply strip seal to the outer edges of the auxiliary control cabinet mounting surface. Use adhesive to secure the strip seal in place. Lift the auxiliary control cabinet into position on the LH side of the main electrical control cabinet. Refer to Figure 6-30. The weight of the auxiliary control box is approximately **445 lbs. (202 kg)**.

    Install the six capscrews (0.50 in. UNC G5) to the cabinet and tighten the capscrews to a torque of **65 ± 6 ft.lbs. (88 ± 8 N.m)**.

23. Ensure that the tapered portion of the suspension rod and the bore of the spindle are clean. Lubricate the two surfaces with multi purpose grease Number 2 (5% Molybdenum Disulphide).

    Lift the spindle/brake assembly into position. The weight of each spindle/brake assembly is approximately **10,670 lbs. (4840 kg)**. Refer to Figures 6-31 thru 6-35.

    A ratchet hoist may be used at the lower portion of the steering arm to the lifting hook to aid in leveling the assembly for easier mounting to the suspension.

    Lift the retainer plates to the bottom of each suspension using blocks and a hydraulic jack.

    Install the fourteen capscrews (1.250 in. UNF G9).

    Tighten the capscrews uniformly to a torque of **500 ft.lbs. (678 N.m)**. Continue to tighten the capscrews in increments of **250 ft.lbs. (330 N.m)** until a torque of **1,995 ± 200 ft.lbs. (2705 ± 270 N.m)** is reached.

    After installation is complete, connect all brake piping to brake assemblies.

FIGURE 6-30.

FIGURE 6-31.

FIGURE 6-32.

FIGURE 6-33.

FIGURE 6-34.

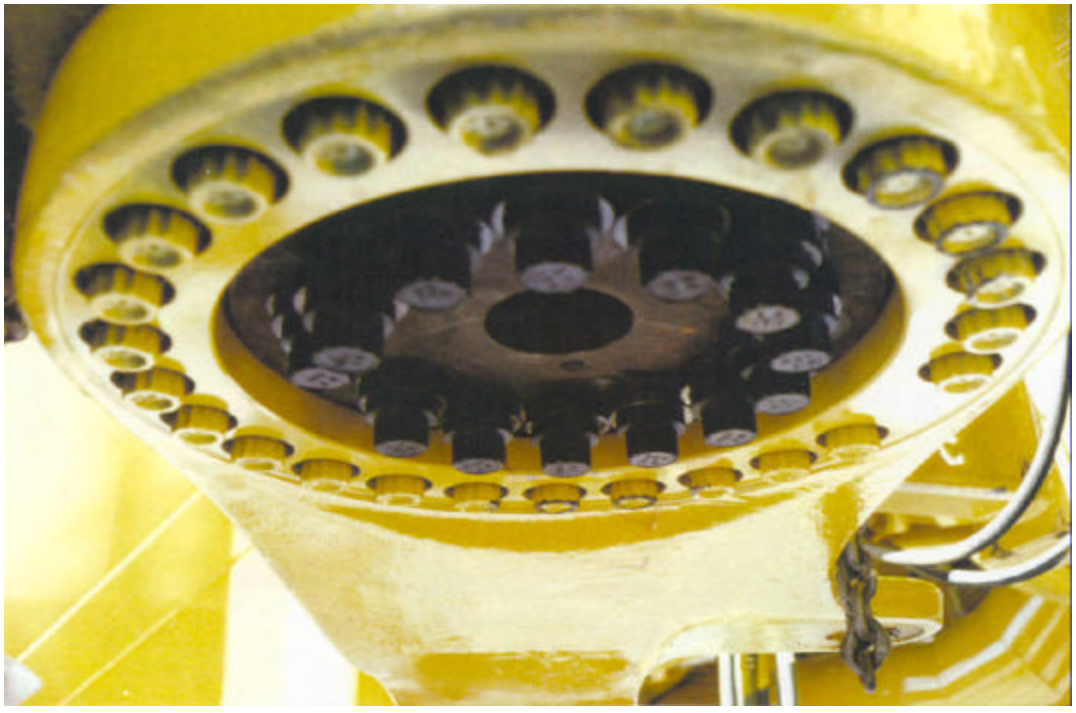


FIGURE 6-35.

24. Connect the steering cylinders and the tie rod to the steering arms.

    The tie rod will need to be adjusted for toe-in once the tires and the body are installed. All hardware needs to be left loose at this time. Refer to *Section G, Drive Axles, Spindles and Wheels*, in the service manual for the proper procedure for adjusting the toe-in.

    Refer to Figures 6-36 & 6-37.

FIGURE 6-36.

FIGURE 6-37.

25. Install the handrails and lift the LH deck into place (Figure 6-38). Loosely install the eight capscrews (M20).

    The weight of the LH deck with handrails is approximately **559 lbs. (254 kg)**.

    After all decking is in place, tighten the capscrews on each deck to a torque of **405 ± 40 ft.lbs. (550 ± 55 N.m)**.

26. Lift the blown grids into place on the RH deck.

    The weight of the grids is approximately **6045 lbs. (2742 kg)**.

    Tighten the eight capscrews (M24) to **590 ± 59 ft.lbs. (800 ± 80 N.m)** torque.

27. Install the handrails on the RH deck.

28. Lift the RH deck into position and loosely install the six capscrews (M20). The weight of the assembly is approximately **6915 lbs. (3137 kg)**. Refer to Figure 6-39.

FIGURE 6-38.

FIGURE 6-39.

29. Lift the operator cab into position. Refer to Figures 6-40 and 6-41.

    Tighten the thirty two capscrews (M24) to a torque of **590 ± 59 ft.lbs. (800 ± 80 N.m)**.

    The diagnonal tubes must be tightened after the installation of the cab. Refer to steps 17 & 18.

FIGURE 6-40.

FIGURE 6-41.

30. Weld the LH & RH upright structures to the front frame tube. Refer to Figure 6-42.

31. Lift the two bumper extensions into place. Refer to Figure 6-43.

    Tighten capscrews to standard torque. Refer to section FAM1003 for Torque Charts and Tables.

FIGURE 6-42.

FIGURE 6-43.

32. Install any remaining handrails. Tighten capscrews to standard torque. Refer to section FAM1003 for Torque Charts and Tables.

FIGURE 6-44.

33. Connect all wiring for the electrical control cabinet, auxiliary control cabinet, operators cab and grid wiring.

34. Connect the hydraulic piping from operators cab to hydraulic cabinet.

35. Install all air intake ductwork and tighten all hardware.

    Refer to Figures 6-45 thru 50.

FIGURE 6-45.

FIGURE 6-46.

FIGURE 6-47.

FIGURE 6-48.

FIGURE 6-49.

FIGURE 6-50.

36. Heat the parking brake gear to 536° F (280° C) and install onto the wheel motor drive shaft. The gear must be evenly seated against the shoulder of the shaft.
37. Install the retainer plate, capscrew and washer. Tighten the capscrew to a torque of **440 to 495 ft.lbs. (595 to 670 Nm)**. Refer to Figure 6-51.
38. Attach a lifting device to the parking brake assembly and lift into position. Refer to Figure 6-52. Use a port-a-power to release spring pressure and allow alignment of the brake discs during installation.
39. Seat the parking brake assembly against the housing and install the eight capscrews and washers. Tighten to standard torque.

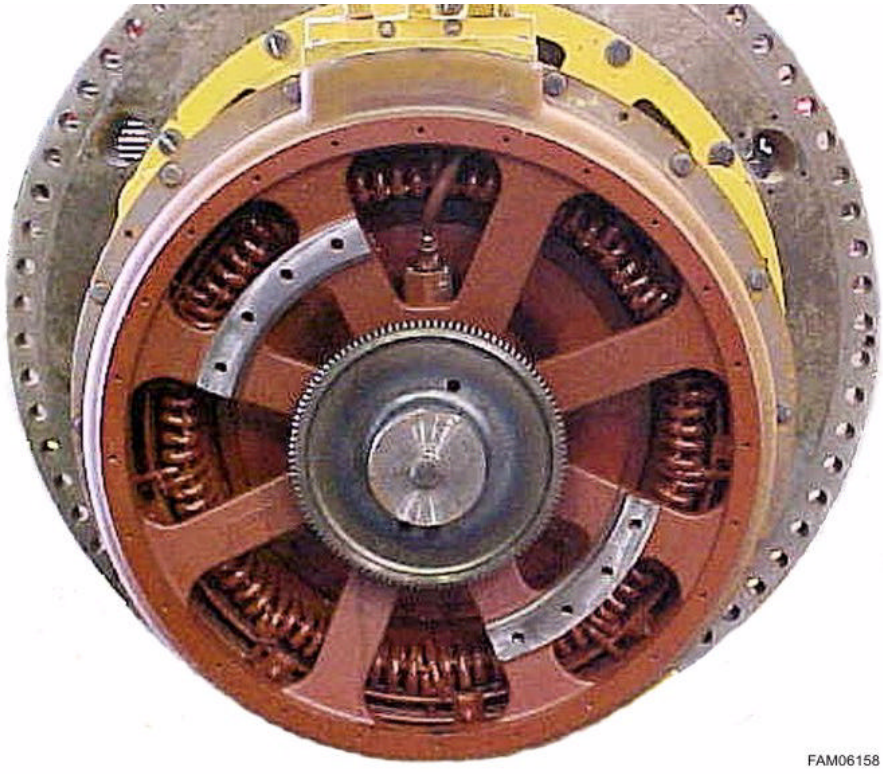


FIGURE 6-51.

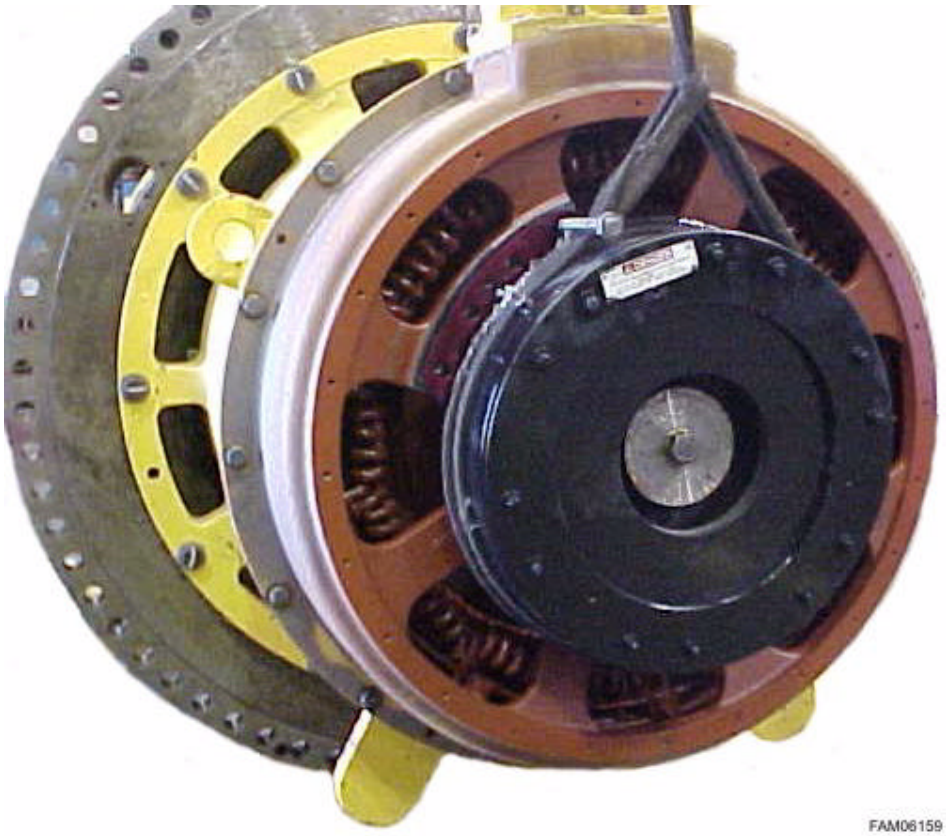


FIGURE 6-52.

⚠ IMPORTANT ⚠

The wheel motors must be properly aligned before installing onto the axle housing. The wheel motor has markings which help determine installation orientation. Two sets of dimples are located at the 3 o'clock and 9 o'clock positions. A centerline symbol marks the 12 o'clock position of the wheel motor. Refer to Figure 6-53.

The axle housing also contains dimples at the 3 o'clock and 9 o'clock positions next to the wheel motor mounting rings. Refer to Figure 6-54.

When installing the wheel motors, ensure the markings on both components line up. The top capscrew hole on the axle housing may also be determined by counting the holes in between the two sets of punch marks. The top hole on the axle housing should line up with the "CL" stamping on the wheel motor.

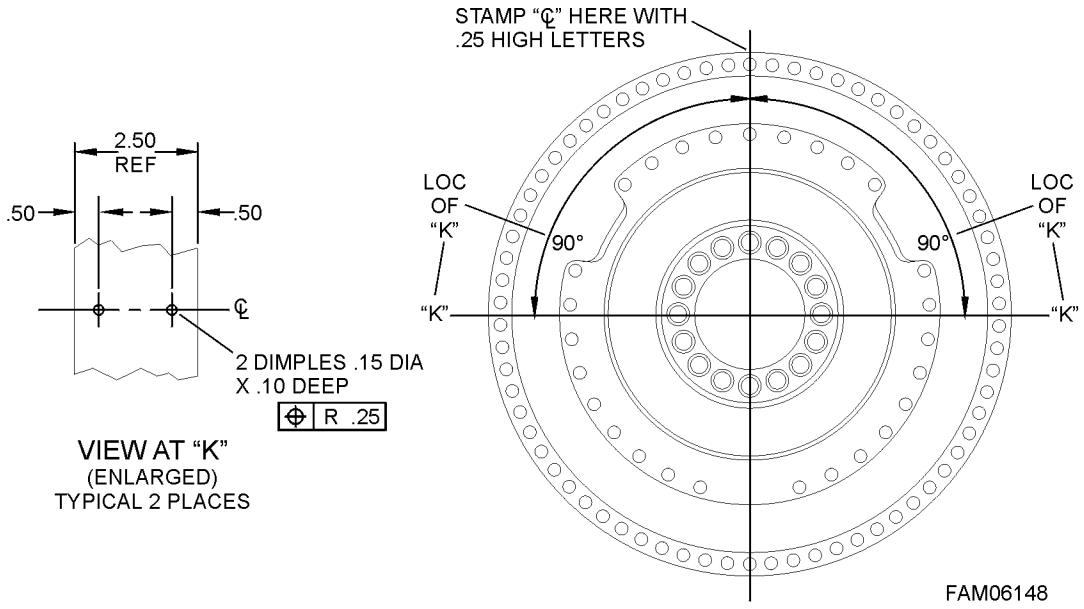


FIGURE 6-53.

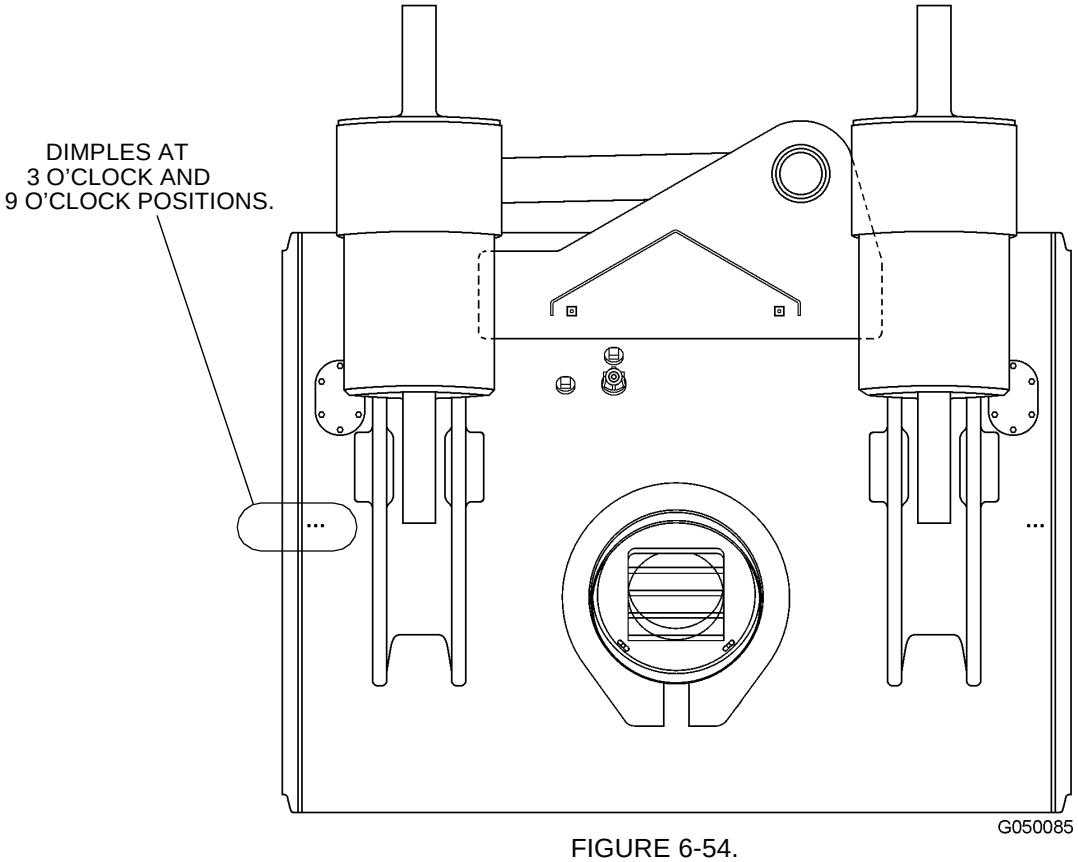


FIGURE 6-54.

