135D Excavator Repair

TECHNICAL MANUAL
135D Excavator Repair

TM10743 09APR09 (ENGLISH)

For complete service information also see:

135D Excavator Operation and Tests	**TM10742**
135D Excavator Operator's Manual	**OMT239673**
Undercarriage Appraisal Manual	**SP326**
Super Caddy Oil Cleanup Procedure	**CTM310**

Worldwide Construction And Forestry Division
LITHO IN U.S.A.

Introduction

Foreword

This manual is written for an experienced technician. Essential tools required in performing certain service work are identified in this manual and are recommended for use.

Live with safety: Read the safety messages in the introduction of this manual and the cautions presented throughout the text of the manual.

 This is the safety-alert symbol. When you see this symbol on the machine or in this manual, be alert to the potential for personal injury.

Technical manuals are divided in two parts: repair and operation and tests. Repair sections tell how to repair the components. Operation and tests sections help you identify the majority of routine failures quickly.

Information is organized in groups for the various components requiring service instruction. At the beginning of each group are summary listings of all applicable essential tools, service equipment and tools, other materials needed to do the job, service parts kits, specifications, wear tolerances, and torque values.

Technical Manuals are concise guides for specific machines. They are on-the-job guides containing only the vital information needed for diagnosis, analysis, testing, and repair.

Fundamental service information is available from other sources covering basic theory of operation, fundamentals of troubleshooting, general maintenance, and basic type of failures and their causes.

DX,TMIFC –19–29SEP98–1/1

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TX,TM,FAX –19–03JUL01–1/1

Contents

All information, illustrations and specifications in this manual are based on the latest information available at the time of publication. The right is reserved to make changes at any time without notice.

Section 00
General Information

Contents

Recognize Safety Information

This is the safety alert symbol. When this symbol is noticed on the machine or in this manual, be alert for the potential of personal injury.

Follow the precautions and safe operating practices highlighted by this symbol.

A signal word — DANGER, WARNING, or CAUTION — is used with the safety alert symbol. DANGER identifies the most serious hazards.

On the machine, DANGER signs are red in color, WARNING signs are orange, and CAUTION signs are yellow. DANGER and WARNING signs are located near specific hazards. General precautions are on CAUTION labels.

T133555 –UN–28AUG00

T133588 –19–28AUG00

TX03679,00016CC –19–03JAN07–1/1

Follow Safety Instructions

Read the safety messages in this manual and on the machine. Follow these warnings and instructions carefully. Review them frequently.

Keep safety signs in good condition.

Be sure new equipment components and repair parts include the current safety signs.

Be sure all operators of this machine understand every safety message. Replace operator's manual and safety signs immediately if missing or damaged. Replacement safety signs are available from your authorized dealer.

TX14740,0000019 –19–10JAN07–1/1

Operate Only If Qualified

Do not operate this machine unless the operator's manual has been read carefully, and you have been qualified by supervised training and instruction.

Operator should be familiar with the job site and surroundings before operating. Try all controls and machine functions with the machine in an open area before starting to work.

Know and observe all safety rules that may apply to every work situation and work site.

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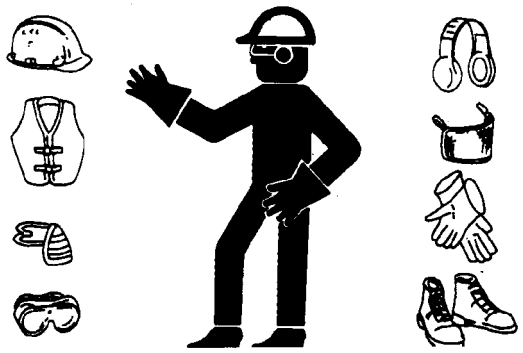
Wear Protective Equipment

Guard against injury from flying pieces of metal or debris; wear goggles or safety glasses.

Wear close fitting clothing and safety equipment appropriate to the job.