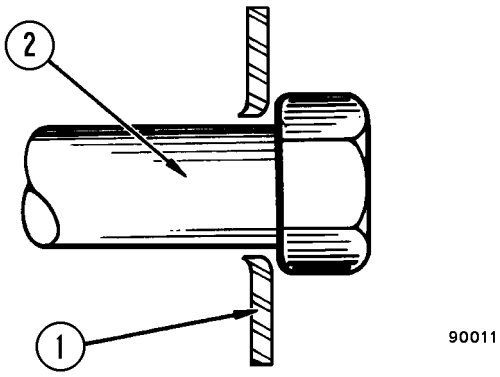
40. Install both wheel motors. The weight of each wheel motor with the service brake and parking brake assemblies installed is approximately **41,105 lbs. (18 645 kg)**. Refer to Figure 6-55.

    The hardened flat washers used in this application are punched during the manufacturing process, therefore, they must be assembled with the punch lip away from head of the mounting capscrews to prevent damage to the fillet between capscrew head and shank. Refer to Figure 6-56.

    Tighten the 70 mounting capscrews for each wheel motor to a torque of **1480 ± 148 ft.lbs. (2007 ± 201 Nm)**.

NOTE: When lifting the wheel motors, do not lift under the brake assembly. (1 1/4 in. shipping fasteners installed in the outboard rim bolt circle need to remain in place during lifting and installation of wheel motors).

FIGURE 6-55.



1. Washer 2. Capscrew

FIGURE 6-56.

41. Connect power cables and speed sensors to each of the wheel motors. Connect apply lines, brake cooling supply lines, and return lines to each wheel.

    Refer to Figures 6-57 thru 6-60.

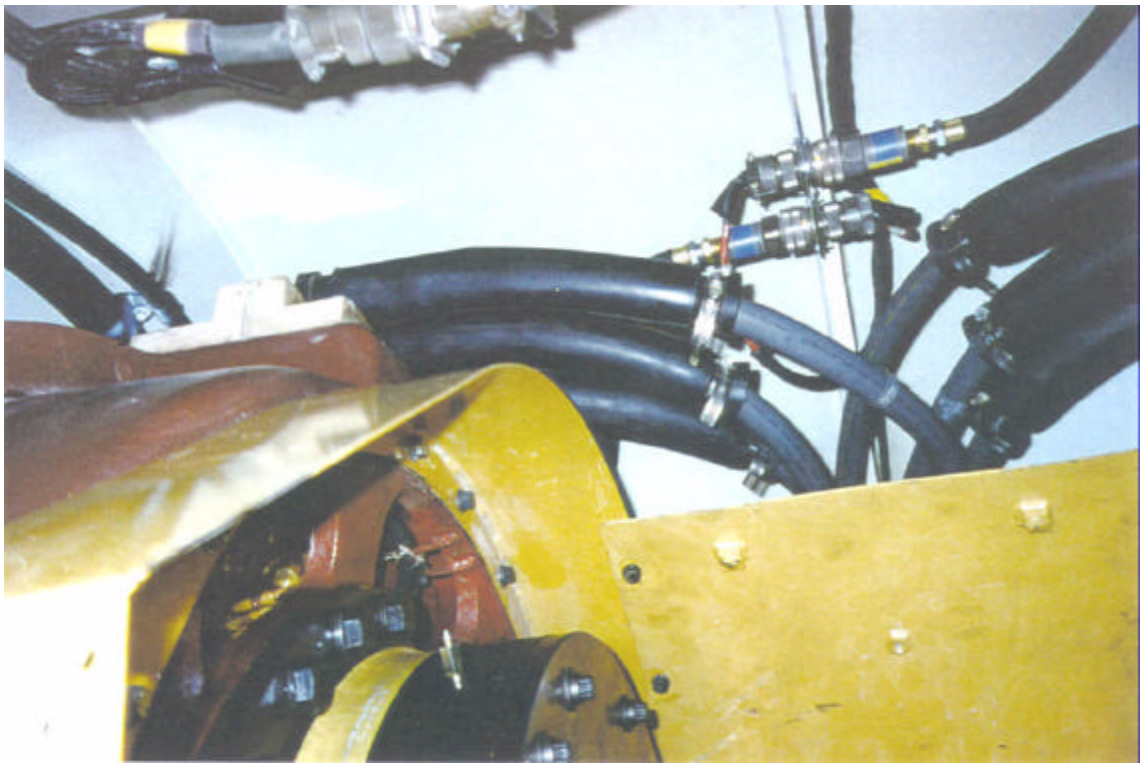


FIGURE 6-57.

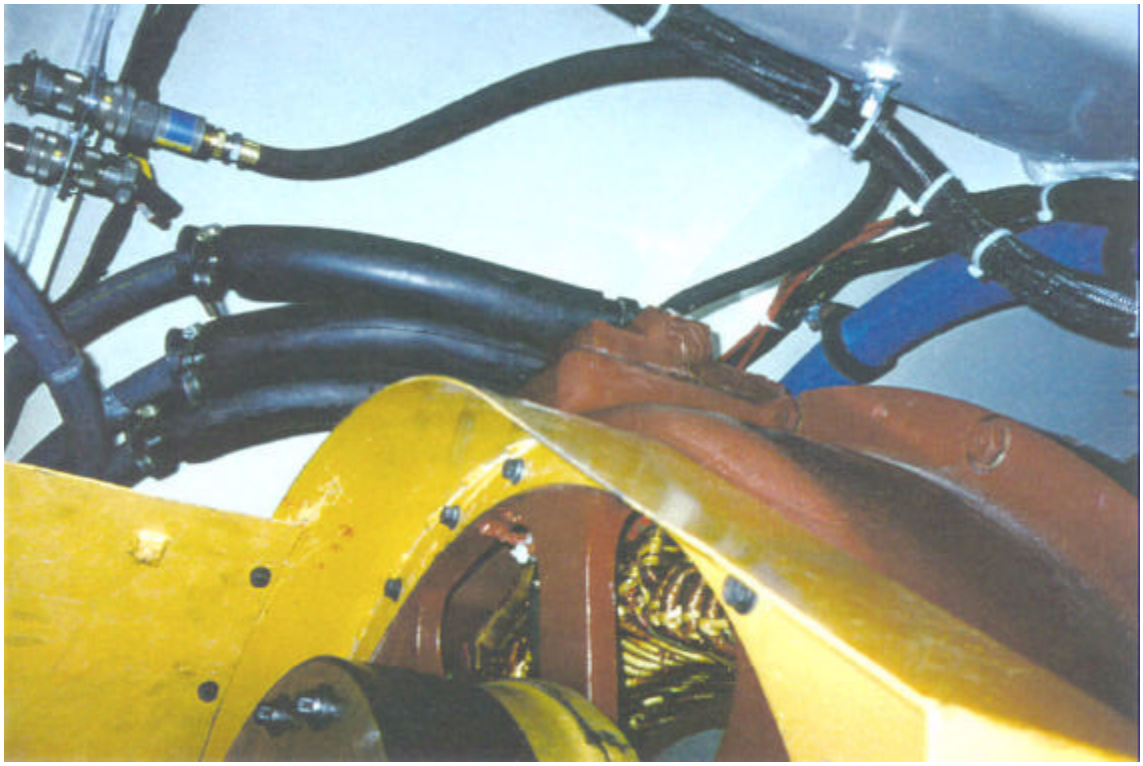


FIGURE 6-58.

NOTES

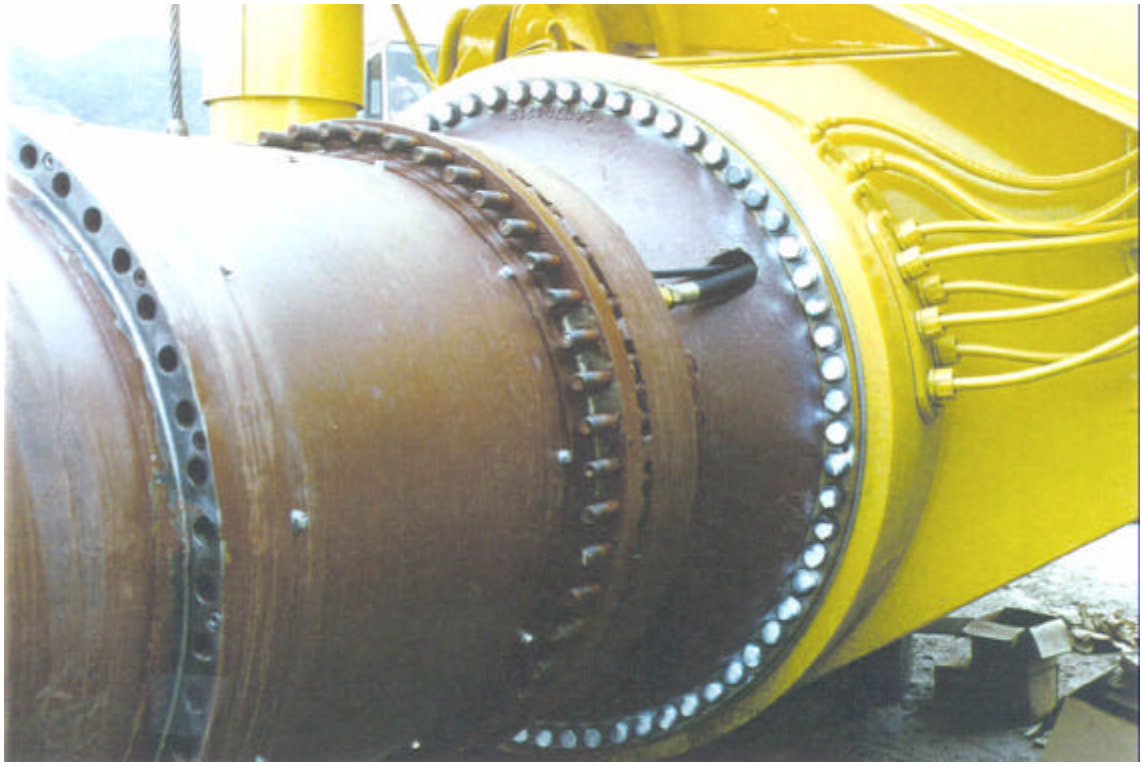


FIGURE 6-59.

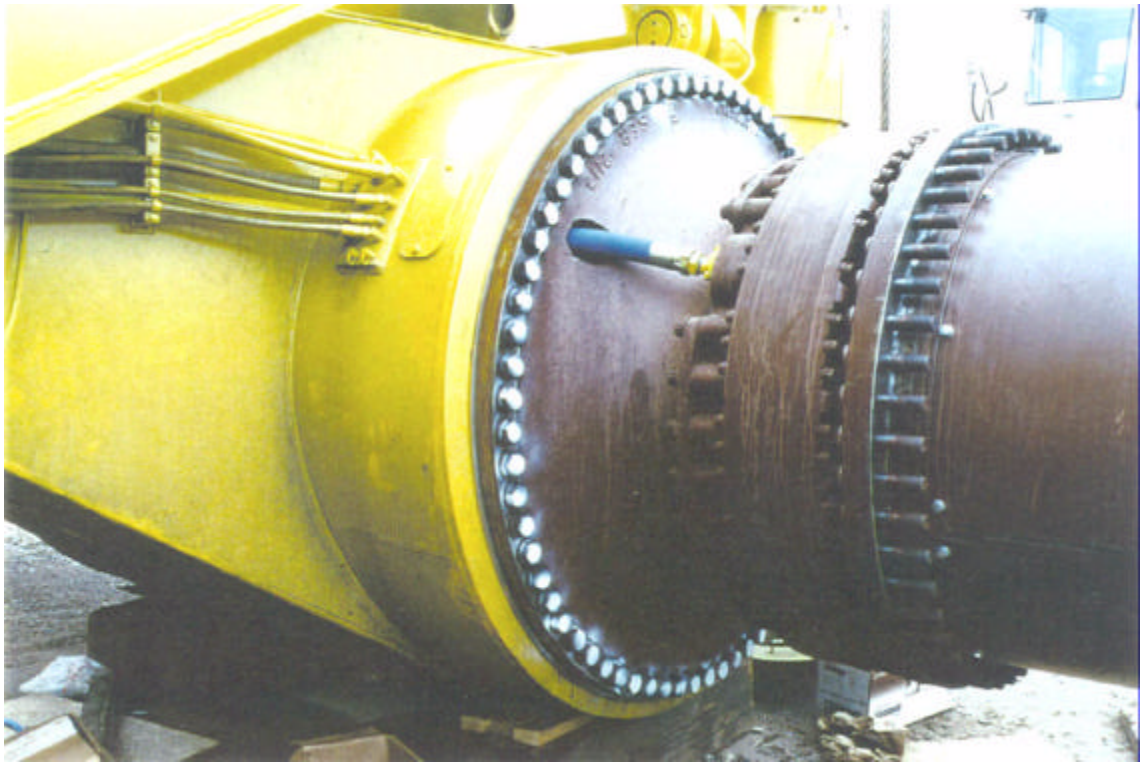


FIGURE 6-60.

Front Wheel Installation

NOTE: Remove all dirt and rust from mating parts before installing wheel assembly.

42. Grip wheel assembly with the tire handler and align the tire inflation hose and wheel hub. Position rim onto wheel hub studs.
43. Lubricate all stud threads and nut seating flanges with lithium base grease. Install and tighten nuts in the following sequence:
    a. Install six nuts at the 12 O'clock and six nuts at the 6 O'clock positions. Tighten each nut to **1715 ± 100 ft. lbs. (2326 ± 136 N.m)** torque.
    b. Install three nuts directly below the 3 O'clock and three nuts directly above the 9 O'clock positions. Tighten the nuts to **1715 ± 100 ft. lbs. (2326 ± 136 N.m)** torque.
    c. Install three nuts directly above the 3 O'clock and three nuts directly below the 9 O'clock positions. Tighten these nuts to **1715 ± 100 ft. lbs. (2326 ± 136 N.m)** torque.
    d. Install the remaining nuts and torque in a clockwise direction to **1715 ± 100 ft. lbs. (2326 ± 136 N.m)** torque.
    e. Retorque all nuts in a clockwise direction to the required **1715 ± 100 ft. lbs. (2326 ± 136 N.m)** torque.

Refer to Figure 6-61 & 6-62.

⚠ IMPORTANT ⚠

After the truck has been assembled and is operational, the truck must be operated for a short period of time, and the torque on the wheels re-checked. Tighten the wheels to the specified torque.

FIGURE 6-61.

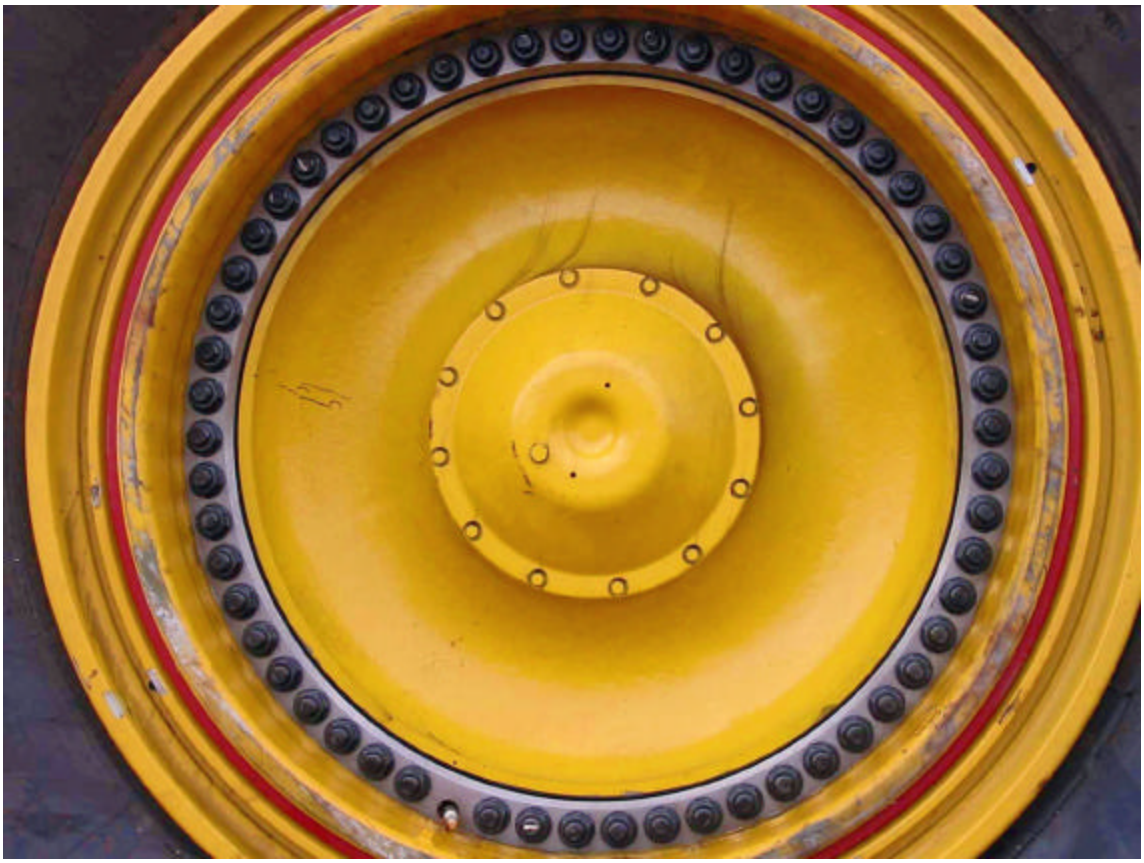


FIGURE 6-62.

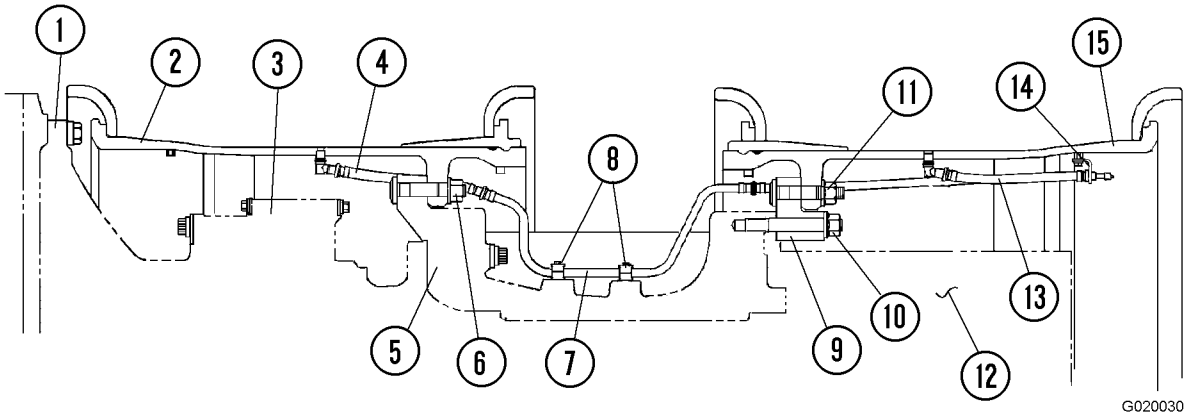


FIGURE 6-63. REAR WHEEL ASSEMBLY

1. Wheel Motor Mounting Flange
2. Inner Wheel Rim
3. Disc Brake Assembly
4. Extension
5. Wheel Hub
6. Flanged Nut
7. Inner Extension
8. Clamps
9. Adapter Ring
10. Flanged Nut
11. Flanged Nut
12. Wheel Motor Transmission
13. Extension
14. Bracket
15. Outer Wheel Rim

NOTE: Clean all mating surfaces and check stud threads before installing wheel assemblies.

44. Bleed the disc brakes **before** installing the rear tires. Refer to Section “J” of the service manual.
45. Grip inner wheel assembly with tire handler and install onto wheel hub (5, Figure 6-63). Use care to align tire inflation extension line (4) for mating with inner extension (7).
46. Lubricate all stud threads and nut seating flanges with lithium base grease. Install and tighten nuts in the following sequence:
    a. Install six (6) nuts at the 12 O'clock and six (6) nuts at the 6 O'clock positions. Tighten each nut to **1715 ± 100 ft. lbs. (2326 ± 136 N.m)** torque.
    b. Install three (3) nuts directly below the 3 O'clock and three (3) nuts directly above the 9 O'clock positions. Tighten these nuts to **1715 ± 100 ft. lbs. (2326 ± 136 N.m)** torque.
    c. Install three (3) nuts directly above the 3 O'clock and three (3) nuts directly below the 9 O'clock positions. Tighten these nuts to **1715 ± 100 ft. lbs. (2326 ± 136 N.m)** torque.
    d. Install the remaining nuts and torque in a clockwise direction to **1715 ± 100 ft. lbs. (2326 ± 136 N.m)** torque.
    e. Retorque all nuts in a clockwise direction to the required **1715 ± 100 ft. lbs. (2326 ± 136 N.m)** torque.

    Refer to Figure 6-64 and 6-65.

47. Install inner extension (7, Figure 6-63) and clamps (8) before installing the outer tires.

FIGURE 6-64.

FIGURE 6-65.

CAUTION

THE TRUCK IS NOT TO BE MOVED WITH ONLY THE REAR INNER DUAL WHEELS MOUNTED ON THE WHEEL MOTORS!

SERIOUS MECHANICAL DAMAGE TO THE WHEEL MOTOR HUB AND/OR TORQUE TUBE CAN RESULT!

THE ADAPTER RING AND OUTER DUAL MOUNTING CAPSCREWS MUST BE IN PLACE AND TIGHTENED TO 1715 FT. LBS. (2325 N.M.) TORQUE!

FAM06052

48. Before the outer tires are installed, position rim adaptor to each outer wheel rim assembly and install fifty flanged nuts. Tighten the nuts to a torque of **1715 ± 100 ft. lbs. (2325 ± 136 N.m)**.

    Install the outer tires and tighten the fifty nuts to a torque of **1715 ± 100 ft. lbs. (2325 ± 136 N.m)**. Refer to Figure 6-66.

IMPORTANT

After the truck has been assembled and is operational, the truck must be operated for a short period of time, and the torque on the wheels re-checked. Tighten the wheels to the specified torque.

FIGURE 6-66.

49. Install the front LH & RH mud-flaps on the corresponding brackets already welded into place on the underside of each deck.

    Weld both rear LH & RH mud-flap brackets into place on backside of deck supports and install the mud-flaps.

    Refer to Figures 6-67 and 6-68.

    The truck is now ready for body installation.

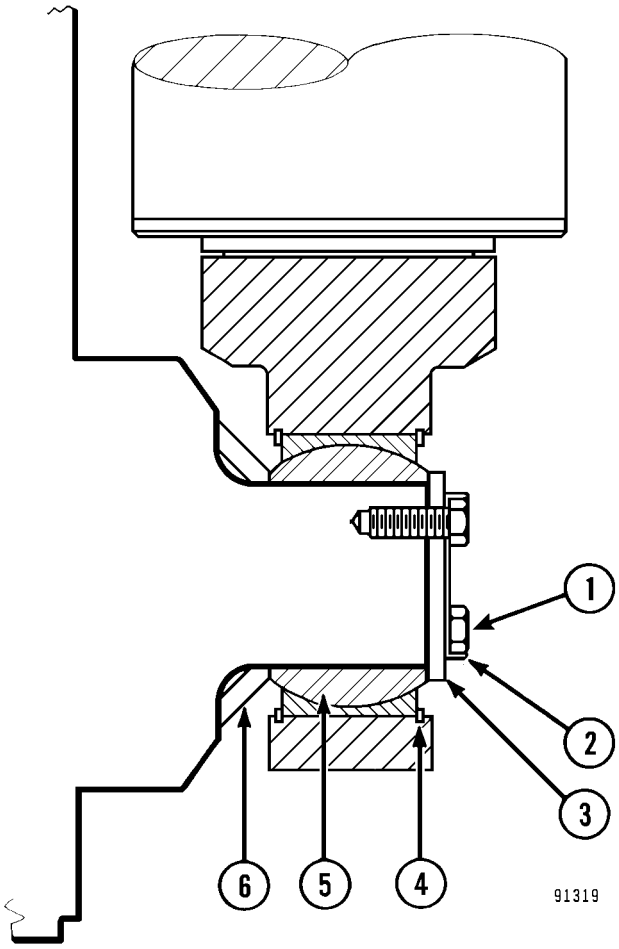
FIGURE 6-67.

FIGURE 6-68.

50. Raise the cylinder into position over the pivot point on the frame. The cylinder should be positioned with the air bleed vent plug on top, toward the front of the truck. Install spacer (6, Figure 6-70). Align bearing eye with pivot point and push cylinder into place.

    Install retaining plate (3), locking plate (2),and capscrews. Tighten capscrews to **220 ft. lbs. (298 N.m)** torque. Bend locking plate tabs over capscrew flats.

FIGURE 6-69.



1. Capscrew
2. Lock Plate
3. Retainer
4. Retainer Ring
5. Bearing
6. Spacer

FIGURE 6-70.

NOTES

BODY ASSEMBLY

Under most conditions, it is easier to assemble and weld the body halves together while it is upside down. After the guide pin, body pads and pivot structure are welded in place, the body can be turned right side up and the remainder of the assembly can be completed.

NOTE: A video tape of the body assembly is available from the factory upon request.

1. On a large, flat, open space, place the body halves side by side and upside down.
2. Remove all the paint from the areas that are to be welded.
3. Place the body halves on blocks and join them together so they are touching.
4. Support the body halves at the rear with blocks and a jack.
5. Align the body halves with one another by placing wedges between the body and the blocks or by adjusting the jack at the rear.
6. Weld body per assembly print.

Assembly Area

The body structure halves should be located on flat terrain with an adequate area for welding machines and maneuvering lifting equipment.

IMPORTANT!: Body halves must be assembled in pairs as originally manufactured. Refer to shipping numbers stenciled on body halves to match correct parts.

If the body is being welded in a cold climate, it is advisable to move the parts to be welded into an enclosed shop area. Surfaces to be welded must be dry and the temperature must be above 50°F (10°C). If shop space is not available, it may be necessary to provide a portable enclosure and provisions made to pre-heat the parts prior to welding.

The body halves should be inverted as described in the following procedures for the initial alignment of the halves and welding the bottom side. All paint must be removed from surfaces to be welded using a wire brush or paint removal equipment.

Refer to assembly prints shipped with the truck for specific welding details and “shipped loose” parts required for assembly.

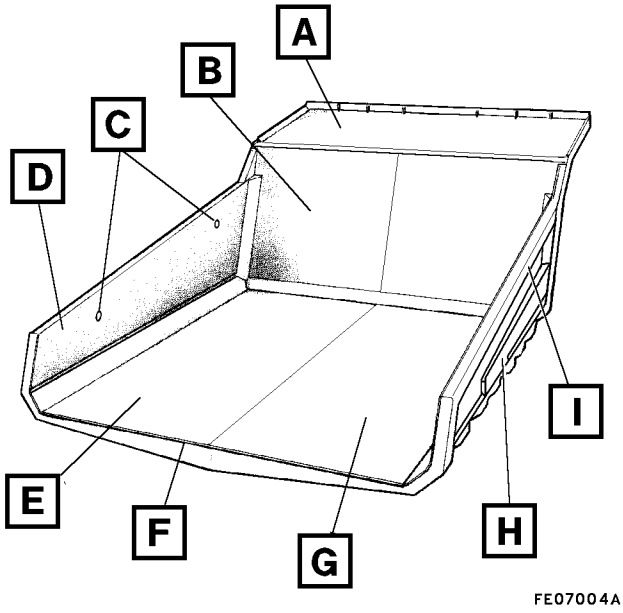


FIGURE 7-1. BODY PARTS NOMENCLATURE

A. Canopy Structure
B. Front Sheet Structure
C. Lift Holes
D. Left Side Sheet Structure
E. Left Body Half
F. Floor Structure
G. Right Body Half
H. Bolsters
I. Right Side Sheet Structure

Body Assembly

1. The body/canopy halves are received in two pieces, as shown. With the aid of a fifty ton crane, position the two halves in an inverted position so that they can be bolted together for welding. Wooden blocks are used at the front, under the canopy, and metal fabricated stands of approximate height of 5 ft. (1.52 m) at the rear corners, as shown. Place some flat wood between the body halves and the stands to prevent metal to metal contact.
2. Once the body/canopy halves are secured in place, welding of the center seam can begin. As the work progresses, the pivot structure, exhaust box, body guide, and body bumper pad assemblies are positioned as per the assembly blueprints, and welded accordingly.

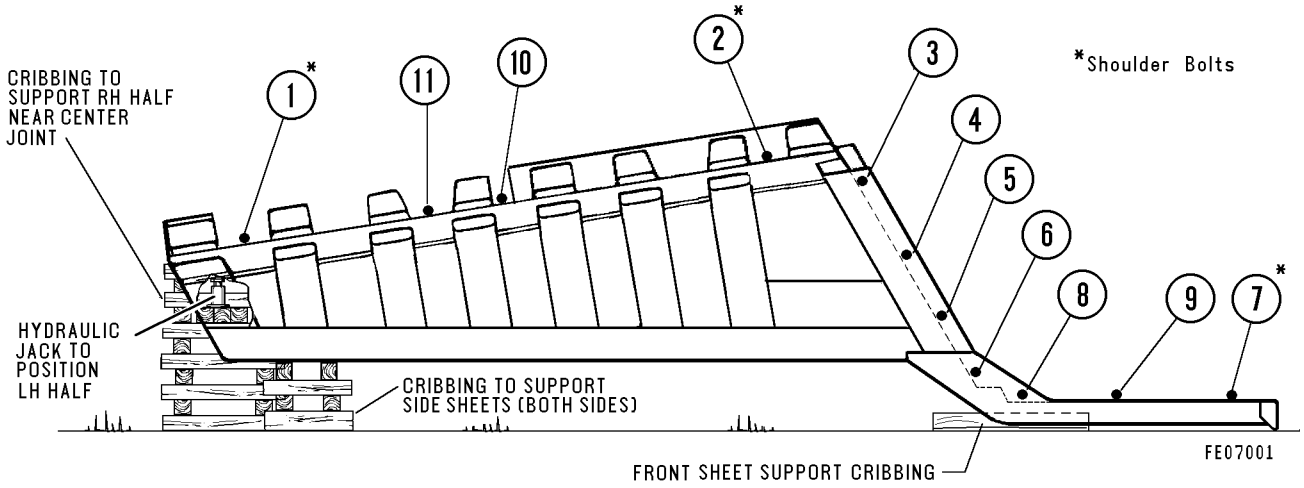


FIGURE 7-2. BODY ASSEMBLY HARDWARE INSTALLATION SEQUENCE

3. Once the body underside is completed, the body can be turned over. Two cranes are used to turn the body as shown. One crane of 120-150 ton capacity and one crane of 50 ton capacity is used to perform this task as shown in the following photographs.
4. When the body is completely turned over, it is blocked securely as shown and the center seam welded as per the assembly blueprint. If not already fitted at the factory, body liners can now be installed.
5. Position and weld the front sheet structure into place, as shown.
6. If sideboards are to be installed, they can now be positioned and welded, as shown.
7. Position and weld the body clearance lights, as shown.

Alignment of Body Halves

NOTE: References made to LH and RH body halves in the following procedures assume the body is in its' normal, upright position, as shown in Figure 7-1.

1. Move RH body half to assembly area and support front sheet, side sheets, and rear edge of floor with cribbing, as shown in Figure 7-2.
2. Move matching LH body half into position with cribbing under front sheet and side sheet. Position a hydraulic jack on cribbing to support the floor at the rear.
3. Using the hydraulic jack, align the body halves at the rear and insert bolt (1) with sleeve. (Refer to Figure 7-2 for installation sequence.)

*NOTE: Bolts (1, 2 & 7) marked (*) are bolts with sleeves. The remainder are capscrews.*

4. Install bolt (2) with sleeve at front of floor.
5. Attach a wedge assembly or a clamp inside the body as necessary to align the front sheet, starting at the top (near floor). Install capscrew (3) in front sheet near floor.
6. Using a wedge assembly, complete alignment of front sheet and canopy. Install capscrews (4, 5 & 6).
7. Install bolt (7) with sleeve in front of canopy.
8. Install capscrews (8 & 9).
9. Install backer strips on front sheet center joint as shown on “Body Structure” drawing.

NOTE: Backer strips must be tack welded in a location where the tack will be burned away on the first pass.

10. Loosely install capscrews (10 & 11) in floor.
11. Loosen bolts (1 & 2).
12. Attach a lifting device to the pivot structure through the body pin bores. Use care not to damage bores when lifting.

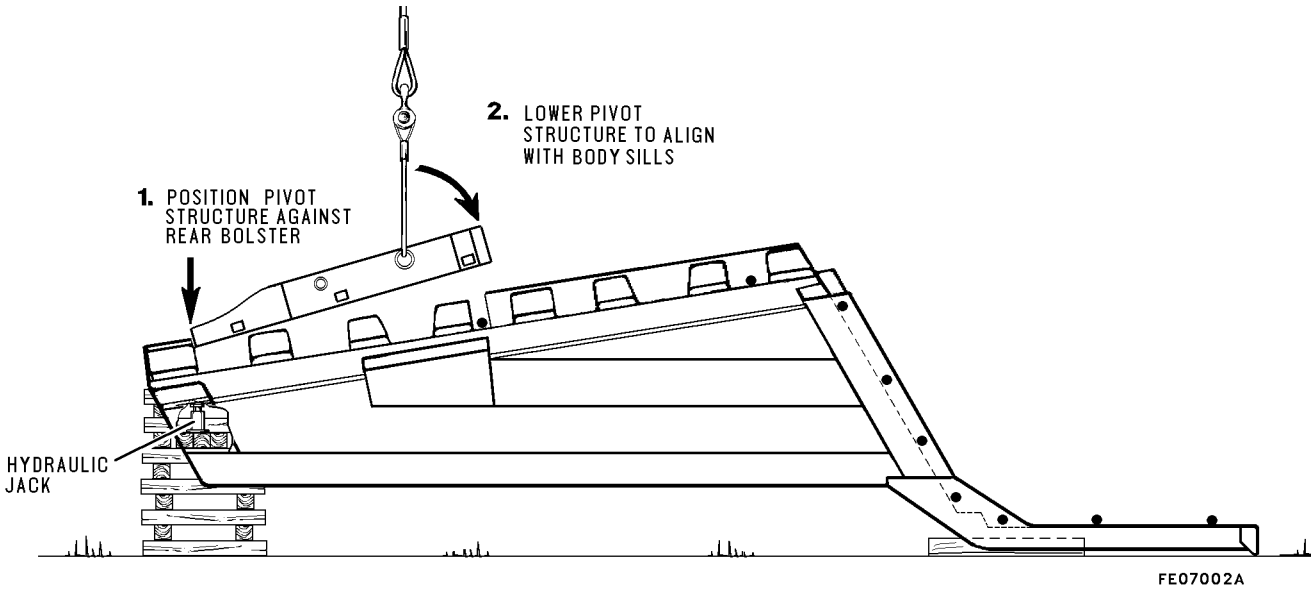


FIGURE 7-3. BODY PIVOT STRUCTURE INSTALLATION

13. Lift the pivot structure over the body and lower into position against the rear of the body as shown in Figure 7-3.
14. Lower the pivot structure until the front aligns with the body sills.
15. If necessary, use a hydraulic jack or crane to raise the center of the body to allow the pivot structure to fit inside the bolsters. Start all cap-screws in pivot structure.
16. Tighten all floor, front sheet, and canopy bolts. Use a chalk line to align the front of the canopy.
17. Tighten all pivot structure bolts.
18. Install filler plates and backer strips for body pivot structure to body sill front weld joints.
19. Check alignment and straightness of components, fit of body, hoist cylinder pins, canopy alignment to body structure, and general fit of structures.
20. Tack weld complete.

Body Welding Procedures

The following field welding procedures must be observed:

- Use dry weld rod or weld wire.
- Surfaces to be welded must be dry and the temperature above 50°F (10°C).
- If stick electrode is used, use as large a diameter rod as practical to weld floor and front sheet joints.
- The following sequence must be followed for front sheet:

  First Pass: Back step and skip weld in 10 increments along the entire length of the joint. (See diagram in Figure 7-4.)