Prolonged exposure to loud noise can cause impairment or loss of hearing. Wear suitable hearing protection such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.



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Avoid Unauthorized Machine Modifications

John Deere recommends using only genuine John Deere replacement parts to ensure machine performance. Never substitute genuine John Deere parts with alternate parts not intended for the application as these can create hazardous situations or hazardous performance. Non-John Deere Parts, or any damage or failures resulting from their use are not covered by any John Deere warranty.

Modifications of this machine, or addition of unapproved products or attachments, may affect machine stability or reliability, and may create a hazard for the operator or others near the machine. The installer of any modification which may affect the electronic controls of this machine is responsible for establishing that the modification does not adversely affect the machine or its performance.

Always contact an authorized dealer before making machine modifications that change the intended use, weight or balance of the machine, or that alter machine controls, performance or reliability.

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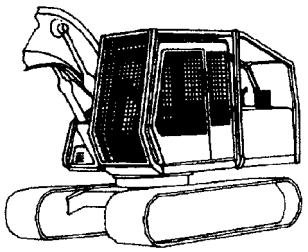
Add Cab Guarding for Special Uses

Special work situations or machine attachments may create an environment with falling or flying objects. Working near an overhead bank, doing demolition work, using a hydraulic hammer, or working in a wooded area, for example, may require added guarding to protect the operator.

FOPS (falling object protective structures) and special screens or guarding should be installed when falling or flying objects may enter or damage the machine. Contact your authorized dealer for information on devices intended to provide protection in special work situations.



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Inspect Machine

Inspect machine carefully each day by walking around it before starting.

Keep all guards and shields in good condition and properly installed. Fix damage and replace worn or broken parts immediately. Pay special attention to hydraulic hoses and electrical wiring.

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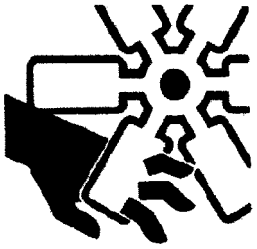
TX03679,0001734 –19–03JAN07–1/1

Stay Clear of Moving Parts

Entanglements in moving parts can cause serious injury.

Stop engine before examining, adjusting or maintaining any part of machine with moving parts.

Keep guards and shields in place. Replace any guard or shield that has been removed for access as soon as service or repair is complete.



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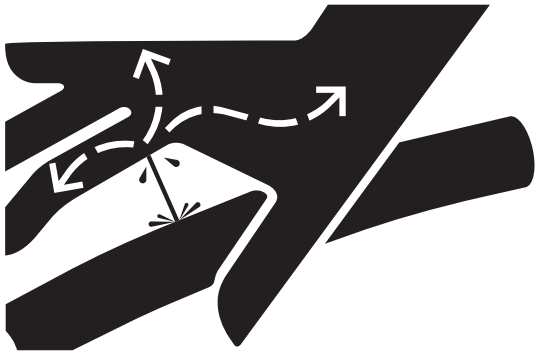
Avoid High-Pressure Fluids

Escaping fluid under pressure can penetrate the skin causing serious injury.

Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.

Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A.



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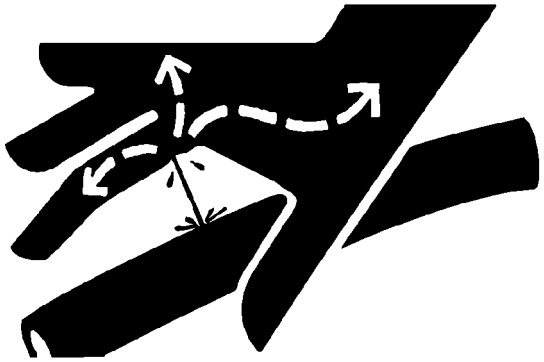
Avoid High-Pressure Oils

This machine uses a high-pressure hydraulic system. Escaping oil under pressure can penetrate the skin causing serious injury.