  Repeat the same procedure until the entire joint is filled. DO NOT stop welding until entire joint is complete.

  The body floor “V” groove must also be welded using the same procedure given above for the front sheet; start welding at the front and work to the rear.

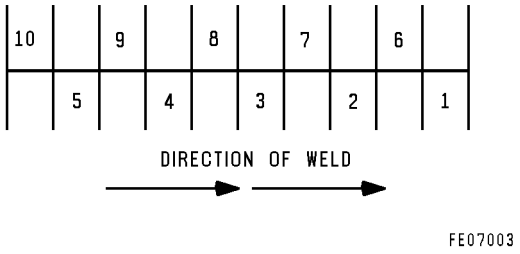


FIGURE 7-4. FRONT SHEET & FLOOR JOINT WELDING PROCEDURE

Final Welding

1. Complete welds on floor, front sheet, and canopy. (Refer to “Body Structure” drawing for weld requirements.)
2. Remove canopy alignment blocks.
3. If body is heated, install heat pans.
4. Install remaining gussets, body pad mounts (1, Figure 7-5), body guide (2) etc. (Refer to “Body & Mud Flap Installation” and “Body Structure” drawings.)
5. Attach lifting cables using holes provided in side sheets and turn body upright using a crane of adequate capacity.
6. Refer to “Body Welding Procedures” on the previous page and the body structure print to complete welds on inside of body.
7. Refer to “Body & Mud Flap Installation” drawing and install mud flap brackets, clearance light housings etc.
8. Install any optional equipment such as body liners.
9. Clean weld joints and paint to match customer's specifications.

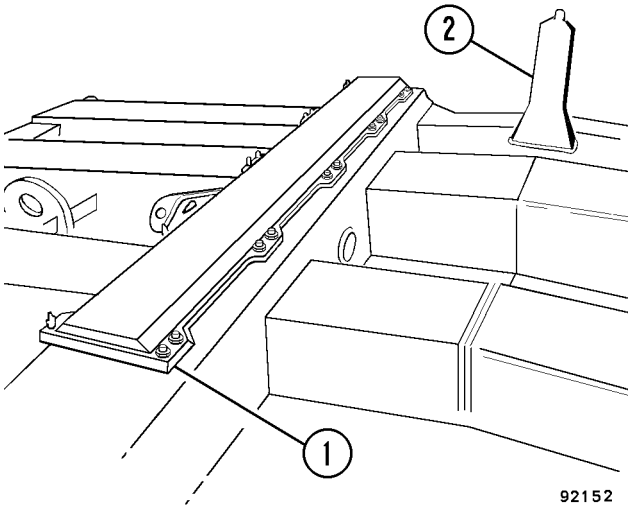


FIGURE 7-5. BODY PADS & GUIDE INSTALLATION

1. Body Pad Mount Plate 2. Body Guide

930E BODY ASSEMBLY

The following information is intended to provide basic guidelines for the assembly of the 930E truck body. Due to differences in machine configurations and shipping restrictions/requirements throughout the world, the shipping and packaging of large machines will vary.

Photographs may show components already installed; however, shipping restrictions may prevent this in some areas and these components will have to be locally installed. Each shipment may be different, depending on the truck configuration and destination.

Photographs or illustrations used in the following procedures are provided as general guidelines only. Actual assembly may be different, but this general outline and photographic procedure should provide a basis for assembly.

In the procedures that follow, very heavy components will be required to be lifted and welded in place.

⚠WARNING

Inspect all lifting devices. Slings, chains, and/or cables used for lifting components must be inspected daily for serviceable condition. Refer to the manufacturer's manual for correct capacities and safety procedures when lifting components. Replace any questionable items.

Slings, chains, and/or cables used for lifting components must be rated to supply a safety factor of approximately 2X the weight being lifted.

When in doubt as to the weight of components or any assembly procedure, contact the area representative for further information.

Lifting eyes and hooks should be fabricated from the proper materials and rated to lift the load being placed on them.

Never stand beneath a suspended load. Use of guy ropes are recommended for guiding and positioning a suspended load.

1. The body/canopy halves are received in two pieces as shown (Figure 7-6).

   With the aid of a fifty ton crane, position the two halves in an inverted position so that they can be bolted together for welding.

   Wooden blocks are used at the front under the canopy and metal fabricated stands of approximate height of 5 ft. (1.5 m) at the rear corners as shown (Figure 7-7).

   Place some flat wood between the body halves and the stands to prevent metal to metal contact.

FIGURE 7-6.

FIGURE 7-7.

2. Once the body/canopy halves are secured in place, welding of the center seam can begin. As the work progresses, the pivot structure, exhaust box, body guide, and body bumper pad assemblies are positioned as per the assembly blueprints and welded, accordingly.

   Refer to Figures 7-8, 7-9, 7-10, & 7-11.

FIGURE 7-8.

FIGURE 7-9.

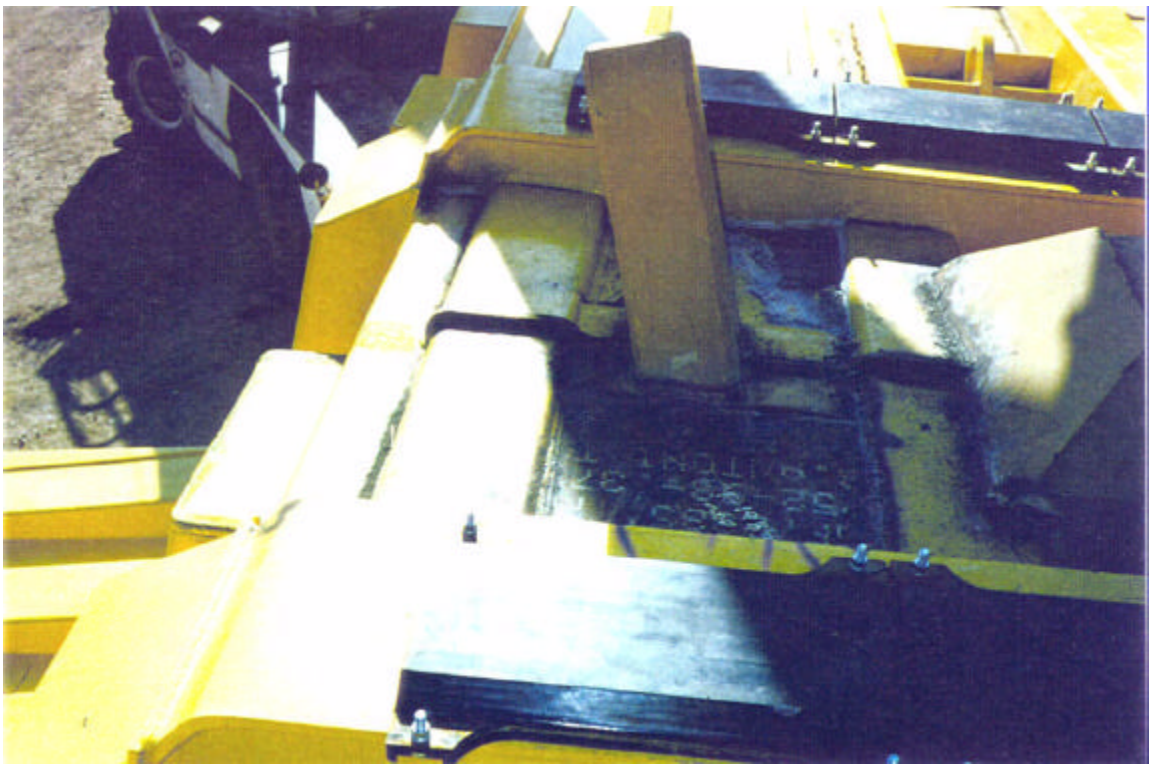


FIGURE 7-10.

FIGURE 7-11.

3. Attach the body retention cable to the underside of the body in the stored position, as shown in Figure 7-12.

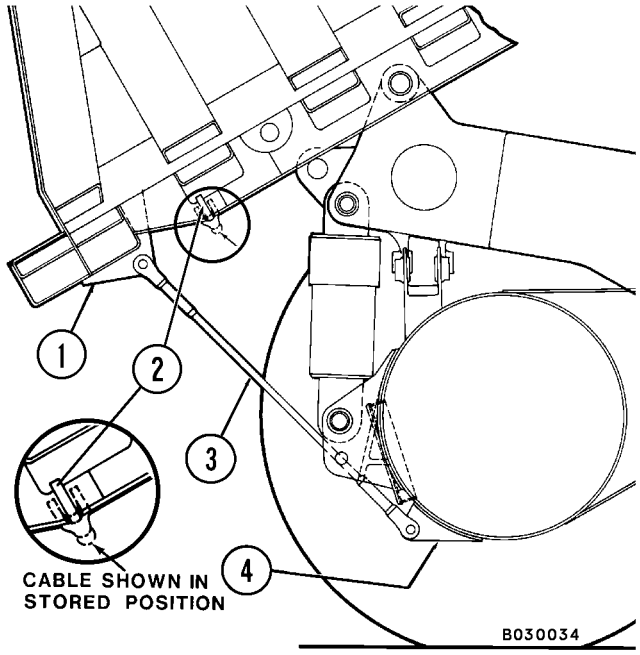


FIGURE 7-12. BODY-UP CABLE INSTALLATION

1. Rear Body Ear Structure
2. Cable Storage
3. Cable Assembly
4. Axle Housing Ear Structure

4. Once the body underside is completed, the body can be turned over.

   Two cranes (one crane of 120-150 ton capacity, and one crane of 50 ton capacity) are used to turn the body as shown in the following six photographs.

   Refer to Figures 7-13, 7-14, 7-15, 7-16, 7-17, & 7-18.

FIGURE 7-13.

FIGURE 7-14.

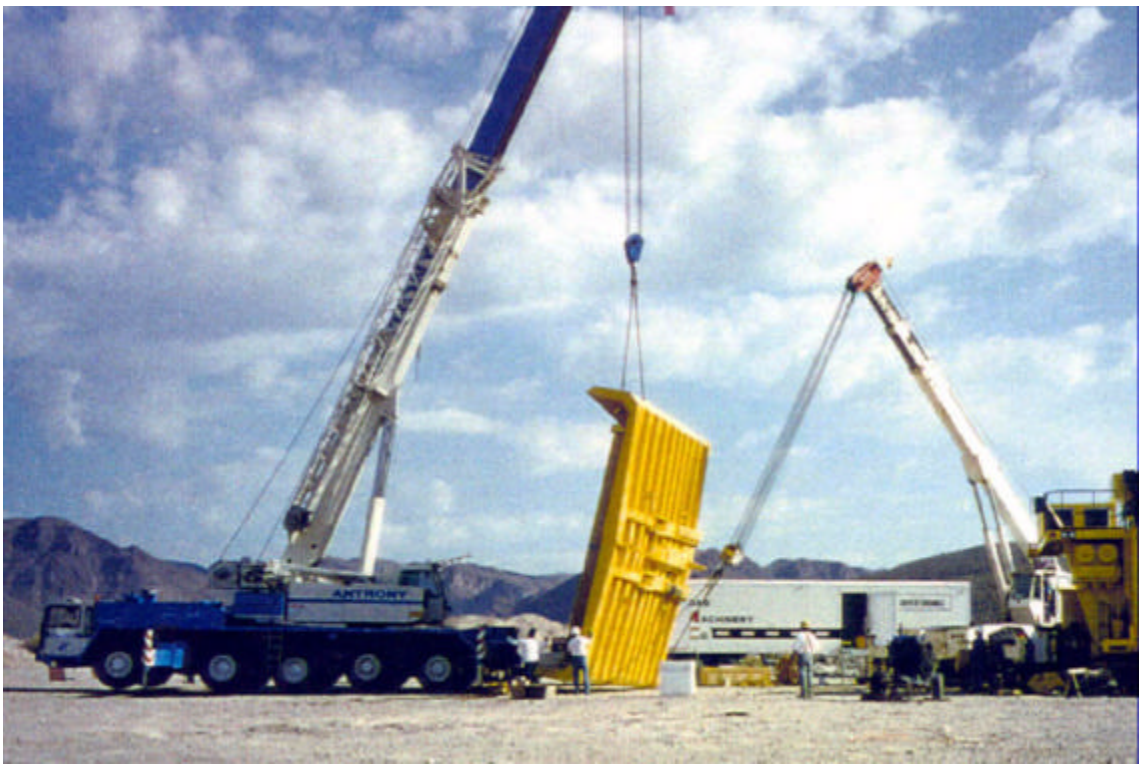


FIGURE 7-15.

FIGURE 7-16.

FIGURE 7-17.

FIGURE 7-18.

5. After the body is completely turned over, block it securely, as shown, and weld the center seam (Figure 7-19) according to the factory-supplied assembly blueprint.

   If not already fitted at the factory, body liners can now be installed.

6. Position and weld the front sheet structure into place, as shown (Figure 7-20).

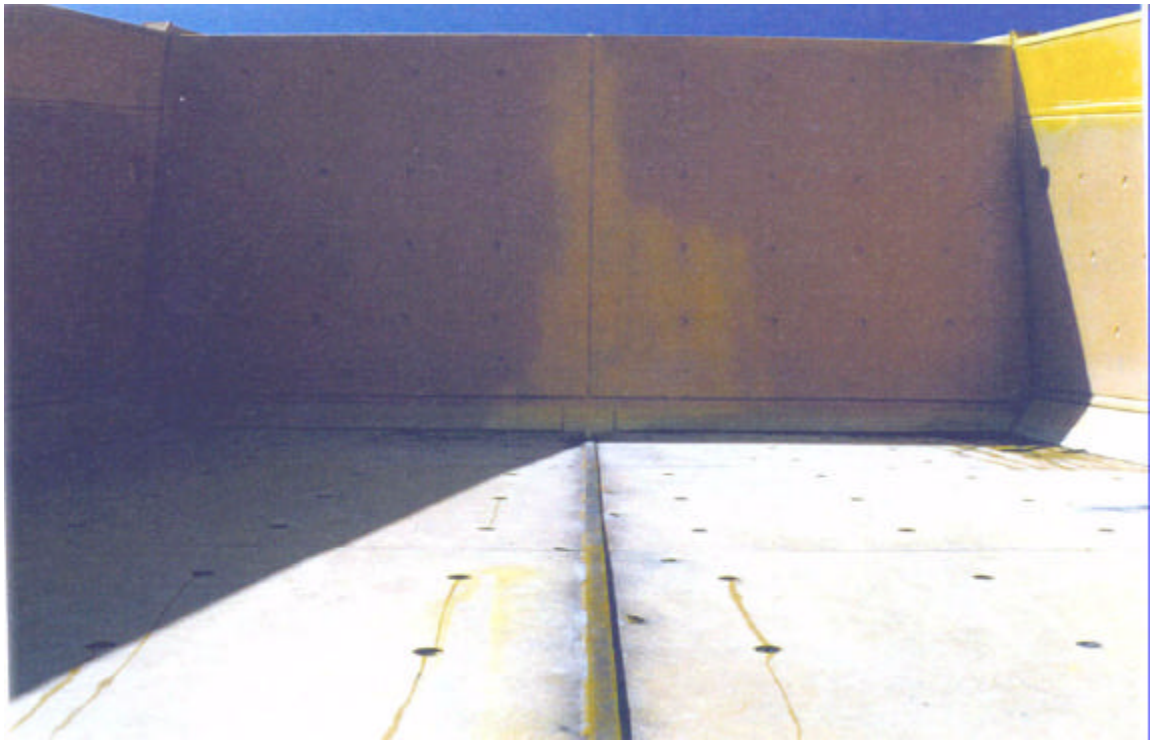


FIGURE 7-19.

FIGURE 7-20.

7. If sideboards are to be installed, they can now be positioned and welded, as shown (Figure 7-21).

8. Position and weld the body clearance lights, as shown (Figure 7-22).

FIGURE 7-21.

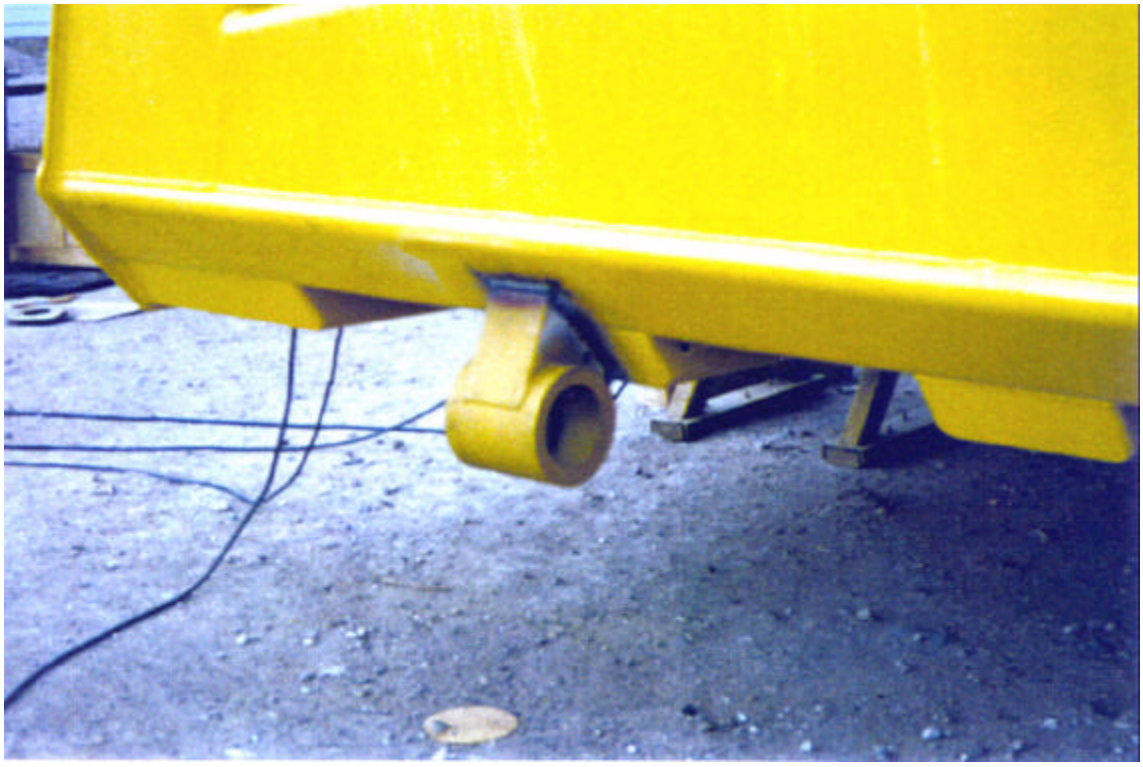


FIGURE 7-22.