Never search for leaks with your hands. Protect hands. Use a piece of cardboard to find location of escaping oil. Stop engine and relieve pressure before disconnecting lines or working on hydraulic system.

If hydraulic oil penetrates your skin, see a doctor immediately. Injected oil must be removed surgically within hours or gangrene may result. Contact a knowledgeable medical source or the Deere & Company Medical Department in Moline, Illinois, U.S.A.



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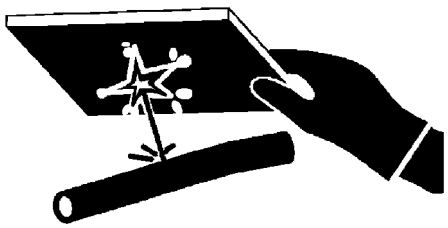

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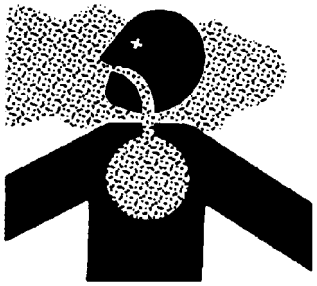
Beware of Exhaust Fumes

Prevent asphyxiation. Engine exhaust fumes can cause sickness or death.

If you must operate in an enclosed space, provide adequate ventilation. Use an exhaust pipe extension to remove the exhaust fumes or open doors and windows to bring outside air into the area.



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Prevent Fires

Handle Fuel Safely: Store flammable fluids away from fire hazards. Never refuel machine while smoking or when near sparks or flame.

Clean Machine Regularly: Keep trash, debris, grease and oil from accumulating in engine compartment, around fuel lines, hydraulic lines, exhaust components, and electrical wiring. Never store oily rags or flammable materials inside a machine compartment.

Maintain Hoses and Wiring: Replace hydraulic hoses immediately if they begin to leak, and clean up any oil spills. Examine electrical wiring and connectors frequently for damage.

Keep A Fire Extinguisher Available: Always keep a multipurpose fire extinguisher on or near the machine. Know how to use extinguisher properly.

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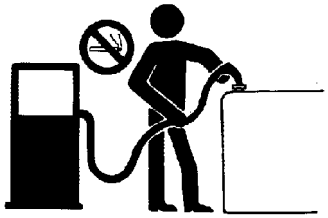

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Prevent Battery Explosions

Battery gas can explode. Keep sparks, lighted matches, and open flame away from the top of battery.

Never check battery charge by placing a metal object across the posts. Use a voltmeter or hydrometer.

Do not charge a frozen battery; it may explode. Warm battery to 16°C (60°F).

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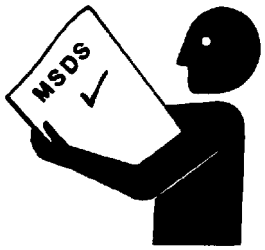
Handle Chemical Products Safely



T133580 –UN–25AUG00

Exposure to hazardous chemicals can cause serious injury. Under certain conditions, lubricants, coolants, paints and adhesives used with this machine may be hazardous.

If uncertain about safe handling or use of these chemical products, contact your authorized dealer for a Material Safety Data Sheet (MSDS) or go to internet website http://www.jdmsds.com. The MSDS describes physical and health hazards, safe use procedures, and emergency response techniques for chemical substances. Follow MSDS recommendations to handle chemical products safely.

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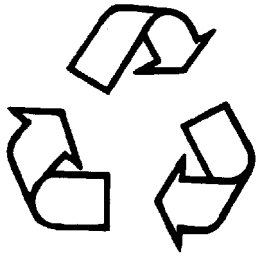
Dispose of Waste Properly



T133567 –UN–25AUG00

Improper disposal of waste can threaten the environment. Fuel, oils, coolants, filters and batteries used with this machine may be harmful if not disposed of properly.

Never pour waste onto the ground, down a drain, or into any water source.