NOTES

NOTES

FINAL ASSEMBLY

1. Body weld-up and chassis assembly must be completed.

   Before the body is lifted off the ground, guy ropes should be tied to each of the four corners of the body to keep it in a stable position for easier installation. There are two methods of installing the body depending on the cranes available.

   a. If the truck is running and can be maneuvered, two 50 ton cranes can be used, one positioned at either side of the body. The body is then lifted high enough to allow the truck to be reversed propelled under the body (Figures 8-1, 8-2 & 8-3).

   b. If a large crane of approximately 150 ton is available, the body can be lifted high enough and swung over the chassis and installed in a similar fashion to that in step (a) above.

FIGURE 8-1.

FIGURE 8-2.

NOTES

FIGURE 8-3.

2. With the body in position, install shims (6, Figure 8-5) in both body pivots, as required to fill the outside gaps and center the body on the frame pivot. **Do not install shims at the inside.** A minimum of 1 shim is required at the outside end of both frame pivots.
3. Align the hole in pivot pin (3) with the capscrew hole in the pin retainer (part of body pivot ear, 4) and push the pivot pin through shims (6), frame pivot (7), and into pivot bushings (5, 9) in each side of the body pivot.
4. Install capscrew (1) through each pin and tighten nuts (2) to **300 ft.lbs. (407 N.m)** torque. Use washers, as necessary on the nut side only, to ensure the capscrew does not run out of threads when tightening.

FIGURE 8-4.

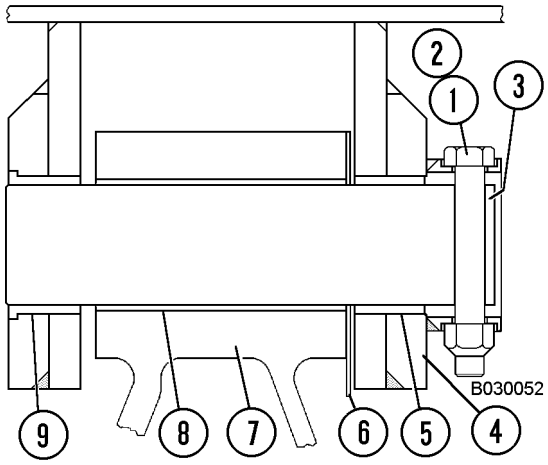


FIGURE 8-5. DUMP BODY PIVOT PIN

1. Capscrew - M36
2. Lock Nut - M36
3. Body Pivot Pin
4. Body Ear
5. Body Pivot Bushing
6. Shim
7. Frame Pivot
8. Pivot Bushing
9. Body Pivot Bushing

5. Align the hoist cylinder upper mounting eye bushings with the hole through the body. Refer to Figure 8-6. Align the retaining capscrew hole and install pin (2, Figure 8-7).

   Install the pin retaining capscrews and nuts and tighten to **2028 ft.lbs. (2750 N.m)** torque.

FIGURE 8-6.

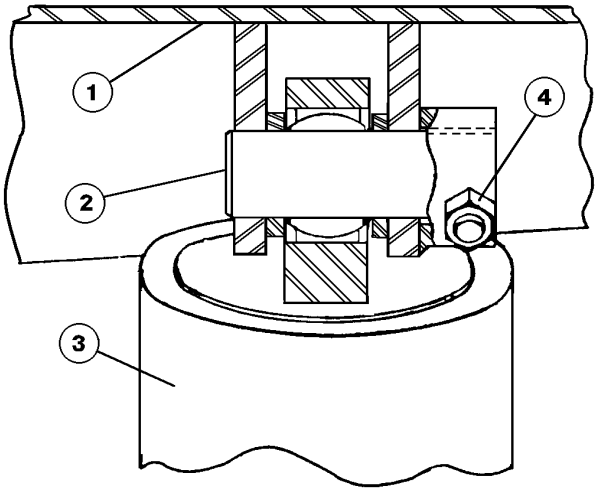


FIGURE 8-7. HOIST CYLINDER UPPER MOUNT

1. Dump Body
2. Hoist Cylinder Pin
3. Hoist Cylinder
4. Pin Retainer

6. Shim body pads as required. All pads, except the rear pad on each side, should contact the frame with approximately equal compression of the rubber. Refer to Figures 8-8 and 8-9.
7. A gap of approximately 0.06 in. (1.5 mm) is required at each rear pad. This can be accomplished by using one less shim at each rear pad.
8. Inspect pad contact. If pad contact appears to be unequal, repeat the above procedure.

⚠ IMPORTANT ⚠

Proper body pad to frame contact is required to assure maximum pad life.

FIGURE 8-8.

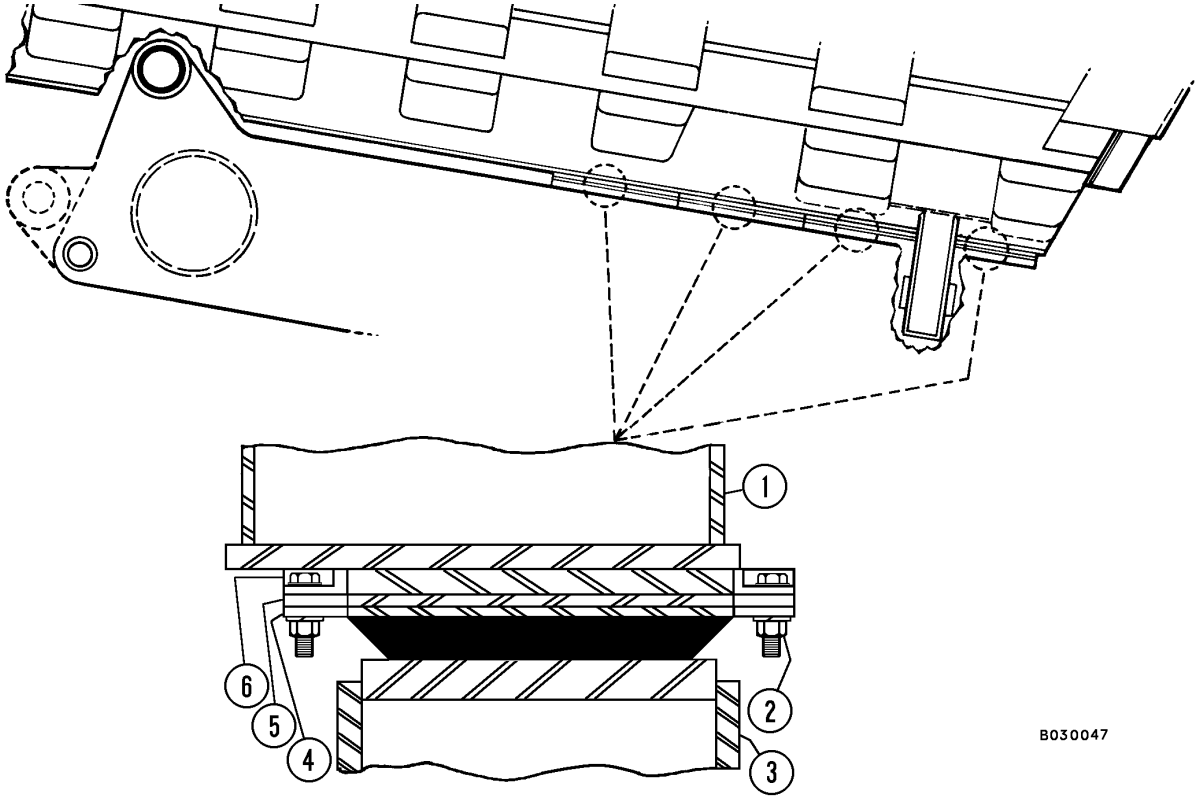


FIGURE 8-9. BODY PAD INSTALLATION

3. Dump Body
4. Pad Mounting Hardware
5. Frame
6. Body Pad
7. Shim
8. Mounting Pad

9. Tack weld rock ejector mounting brackets into position on underside of body (Figure 8-11). The ejectors must be positioned on the center line between the rear tires within 0.25 in. (6.0 mm). Before full welding is performed, drop a plumb line to be sure that the rock ejector has a clearance of approximately 17.9 in. (455 mm) between the rock ejector and the wheel housing. Refer to Figure 8-12.

NOTE: With rock ejector arm (1) hanging vertical as shown in Figure 8-12, there must be NO GAP at stop block (3, Figure 8-11).

⚠ IMPORTANT ⚠

If ejector arms (1) are bent during operation, they must be removed and straightened. Inspect mounting brackets (4, Figure 8-11), pins (2) and stops (3) at each shift change for wear and/or damage, and repair as necessary.

FIGURE 8-10.

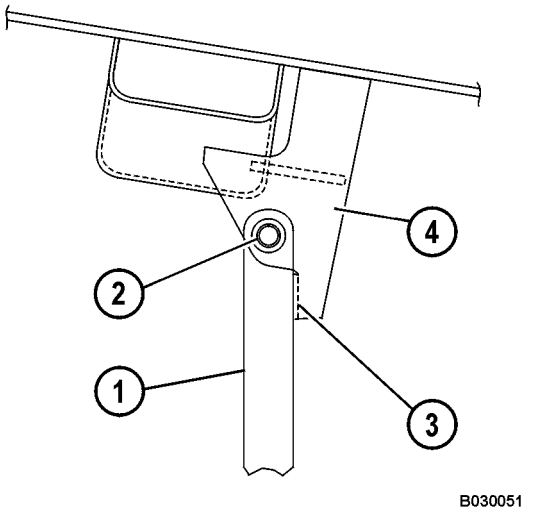


FIGURE 8-11. ROCK EJECTOR MOUNTING

1. Rock Ejector Arm
2. Pin
3. Stop Block
4. Mounting Bracket

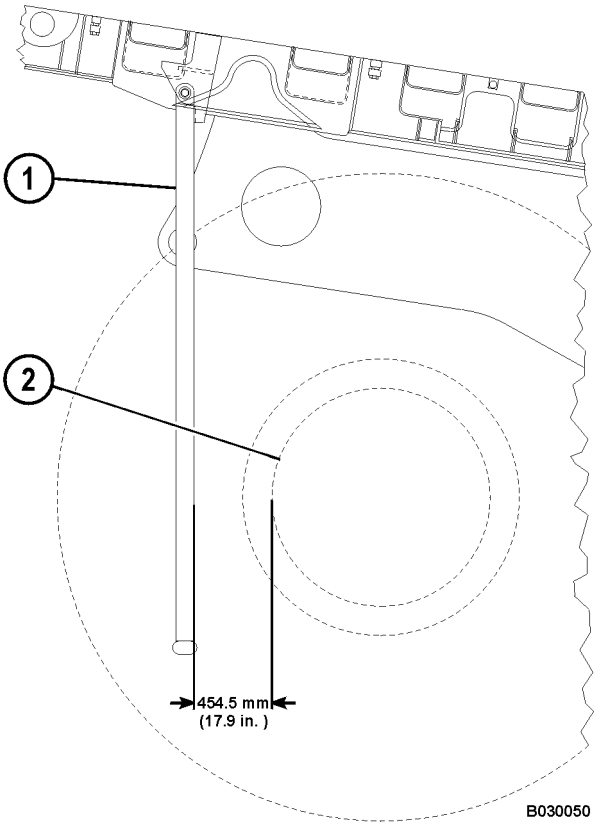


FIGURE 8-12. ROCK EJECTOR INSTALLATION

1. Rock Ejector Arm
2. Wheel Housing

10. IInstall remaining axle box air ducting. Refer to Figures 8-13 through 8-16.

FIGURE 8-13.

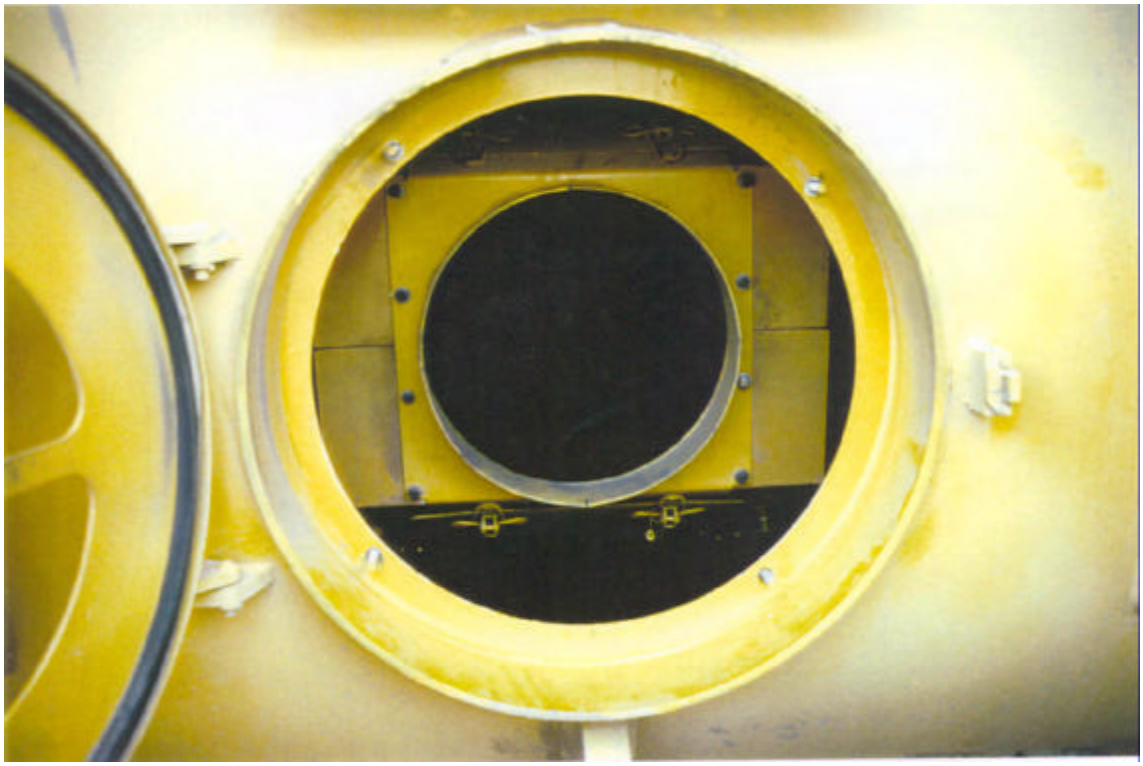


FIGURE 8-14.

NOTES

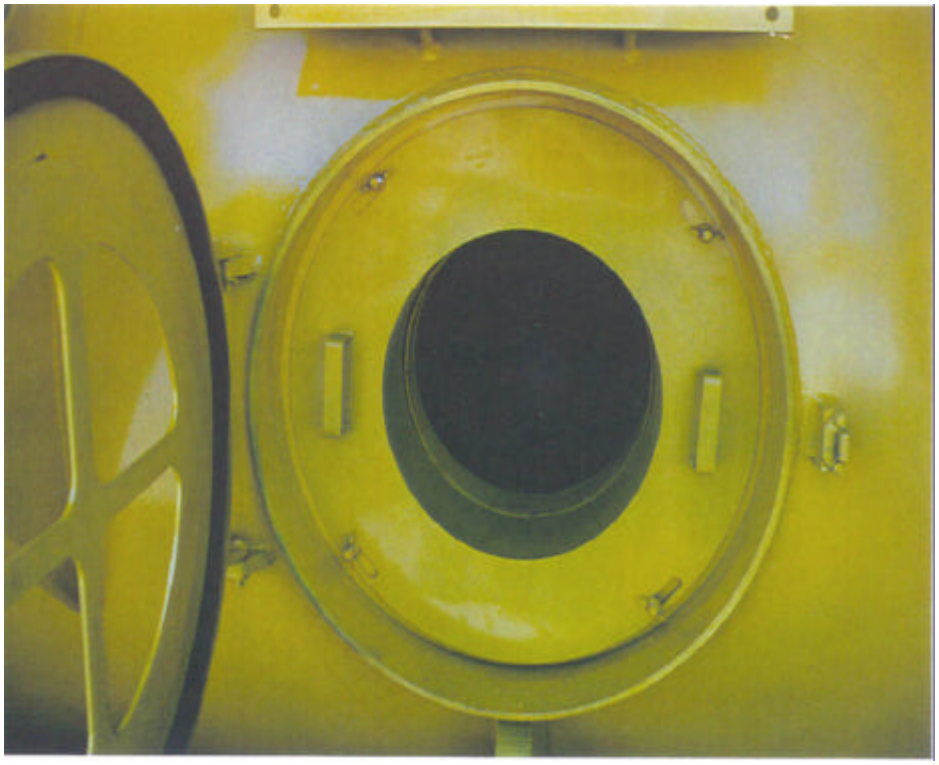


FIGURE 8-15.

FIGURE 8-16.

11. Install mud flaps onto the body and chassis (Figures 8-17 & 8-18).

FIGURE 8-17.