Air conditioning refrigerants can damage the atmosphere. Government regulations may require using a certified service center to recover and recycle used refrigerants.

If uncertain about the safe disposal of waste, contact your local environmental or recycling center or your authorized dealer for more information.

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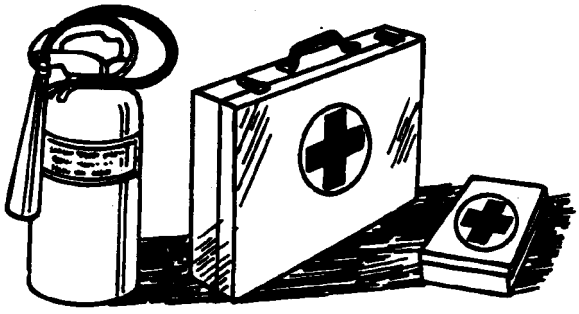
Prepare for Emergencies



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Be prepared if an emergency occurs or a fire starts.

Keep a first aid kit and fire extinguisher handy.

Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.

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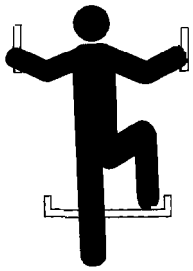
Use Steps and Handholds Correctly

Prevent falls by facing the machine when getting on and off. Maintain 3-point contact with steps and handrails. Never use machine controls as handholds.

Use extra care when mud, snow, or moisture present slippery conditions. Keep steps clean and free of grease or oil. Never jump when exiting machine. Never mount or dismount a moving machine.



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Start Only From Operator's Seat

Avoid unexpected machine movement. Start engine only while sitting in operator's seat. Ensure all controls and working tools are in proper position for a parked machine.

Never attempt to start engine from the ground. Do not attempt to start engine by shorting across the starter solenoid terminals.

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Use and Maintain Seat Belt

Use seat belt when operating machine. Remember to fasten seat belt when loading and unloading from trucks and during other uses.

Examine seat belt frequently. Be sure webbing is not cut or torn. Replace seat belt immediately if any part is damaged or does not function properly.

The complete seat belt assembly should be replaced every 3 years, regardless of appearance.

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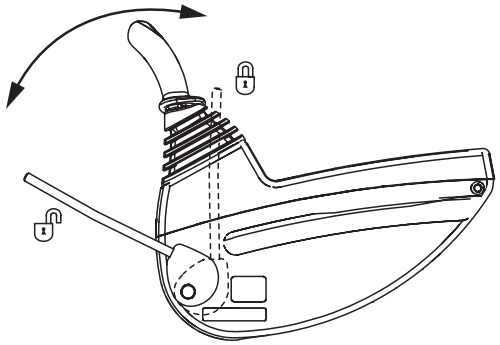
Prevent Unintended Machine Movement

Be careful not to accidentally actuate control levers when coworkers are present. Pull pilot control shutoff lever to locked position during work interruptions. Pull pilot control shutoff lever to locked position and stop engine before allowing anyone to approach machine.

Always lower work equipment to the ground and pull pilot control shutoff lever to locked position before standing up or leaving the operator's seat. Stop engine before exiting.



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Avoid Work Site Hazards

Avoid contact with gas lines, buried cables and water lines. Call utility line location services to identify all underground utilities before you dig.

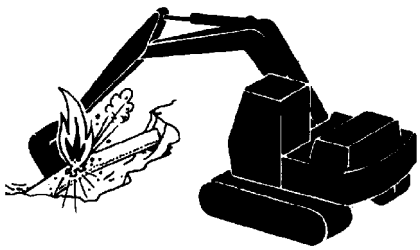
Prepare work site properly. Avoid operating near structures or objects that could fall onto the machine. Clear away debris that could move unexpectedly if run over.

Avoid boom or arm contact with overhead obstacles or overhead electrical lines. Never move any part of machine or load closer than 3 m (10 ft) plus twice the line insulator length to overhead wires.

Keep bystanders clear at all times. Keep bystanders away from raised booms, attachments, and unsupported loads. Avoid swinging or raising booms, attachments, or loads over or near personnel. Use barricades or a signal person to keep vehicles and pedestrians away. Use a signal person if moving machine in congested areas or where visibility is restricted. Always keep signal person in view. Coordinate hand signals before starting machine.

Operate only on solid footing with strength sufficient to support machine. When working close to an excavation, position travel motors away from the hole.

Reduce machine speed when operating with tool on or near ground when obstacles may be hidden (e.g., during snow removal or clearing mud, dirt, etc). At high speeds, hitting obstacles (rocks, uneven concrete or manholes) can cause a sudden stop. Always wear your seat belt.



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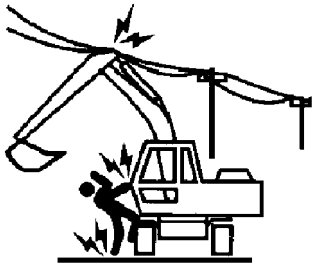

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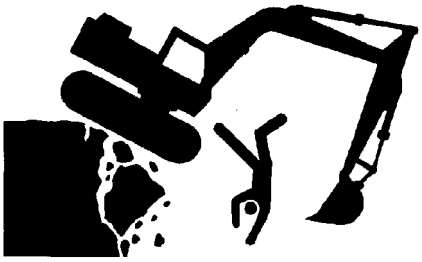

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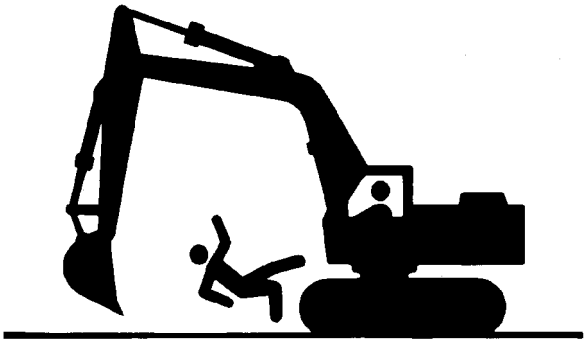
Keep Riders Off Machine

Only allow operator on machine.

Riders are subject to injury. They may fall from machine, be caught between machine parts, or be struck by foreign objects.

Riders may obstruct operator's view or impair his ability to operate machine safely.



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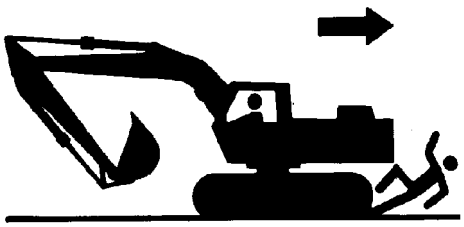
Avoid Backover Accidents



T133548 –UN–24AUG00

Before moving machine, be sure all persons are clear of both travel and swing paths. Turn around and look directly for best visibility. Use mirrors to assist in checking all around machine. Keep windows and mirrors clean, adjusted, and in good repair.

Be certain travel alarm is working properly.

Use a signal person when backing if view is obstructed or when in close quarters. Keep signal person in view at all times. Use prearranged hand signals to communicate.

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Avoid Machine Tip Over

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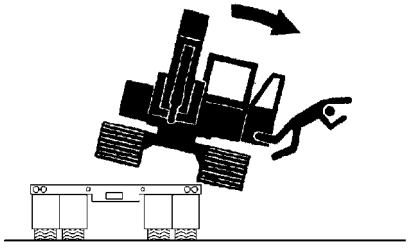
Use seat belt at all times.

Do not jump if the machine tips. You will be unlikely to jump clear and the machine may crush you.

Load and unload from trucks or trailers carefully. Be sure truck is wide enough and on a firm level surface. Use loading ramps and attach them properly to truck bed. Avoid trucks with steel beds because tracks slip more easily on steel.