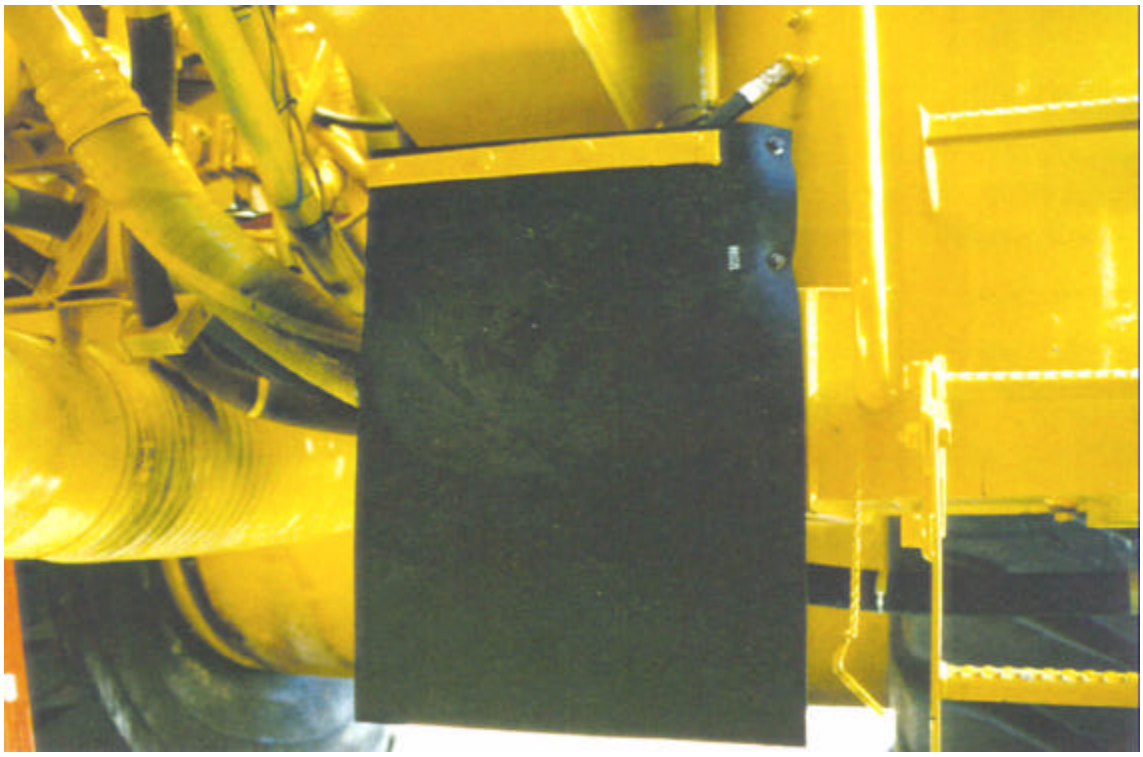


FIGURE 8-18.

12. Install both body guide brackets loosely into place (Figure 8-19).

    Once in position, lower the body slowly and mark the position in which the brackets need to be welded. The body guide should be centered between the wear plates (3), with a maximum gap of 0.19 in. (4.8 mm) at each side when new.

13. With the body in its lowered position on the frame rail, the body up limit switch actuator arm (4, Figure 8-21) position can be marked on the underside of the body. Refer to the assembly prints or the shop manual for precise positioning specifications.

    Raise the body enough to be able to weld the mounting pad to the underside of the body.

WARNING! Before welding ensure that sufficient blocking is placed between the body and the frame.

14. On completion of this installation, raise the body and attach the body retention cable. Remove the blocking, and weld the body guide brackets into place. Refer to Figures 8-19 & 8-20.

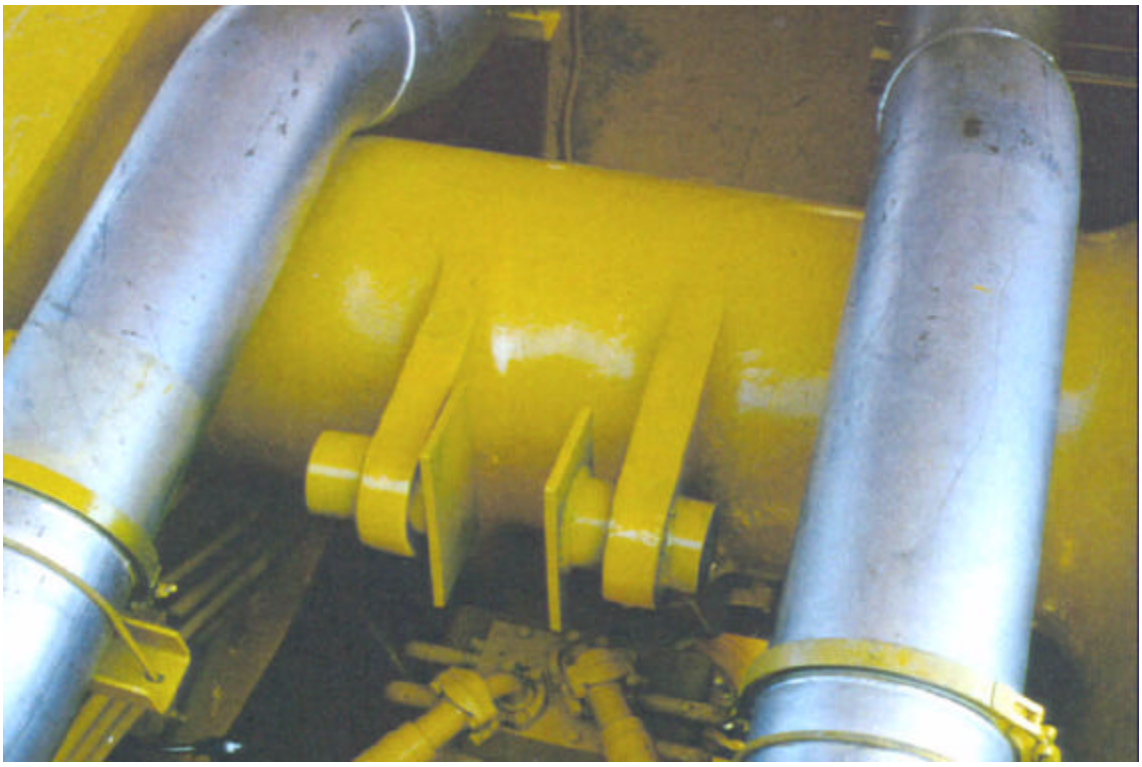


FIGURE 8-19.

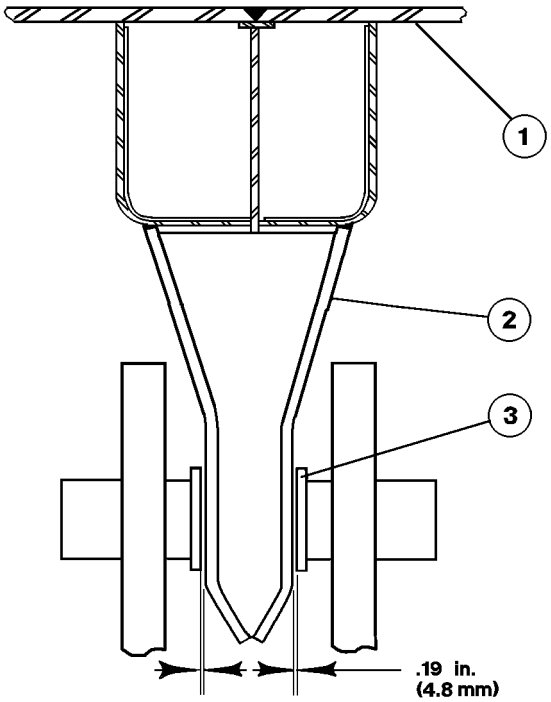


FIGURE 8-20. BODY GUIDE

1. Dump Body
2. Body Guide
3. Body Guide Wear Plates

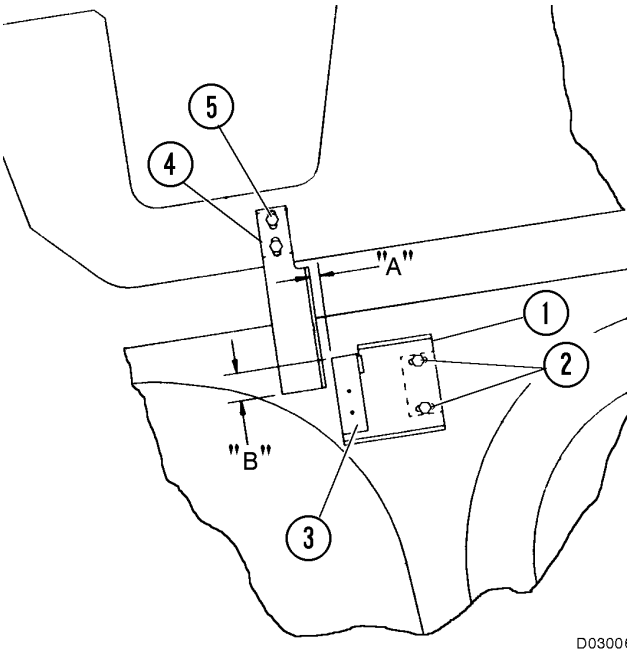


FIGURE 8-21. BODY-UP SWITCH ADJUSTMENT

1. Switch Mounting Bracket
2. Adjustment Capscrews
3. Proximity Switch
4. Actuator Arm
5. Adjustment Screws

15. If the truck is to be equipped with a heated body, install the exhaust box at the pivot structure and tighten all the hardware (Figures 8-22 & 8-23).

    If the body is installed with a muffler, it should be installed at the factory; if not, it can be installed at this stage.

FIGURE 8-22.

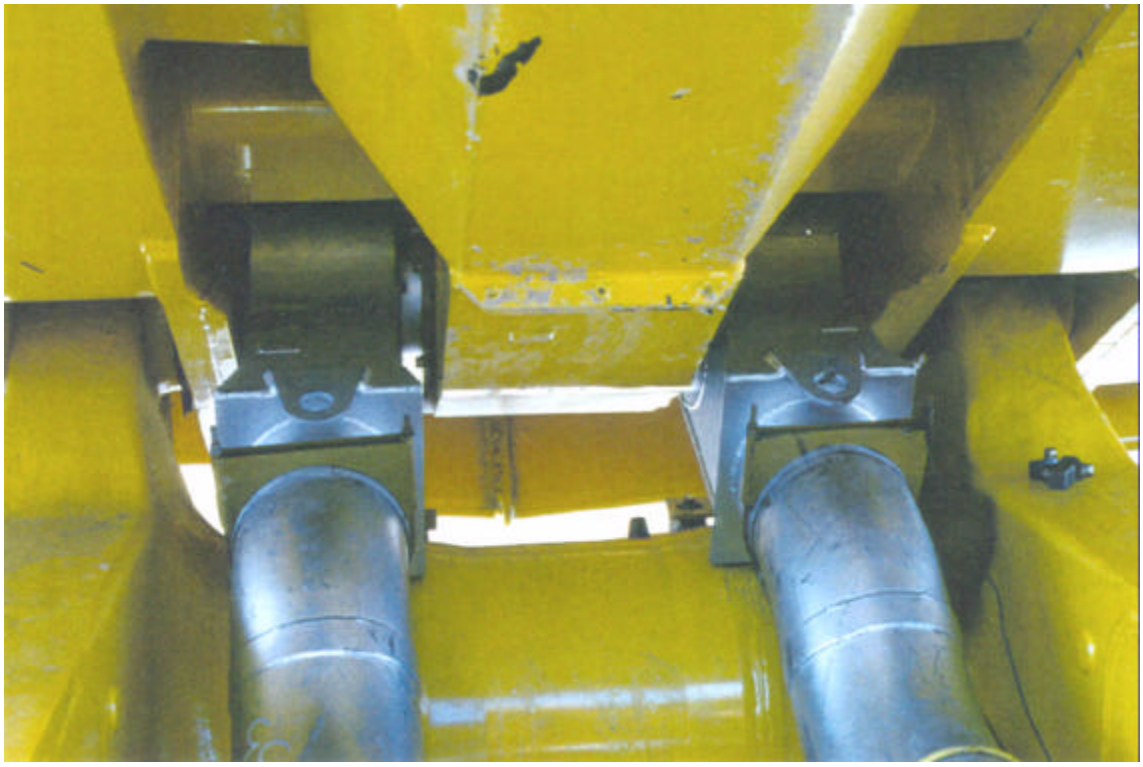


FIGURE 8-23.

16. With the body in the raised position, the body hoist limit switch can be set and the striker plate welded into position (Figure 8-24). It is normal practice to leave about 6 in. (152 mm) of unused cylinder stroke. Refer to the assembly prints or the shop manual for precise positioning specifications.

17. With the body in the raised position, the grease lines for the hoist cylinders can be placed into position and clamped along the inside of the body (Figure 8-25).

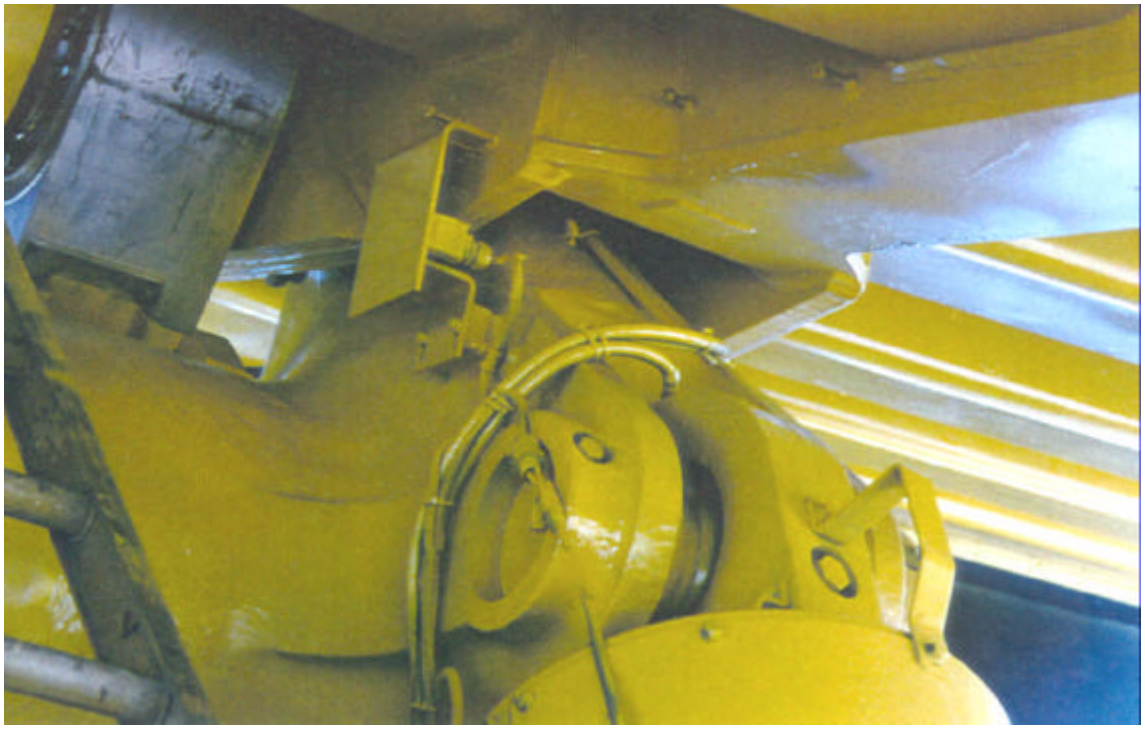


FIGURE 8-24.

FIGURE 8-25.

18. Install exhaust tubing blankets (Figure 8-26).

19. Install and connect the LH & RH engine inspection light (Figure 8-27).

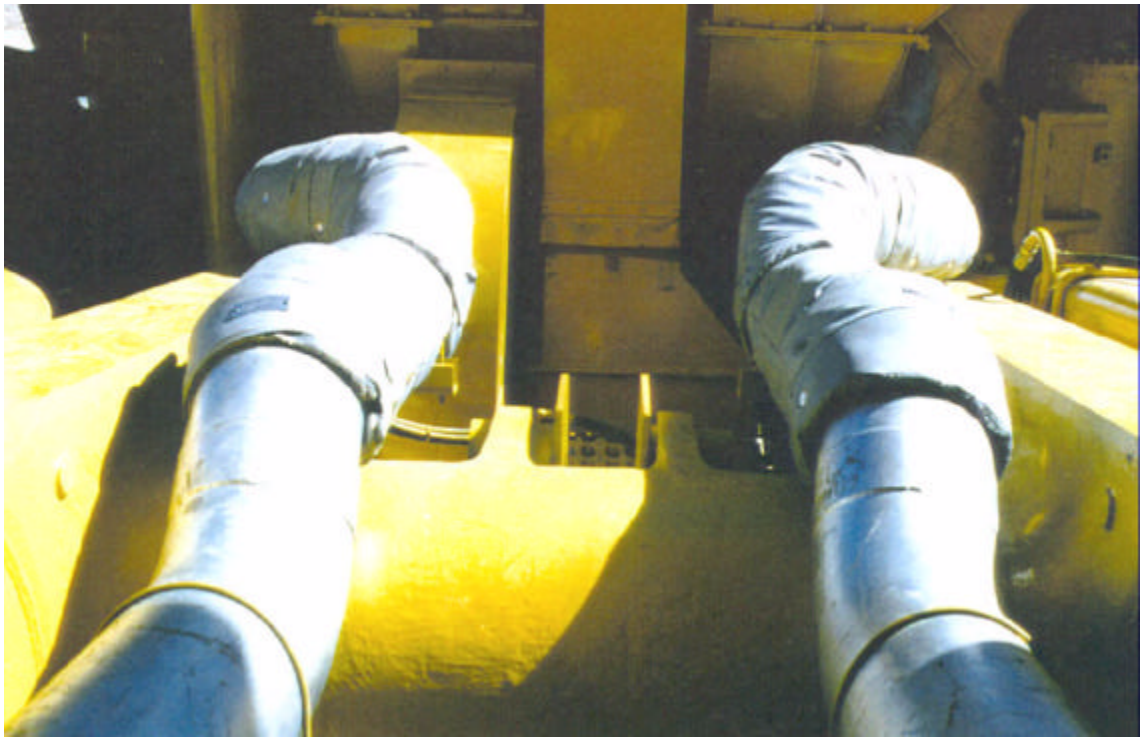


FIGURE 8-26.