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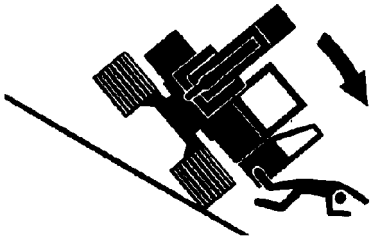
Be careful on slopes. Use extra care on soft, rocky or frozen ground. Machine may slip sideways in these conditions. When traveling up or down slopes, keep the bucket on uphill side and just above ground level.

Be careful with heavy loads. Using oversize buckets or lifting heavy objects reduces machine stability. Extending a heavy load or swinging it over side of undercarriage may cause machine to tip.



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Ensure solid footing. Use extra care when operating near banks or excavations that may cave-in and cause machine to tip or fall.

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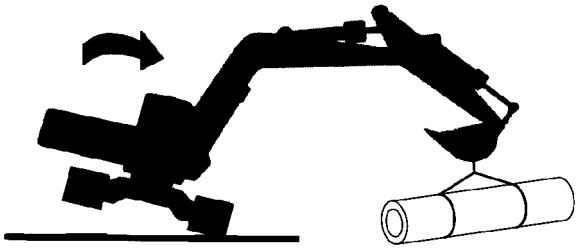
Use Special Care When Lifting Objects

Never use this machine to lift people.

Never lift a load above another person. Keep bystanders clear of all areas where a load might fall if it breaks free. Do not leave the seat when there is a raised load.

Do not exceed lift capacity limits posted on machine and in this manual. Extending heavy loads too far or swinging over undercarriage side may cause machine to tip over.

Use proper rigging to attach and stabilize loads. Be sure slings or chains have adequate capacity and are in good condition. Use tether lines to guide loads and prearranged hand signals to communicate with co-workers.



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Add and Operate Attachments Safely

Always verify compatibility of attachments by contacting your authorized dealer. Adding unapproved attachments may affect machine stability or reliability and may create a hazard for others near the machine.

Ensure that a qualified person is involved in attachment installation. Add guards to machine if operator protection is required or recommended. Verify that all connections are secure and attachment responds properly to controls.

Carefully read attachment manual and follow all instructions and warnings. In an area free of bystanders and obstructions, carefully operate attachment to learn its characteristics and range of motion.

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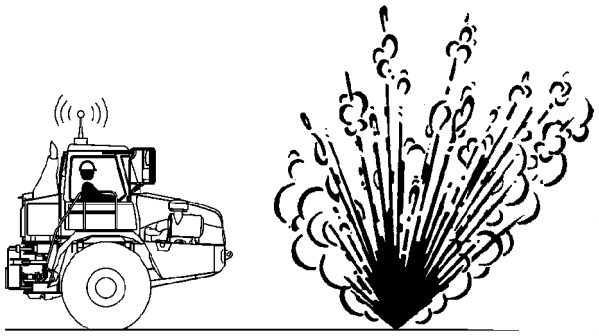
Prevent Unintended Detonation of Explosive Devices

Avoid serious injury or death from an explosion hazard. Deactivate all cellular or radio frequency devices on equipment stored or operating in an area, such as a blasting zone, where the use of radio transmitting devices are prohibited.



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Park and Prepare for Service Safely

Warn others of service work. Always park and prepare your machine for service or repair properly.

- Park machine on a level surface and lower equipment and attachments to the ground.
- Place pilot shutoff lever in “lock” position. Stop engine and remove key.
- Attach a “Do Not Operate” tag in an obvious place in the operator’s station.

Securely support machine or attachment before working under it.

- Do not support machine with boom, arm, or other hydraulically actuated attachments.
- Do not support machine with cinder blocks or wooden pieces that may crumble or crush.
- Do not support machine with a single jack or other devices that may slip out of place.

Understand service procedures before beginning repairs. Keep service area clean and dry. Use two people whenever the engine must be running for service work.

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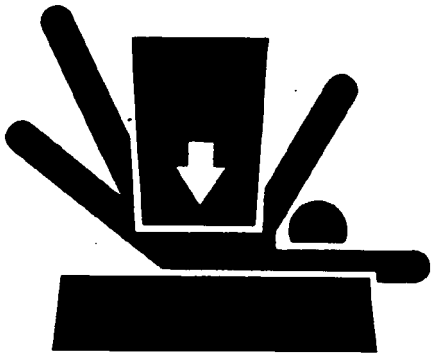

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Service Cooling System Safely

Explosive release of fluids from pressurized cooling system can cause serious burns. Shut off engine.

Do not service radiator through the radiator filler cap. Fill through the recovery tank filler cap.

CAUTION: Prevent possible injury from hot spraying water. DO NOT remove radiator filler cap unless engine is cool. Then turn cap slowly to the stop. Release all pressure before you remove cap.

If recovery tank is empty, check for leaks. Repair as required. Only remove radiator filler cap when cool enough to touch with bare hands. Slowly loosen cap to relieve pressure before removing completely. Add coolant to the radiator and the recovery tank.

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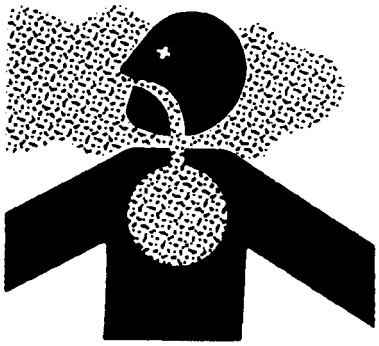
Remove Paint Before Welding or Heating



TS220 –UN–23AUG88

Avoid potentially toxic fumes and dust.

Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch.

Remove paint before heating:

- Remove paint a minimum of 100 mm (4 in.) from area to be affected by heating. If paint cannot be removed, wear an approved respirator before heating or welding.
- If you sand or grind paint, avoid breathing the dust. Wear an approved respirator.
- If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area. Allow fumes to disperse at least 15 minutes before welding or heating.

Do not use a chlorinated solvent in areas where welding will take place.

Do all work in an area that is well ventilated to carry toxic fumes and dust away.

Dispose of paint and solvent properly.

DX,PAINT –19–24JUL02–1/1

Make Welding Repairs Safely

IMPORTANT: Disable electrical power before welding. Turn off main battery switch or disconnect positive battery cable. Separate harness connectors to engine and vehicle microprocessors.

T133547 –UN–31AUG00

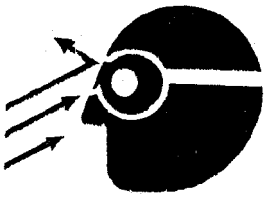
Avoid welding or heating near pressurized fluid lines. Flammable spray may result and cause severe burns if pressurized lines fail as a result of heating. Do not let heat go beyond work area to nearby pressurized lines.

Remove paint properly. Do not inhale paint dust or fumes. Use a qualified welding technician for structural repairs. Make sure there is good ventilation. Wear eye protection and protective equipment when welding.

TX03679,00016D5 –19–25APR08–1/1

Drive Metal Pins Safely

Always wear protective goggles or safety glasses and other protective equipment before striking hardened parts. Hammering hardened metal parts such as pins and bucket teeth may dislodge chips at high velocity.