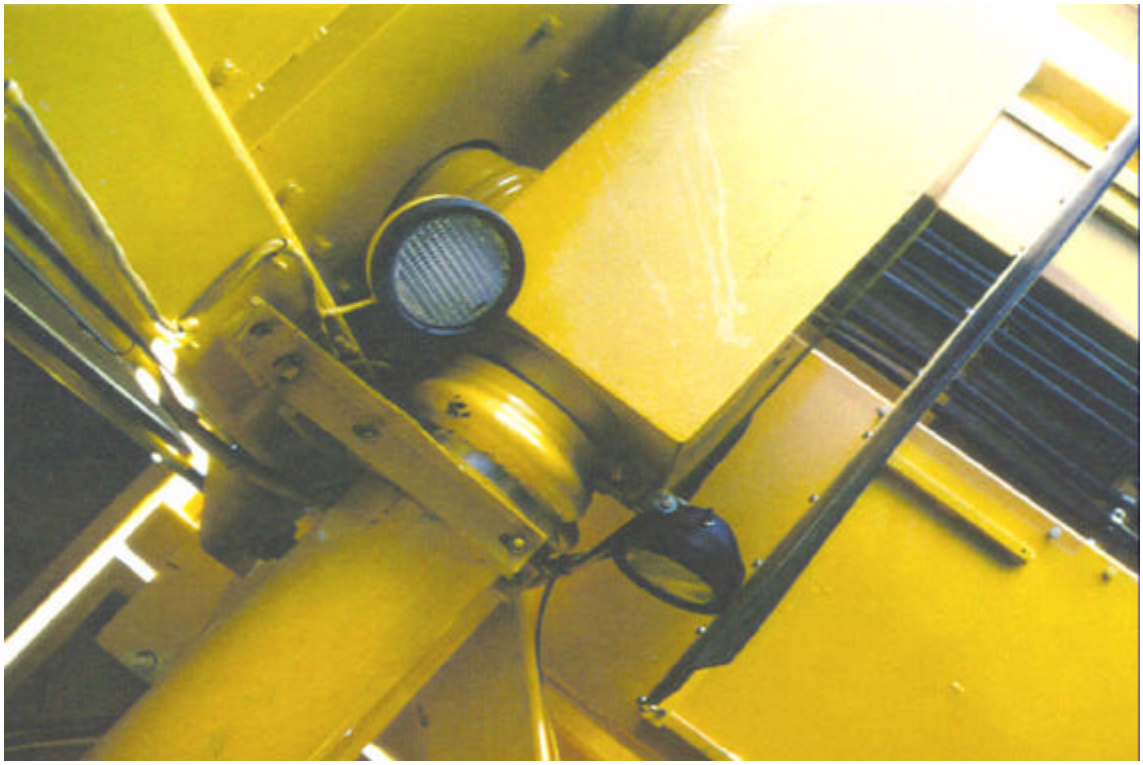


FIGURE 8-27.

20. Install Ansul Fire System. Refer to Figures 8-28, 8-29, 8-30.

    This installation is normally performed by an Ansul distributor.

FIGURE 8-28.

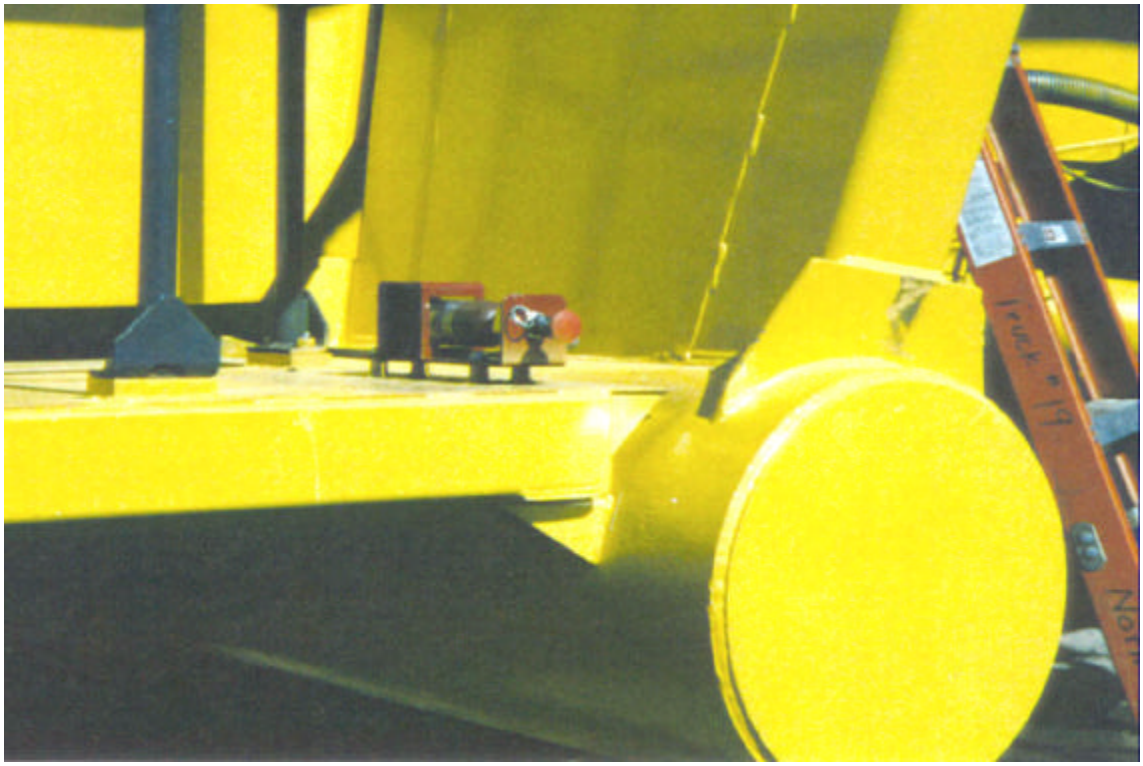


FIGURE 8-29.

21. Install the battery “belly pan” (Figure 8-31).

FIGURE 8-30.

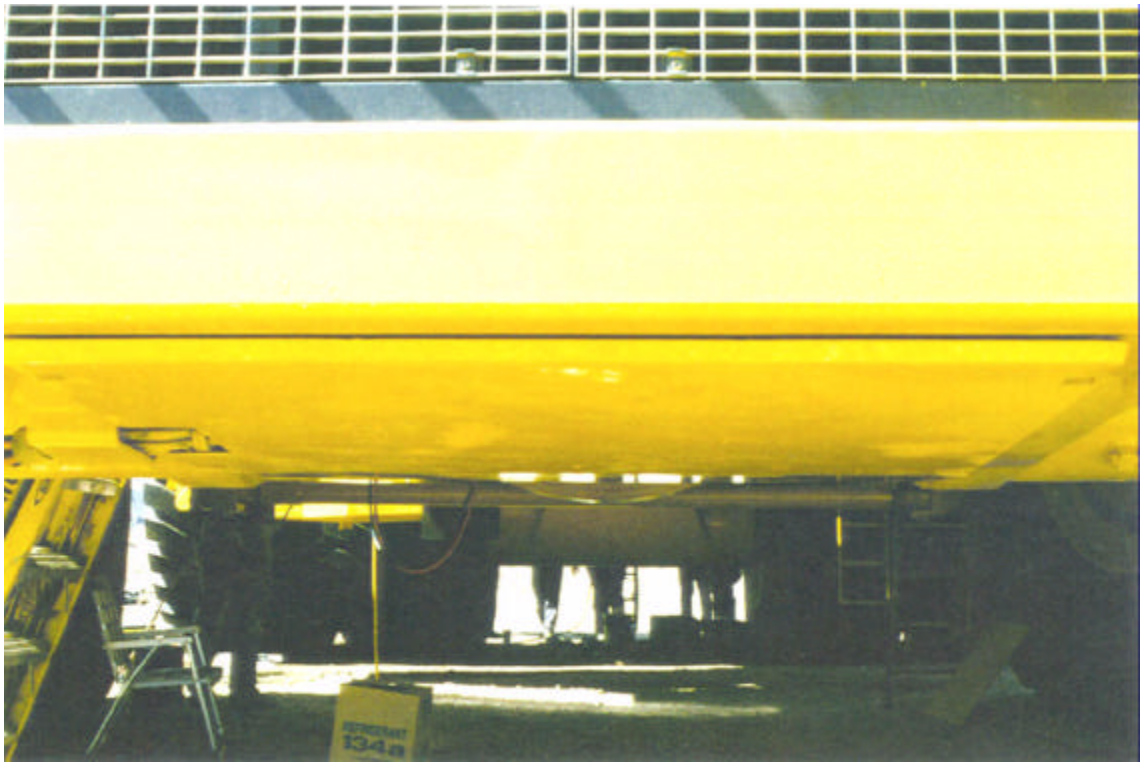


FIGURE 8-31.

22. Final touch-up painting can now be applied where needed.

23. Apply the anti-skid to the designated areas on the decks (Figure 8-32).

24. Place all the decals to their designated areas (Figure 8-33).

FIGURE 8-32.

FIGURE 8-33.

25. Charge both front and rear suspensions, steering and brake accumulators.

    Connect boots to front suspensions (Figure 8-34).

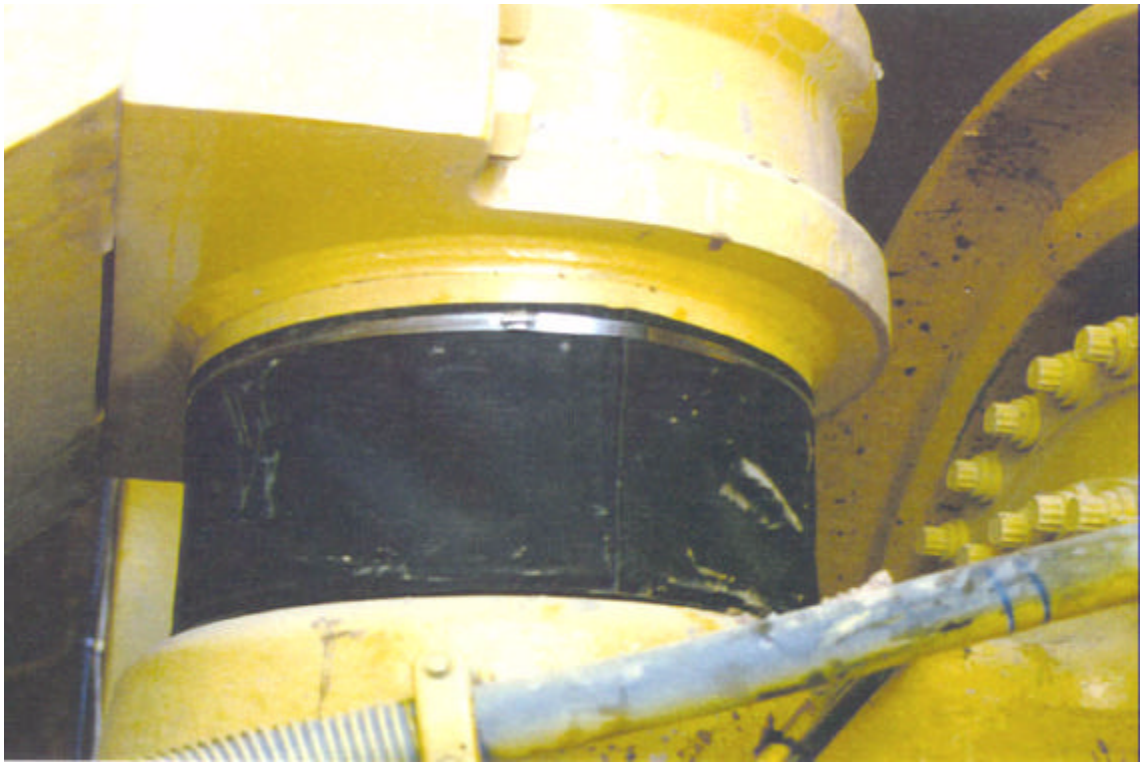


FIGURE 8-34.

26. After the completion of the truck assembly, thoroughly check all hardware to ensure that the capscrew heads or nuts are marked with paint, indicating they have been properly tightened.

    Check all hydraulic lines and electrical connections for secure installation and tightness.

    Notify qualified maintenance personnel that the truck is ready for final static and dynamic systems checkout.

FIGURE 8-35.

FIGURE 8-36.

NOTES

FINAL CHECK-OUT

Final check-out will require truck operation.

The Operation and Maintenance Manual and safety manuals which are shipped with the truck should be located and placed in the operator cab, if not already there.

Any personnel involved in the final check-out of the truck should read and understand all safety and operating instructions in the Operation and Maintenance Manual.

1. Acknowledgement of Receipt Form*
2. Service Report Form*
3. Receiving Inspection Report Form*
4. Field Assembly Inspection Report Form*

(* supplied from factory; Complete these forms and return to the appropriate facilities.)

5. Check all coolant and lubricants for proper levels and specifications; refer to 930E Lubrication and Service in the Operation and Maintenance Manual.
6. If not completed in earlier stages of assembly, make the following checks:
   - Electrical Propulsion Checkout Procedure (available in service manual, Section "E")
   - Hydraulic Checkout Procedure (available in service manual, Section "L")
   - Steering & Brake Schematic (See schematic Section "R", of service manual)
   - Hydraulic Brake Checkout Procedure (available in service manual, Section "J")
   - Park Brake Installation & Adjustment Procedure (available in service manual, Section "J")

Using only a qualified operator, operate the truck in a traffic-free area until safe operation has been assured.

Release the truck for hauling, only after all checks have been completed, and all deficiencies corrected.

NOTES

STANDARD CHARTS AND TABLES

This manual provides dual dimensioning for most specifications. U.S. standard units are specified first, with metric (SI) units in parentheses. References throughout the manual to standard torques or other standard values will be to one of the following Charts or Tables. For values not shown in any of the charts or tables, standard conversion factors for most commonly used measurements are provided in TABLE XIII, page 10-6.

INDEX OF TABLES

EFFECT OF SPECIAL LUBRICANTS On Fasteners and Standard Torque Values

KOMATSU engineering department does NOT recommend the use of special “friction-reducing” lubricants such as, “Copper Coat”, “Never Seize”, and other similar products on the threads of standard fasteners where “standard torque” values are applied.

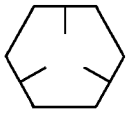
The use of special “friction-reducing” lubricants will significantly alter the clamping force being applied to fasteners during the tightening process.

If special “friction-reducing” lubricants are used with the “Standard Torque” values listed below in Table I (and in Komatsu shop manuals), excessive stress and possible breakage of the fasteners may result.

Where Torque Tables specify “Lubricated Threads” for the Standard Torque values listed, **these standard torque values are to be used with simple lithium base chassis grease (multi-purpose EP NLGI) or a rust- preventive grease (see list, page 10-2) on the threads and seats,** unless specified otherwise.

NOTE: Always be sure threads of fasteners and tapped holes are free of burrs and other imperfections before assembling.

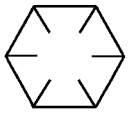
Standard torque values are not to be used when “Turn-of-the-Nut” tightening procedures are recommended.



Grade 5

TABLE I. -STANDARD TORQUE CHART SAE HEX HEAD CAPSCREW AND NUT ASSEMBLY (LUBRICATED THREADS) - TOLERANCES ±10%

Grade 8



Capscrew Thread Size	TORQUE - GRADE 5			TORQUE - GRADE 8			Capscrew Thread Size	TORQUE - GRADE 5			TORQUE - GRADE 8		
	ft. lbs.	kg.m	N.m	ft. lbs.	kg.m	N.m		ft. lbs.	kg.m	N.m	ft. lbs.	kg.m	N.m
1/4-20	7	0.97	9.5	10	1.38	13.6	3/4-16	235	32.5	319	335	46.3	454
1/4-28	8	1.11	10.8	11	1.52	14.9	7/8-9	350	48.4	475	500	69.2	678
5/16-18	15	2.07	20.3	21	2.90	28	7/8-14	375	51.9	508	530	73.3	719
5/16-24	16	2.21	22	22	3.04	30	1.0-8	525	72.6	712	750	103.7	1017
3/8-16	25	3.46	34	35	4.84	47	1.0-12	560	77.4	759	790	109.3	1071
3/8-24	30	4.15	41	40	5.5	54	1.0-14	570	78.8	773	800	110.6	1085
7/16-14	40	5.5	54	58	8.0	79	1 1/8-7	650	89.9	881	1050	145	1424
7/16-20	45	6.2	61	62	8.57	84	1 1/8-12	700	96.8	949	1140	158	1546
1/2-13	65	9	88	90	12.4	122	1 1/4-7	910	125.9	1234	1480	205	2007
1/2-20	70	9.7	95	95	13.1	129	1 1/4-12	975	134.8	1322	1580	219	2142
9/16-12	90	12.4	122	125	17.3	169	1 3/8-6	1200	166	1627	1940	268	2630
9/16-18	95	13.1	129	135	18.7	183	1 3/8-12	1310	181	1776	2120	293	2874
5/8-11	125	17.3	169	175	24.2	237	1 1/2-6	1580	219	2142	2560	354	3471
5/8-18	135	18.7	183	190	26.2	258	1 1/2-12	1700	235	2305	2770	383	3756
3/4-10	220	30.4	298	310	42.8	420							

1 ft. lbs. = 0.138 kg.m = 1.356 N.m

Standard Assembly Torques For 12-Point, Grade 9, Capscrews (SAE)

The following specifications apply to required assembly torques for all 12-Point, Grade 9 (170,000 psi minimum tensile), Capscrews.

- Capscrew threads and seats SHALL be lubricated when assembled.

Unless instructions specifically recommend otherwise, these standard torque values are to be used with simple lithium base chassis grease (multi-purpose EP NLGI) or a rust-preventive grease (see list, this page) on the threads.

- Torques are calculated to give a clamping force of approximately 75% of proof load.
- The maximum torque tolerance shall be ±10% of the torque value shown.

TABLE II. - STANDARD ASSEMBLY TORQUE for 12-Point, Grade 9 Capscrews

CAPSCREW SIZE*	TORQUE ft. lbs.	TORQUE N.m	TORQUE kg.m
0.250 - 20	12	16	1.7
0.312 - 18	24	33	3.3
0.375 - 16	42	57	5.8
0.438 -14	70	95	9.7
0.500 -13	105	142	14.5
0.562 - 12	150	203	20.7
0.625 - 11	205	278	28.3
0.750 - 10	360	488	49.7
0.875 - 9	575	780	79.4
1.000 - 8	860	1166	119
1.000 - 12	915	1240	126
1.125 - 7	1230	1670	170
1.125 - 12	1330	1800	184
1.250 - 7	1715	2325	237
1.250 - 12	1840	2495	254
1.375 - 6	2270	3080	313
1.375 - 12	2475	3355	342
1.500 - 6	2980	4040	411
1.500 - 12	3225	4375	445
* Shank Diameter (in.) - Threads per inch			
This table represents standard values only. Do not use these values to replace torque values which are specified in assembly instructions.			

Standard Metric Assembly Torque For Class 10.9 Capscrews & Class 10 Nuts

The following specifications apply to required assembly torques for all metric Class 10.9 finished hexagon head capscrews and Class 10 nuts.

- Capscrew threads and seats SHALL NOT be lubricated when assembled. These specifications are based on all capscrews, nuts, and hardened washers being phosphate and oil coated.NOTE: If zinc-plated hardware is used, each piece must be lubricated with a Rust Preventive Grease or Lithium-base grease to achieve the same clamping forces provided below.
- Torques are calculated to give a clamping force of approximately 75% of proof load.
- The maximum torque tolerance shall be within ±10% of the torque value shown.

TABLE III. - STANDARD METRIC ASSEMBLY TORQUE

CAPSCREW SIZE*	TORQUE ft. lbs.	TORQUE N.m	TORQUE kg.m
M6 x1	12	9	1.22
M8 x 1.25	30	22	3.06
M10 x 1.5	55	40	5.61
M12 x 1.75	95	70	9.69
M14 x 2	155	114	15.81
M16 x 2	240	177	24.48
M20 x 2.25	465	343	47.43
M24 x 3	800	590	81.6
M30 x 3.5	1600	1180	163.2
M36 x 4	2750	2028	280.5
* Shank Diameter (mm) - Threads per millimeter			
This table represents standard values only. Do not use these values to replace torque values which are specified in assembly instructions.			

Suggested* Sources for Rust Preventive Grease:

- AMERICAN ANTI-RUST GREASE #3-X from Standard Oil Company (also American Oil Co.)
- GULF NORUST #3 from Gulf Oil Company.
- MOBILARMA 355, Product No. 66705 from Mobil Oil Corporation.
- RUST BAN 326 from Humble Oil Company.
- RUSTOLENE B GREASE from Sinclair Oil Company.
- RUST PREVENTIVE GREASE - CODE 312 from the Southwest Grease and Oil Company.

**** NOTE: This list represents the current Engineering approved sources for use in Komatsu manufacture. It is not exclusive. Other products may meet the same specifications of this list.***

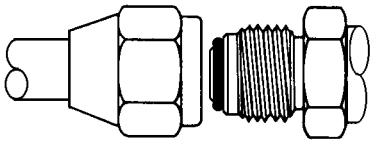


TABLE IV.
TORQUE CHART FOR JIC 37° SWIVEL NUTS
WITH OR WITHOUT O-RING SEALS

SIZE CODE	TUBE SIZE (O.D.)	THREADS UNF-2B	TORQUE FT. LBS.
– 2	0.125	0.312 – 24	4 ±1
– 3	0.188	0.375 – 24	8 ±3
– 4	0.250	0.438 – 20	12 ±3
– 5	0.312	0.500 – 20	15 ±3
– 6	0.375	0.562 – 18	18 ±5
– 8	0.500	0.750 – 16	30 ±5
– 10	0.625	0.875 – 14	40 ±5
– 12	0.750	1.062 – 12	55 ±5
– 14	0.875	1.188 – 12	65 ±5
– 16	1.000	1.312 – 12	80 ±5
– 20	1.250	1.625 – 12	100 ±10
– 24	1.500	1.875 – 12	120 ±10
– 32	2.000	2.500 – 12	230 ±20

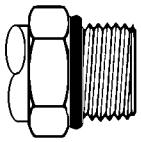


TABLE VI.
TORQUE CHART FOR
O-RING BOSS FITTINGS

SIZE CODE	TUBE SIZE (O.D.)	THREADS UNF-2B	TORQUE FT. LBS.
– 2	0.125	0.312 – 24	4 ±2
– 3	0.188	0.375 – 24	5 ±2
– 4	0.250	0.438 – 20	8 ±3
– 5	0.312	0.500 – 20	10 ±3
– 6	0.375	0.562 – 18	13 ±3
– 8	0.500	0.750 – 16	24 ±5
– 10	0.625	0.875 – 14	32 ±5
– 12	0.750	1.062 – 12	48 ±5
– 14	0.875	1.188 – 12	54 ±5
– 16	1.000	1.312 – 12	72 ±5
– 20	1.250	1.625 – 12	80 ±5
– 24	1.500	1.875 – 12	80 ±5
– 32	2.000	2.500 – 12	96 ±10

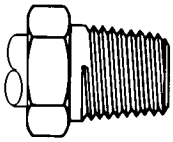


TABLE V.
TORQUE CHART FOR
PIPE THREAD FITTINGS

SIZE CODE	PIPE THREAD SIZE	WITH SEALANT FT. LBS.	WITHOUT SEALANT FT. LBS.
– 2	0.125 – 27	15 ±3	20 ±5
– 4	0.250 – 18	20 ±5	25 ±5
– 6	0.375 – 18	25 ±5	35 ±5
– 8	0.500 – 14	35 ±5	45 ±5
– 12	0.750 – 14	45 ±5	55 ±5
– 16	1.000 – 11.50	55 ±5	65 ±5
– 20	1.250 – 11.50	70 ±5	80 ±5
– 24	1.500 – 11.50	80 ±5	95 ±10
– 32	2.000 – 11.50	95 ±10	120 ±10

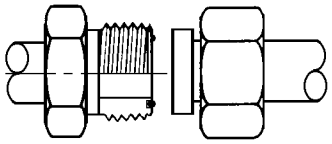


TABLE VII.
TORQUE CHART FOR
O-RING FACE SEAL FITTINGS

SIZE CODE	TUBE SIZE (O.D.)	THREADS UNF-2B	TORQUE FT. LBS.
– 4	0.250	0.438 – 20	11 ±1
– 6	0.375	0.562 – 18	18 ±2
– 8	0.500	0.750 – 16	35 ±4
– 10	0.625	0.875 – 14	51 ±5
– 12	0.750	1.062 – 12	71 ±7
– 16	1.000	1.312 – 12	98 ±6
– 20	1.250	1.625 – 12	132 ±7
– 24	1.500	1.875 – 12	165 ±15

TABLE VIII. TORQUE CONVERSIONS
Foot Pounds – ft. lbs. To Newton-meters (N.m)

FT. LBS.	0	1	2	3	4	5	6	7	8	9
0	(N.m)	1.36	2.71	4.07	5.42	6.78	8.14	9.49	10.85	12.20
10	13.56	14.91	16.27	17.63	18.98	20.34	21.69	23.05	24.40	25.76
20	27.12	28.47	29.83	31.18	32.54	33.90	35.25	36.61	37.96	39.32
30	40.67	42.03	43.39	44.74	46.10	47.45	48.81	50.17	51.52	52.87
40	54.23	55.59	56.94	58.30	59.66	60.01	62.37	63.72	65.08	66.44
50	67.79	69.15	70.50	71.86	73.21	74.57	75.93	77.28	78.64	80.00
60	81.35	82.70	84.06	85.42	86.77	88.13	89.48	90.84	92.20	93.55
70	94.91	96.26	97.62	98.97	100.33	101.69	103.04	104.40	105.75	107.11
80	108.47	109.82	111.18	112.53	113.89	115.24	116.60	117.96	119.31	120.67
90	122.03	123.38	124.74	126.09	127.45	128.80	130.16	131.51	132.87	134.23
See NOTE on page 10-5 regarding Table usage										

TABLE IX. TORQUE CONVERSIONS
Foot Pounds – ft. lbs. To kilogram-meters (kg.m)

FT. LBS.	0	1	2	3	4	5	6	7	8	9
0	(kg.m)	0.138	0.277	0.415	0.553	0.692	0.830	0.968	1.106	1.245
10	1.38	1.52	1.66	1.80	1.94	2.07	2.21	2.35	2.49	2.63
20	2.77	2.90	3.04	3.18	3.32	3.46	3.60	3.73	3.87	4.01
30	4.15	4.29	4.43	4.56	4.70	4.84	4.98	5.12	5.26	5.39
40	5.53	5.67	5.81	5.95	6.09	6.22	6.36	6.50	6.64	6.78
50	6.92	7.05	7.19	7.33	7.47	7.61	7.74	7.88	8.02	8.16
60	8.30	8.44	8.57	8.71	8.85	8.99	9.13	9.27	9.40	9.54
70	9.68	9.82	9.96	10.10	10.23	10.37	10.51	10.65	10.79	10.93
80	11.06	11.20	11.34	11.48	11.62	11.76	11.89	12.03	12.17	12.30
90	12.45	12.59	12.72	12.86	13.00	13.14	13.28	13.42	13.55	13.69
See NOTE on page 10-5 regarding Table usage										

TABLE X. PRESSURE CONVERSIONS
Pounds/square inch (psi) To Kilopascals (kPa)
Formula: psi x 6.895 = kPa

PSI	0	1	2	3	4	5	6	7	8	9
0	(kPa)	6.895	13.79	20.68	27.58	34.47	41.37	48.26	55.16	62.05
10	68.95	75.84	82.74	89.63	96.53	103.42	110.32	117.21	124.1	131.0
20	137.9	144.8	151.7	158.6	165.5	172.4	179.3	186.2	193.1	200.0
30	206.8	213.7	220.6	227.5	234.4	241.3	248.2	255.1	262.0	268.9
40	275.8	282.7	289.6	296.5	303.4	310.3	317.2	324.1	331.0	337.9
50	344.7	351.6	358.5	365.4	372.3	379.2	386.1	393.0	399.9	406.8
60	413.7	420.6	427.5	434.4	441.3	448.2	455.1	462.0	468.9	475.8
70	482.6	489.5	496.4	503.3	510.2	517.1	524.0	530.9	537.8	544.7
80	551.6	558.5	565.4	572.3	579.2	586.1	593.0	599.9	606.8	613.7
90	620.5	627.4	634.3	641.2	648.1	655.0	661.9	668.8	675.7	682.6
See NOTE on page 10-5 regarding Table usage										

TABLE XI. PRESSURE CONVERSIONS
Pounds/square inch (psi) To Megapascals (MPa)
Formula: psi x 0.0069 = MPa

FT. LBS.	0	10	20	30	40	50	60	70	80	90
0	(MPa)	0.069	0.14	0.21	0.28	0.34	0.41	0.48	0.55	0.62
100	0.69	0.76	0.83	0.90	0.97	1.03	1.10	1.17	1.24	1.31
200	1.38	1.45	1.52	1.59	1.65	1.72	1.79	1.86	1.93	2.00
300	2.07	2.14	2.21	2.28	2.34	2.41	2.48	2.55	2.62	2.69
400	2.76	2.83	2.90	2.96	3.03	3.10	3.17	3.24	3.31	3.38
500	3.45	3.52	3.59	3.65	3.72	3.79	3.86	3.93	4.00	4.07
600	4.14	4.21	4.27	4.34	4.41	4.48	4.55	4.62	4.69	4.76
700	4.83	4.90	4.96	5.03	5.10	5.17	5.24	5.31	5.38	5.45
800	5.52	5.58	5.65	5.72	5.79	5.86	5.93	6.00	6.07	6.14
900	6.21	6.27	6.34	6.41	6.48	6.55	6.62	6.69	6.76	6.83
See NOTE below regarding Table usage										

NOTE: Tables such as Table VIII, IX, X, and XI may be used as in the following example:

Example: Convert 975 psi to kilopascals (kPa).

1. Select Table X.
2. Go to PSI row 90, column 7; read 668.8
   97 psi = 668.8 kPa.
3. Multiply by 10:
   970 psi = 6688 kPa.
4. Go to PSI row 0, column 5; read 34.475
   psi = 34.47 kPa. Add to step 3.
5. 970 + 5 psi = 6688 + 34 = 6722 kPa.

TABLE XII. TEMPERATURE CONVERSIONS
Formula: F° - 32 ÷ 1.8 = C° or C° x 1.8 + 32 = F°

CELSIUS C°		FAHRENHEIT F°	CELSIUS C°		FAHRENHEIT F°	CELSIUS C°		FAHRENHEIT F°
121	250	482	63	145	293	4	40	104
118	245	473	60	140	284	2	35	95
116	240	464	57	135	275	– 1	30	86
113	235	455	54	130	266	– 4	25	77
110	230	446	52	125	257	– 7	20	68
107	225	437	49	120	248	– 9	15	59
104	220	428	46	115	239	– 12	10	50
102	215	419	43	110	230	– 15	5	41
99	210	410	41	105	221	– 18	0	32
96	205	401	38	100	212	– 21	– 5	23
93	200	392	35	95	293	– 23	– 10	14
91	195	383	32	90	194	– 26	– 15	5
88	190	374	29	85	185	– 29	– 20	– 4
85	185	365	27	80	176	– 32	– 25	– 13
82	180	356	24	75	167	– 34	– 30	– 22
79	175	347	21	70	158	– 37	– 35	– 31
77	170	338	18	65	149	– 40	– 40	– 40
74	165	329	15	60	140	– 43	– 45	– 49
71	160	320	13	55	131	– 46	– 50	– 58
68	155	311	10	50	122	– 48	– 55	– 67
66	150	302	7	45	113	– 51	– 60	– 76

NOTE: The numbers in the unmarked columns refer to temperature in either degrees Celsius (C°) or Fahrenheit (F°). Select a number in this unmarked column and read to the left to convert to degrees Celsius (C°) or read to the right to convert to degrees Fahrenheit (F°). If starting with a known temperature (either C° or F°), find that temperature in the **marked** column and read the converted temperature in the center, **unmarked** column.

TABLE XIII
COMMON CONVERSION MULTIPLIERS

COMMON CONVERSION MULTIPLIERS ENGLISH To METRIC		
To Convert From	**TO**	**Multiply By**
inch – in.	millimeter (mm)	25.40
inch – in.	centimeter (cm)	2.54
foot – ft.	meter (m)	0.3048
yard – yd.	meter (m)	0.914
mile – mi.	kilometer (km)	1.61
sq. in. – $in.^2$	sq. centimeters (cm^2)	6.45
sq. ft. – $ft.^2$	sq. centimeters (cm^2)	929
cu. in. – $in.^3$	cu. centimeters (cm^3)	16.39
cu. in. – $in.^3$	liters (l)	0.016
cu. ft. – $ft.^3$	cu. meters (m^3)	0.028
cu. ft. – $ft.^3$	liters (l)	28.3
ounce – oz.	kilogram (kg)	0.028
fluid ounce – fl. oz.	milliliter (ml)	29.573
pound (mass)	kilogram (kg)	0.454
pound (force) – lbs.	Newton (N)	4.448
in. lbs. (force)	Newton.meters (N.m)	0.113
ft. lbs. (force)	Newton.meters (N.m)	1.356
ft. lbs. (force)	kilogram.meters (kg.m)	0.138
kilogram.meters (kg.m)	Newton.meters (N.m)	9.807
psi (pressure)	kilopascals (kPa)	6.895
psi (pressure)	megapascals (MPa)	0.007
psi (pressure)	kilograms/cm^2 (kg/cm^2)	0.0704
ton (short)	kilogram (kg)	907.2
ton (short)	metric ton	0.0907
quart – qt.	liters (l)	0.946
gallon – gal.	liters (l)	3.785
HP (horsepower)	Watts	745.7
HP (horsepower)	kilowatts (kw)	0.745

COMMON CONVERSION MULTIPLIERS METRIC To ENGLISH		
To Convert From	**TO**	**Multiply By**
millimeter (mm)	inch – in.	0.0394
centimeter (cm)	inch – in.	0.3937
meter (m)	foot – ft.	3.2808
meter (m)	yard – yd.	1.0936
kilometer (km)	mile – mi.	0.6210
sq. centimeters (cm^2)	sq. in. – $in.^2$	0.1550
sq. centimeters (cm^2)	sq. ft. – $ft.^2$	0.001
cu. centimeters (cm^3)	cu. in. – $in.^3$	0.061
liters (l)	cu. in. – $in.^3$	61.02
cu. meters (m^3)	cu. ft. – $ft.^3$	35.314
liters (l)	cu. ft. – $ft.^3$	0.0353
grams (g)	ounce – oz.	0.0353
milliliter (ml)	fluid ounce – fl. oz.	0.0338
kilogram (kg)	pound (mass)	2.2046
Newton (N)	pound (force) – lbs.	0.2248
Newton.meters (N.m)	kilogram.meters (kg.m)	0.102
Newton.meters (N.m)	ft. lbs. (force)	0.7376
kilogram.meters (kg.m)	ft. lbs. (force)	7.2329
kilogram.meters (kg.m)	Newton.meters (N.m)	9.807
Kilopascals (kPa)	psi (pressure)	0.1450
megapascals (MPa)	psi (pressure)	145.038
kilograms/cm^2 (kg/cm^2)	psi (pressure)	14.2231
kilograms/cm^2 (kg/cm^2)	kilopascals (kPa)	98.068
kilogram (kg)	ton (short)	0.0011
metric ton	ton (short)	1.1023
liters (l)	quart – qt.	1.0567
liters (l)	gallon – gal.	0.2642
Watts	HP (horsepower)	0.00134
kilowatts (kw)	HP (horsepower)	1.3410

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