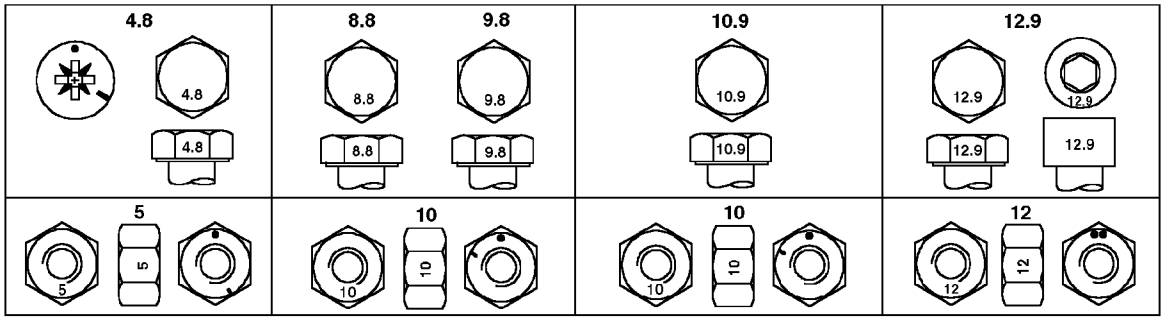


T133738 –UN–14SEP00

Use a soft hammer or a brass bar between hammer and object to prevent chipping.

TX03679,0001745 –19–03JAN07–1/1

Metric Bolt and Cap Screw Torque Values



TORQ2 –UN–07SEP99

Top—Property Class and Head Markings; Bottom—Property Class and Nut Markings

METRIC BOLT AND CAP SCREW TORQUE VALUES—Tolerance is ±10% unless otherwise specified								
	Class 4.8		Class 8.8 or 9.8		Class 10.9		Class 12.9	
Thread Size	Lubricated[a] Nm (lb-ft)	Dry[b] Nm (lb-ft)	Lubricated[a] Nm (lb-ft)	Dry[b] Nm (lb-ft)	Lubricated[a] Nm (lb-ft)	Dry[b] Nm (lb-ft)	Lubricated[a] Nm (lb-ft)	Dry[b] Nm (lb-ft)
M6	4.7 (3.5)	6 (4.4)	9 (6.6)	11.5 (8.5)	13 (9.5)	16.5 (12.2)	15.5 (11.5)	19.5 (14.5)
M8	11.5 (8.5)	14.5 (10.7)	22 (16)	28 (20.5)	32 (23.5)	40 (29.5)	37 (27.5)	47 (35)
M10	23 (17)	29 (21)	43 (32)	55 (40)	63 (46)	80 (59)	75 (55)	95 (70)
M12	40 (29.5)	50 (37)	75 (55)	95 (70)	110 (80)	140 (105)	130 (95)	165 (120)
M14	63 (46)	80 (59)	120 (88)	150 (110)	175 (130)	220 (165)	205 (150)	260 (190)
M16	100 (74)	125 (92)	190 (140)	240 (175)	275 (200)	350 (255)	320 (235)	400 (300)
M18	135 (100)	170 (125)	265 (195)	330 (245)	375 (275)	475 (350)	440 (325)	560 (410)
M20	190 (140)	245 (180)	375 (275)	475 (350)	530 (390)	675 (500)	625 (460)	790 (580)
M22	265 (195)	330 (245)	510 (375)	650 (480)	725 (535)	920 (680)	850 (625)	1080 (800)
M24	330 (245)	425 (315)	650 (480)	820 (600)	920 (680)	1150 (850)	1080 (800)	1350 (1000)
M27	490 (360)	625 (460)	950 (700)	1200 (885)	1350 (1000)	1700 (1250)	1580 (1160)	2000 (1475)
M30	660 (490)	850 (625)	1290 (950)	1630 (1200)	1850 (1350)	2300 (1700)	2140 (1580)	2700 (2000)
M33	900 (665)	1150 (850)	1750 (1300)	2200 (1625)	2500 (1850)	3150 (2325)	2900 (2150)	3700 (2730)
M36	1150 (850)	1450 (1075)	2250 (1650)	2850 (2100)	3200 (2350)	4050 (3000)	3750 (2770)	4750 (3500)

[a] *"Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings.*

[b] *"Dry" means plain or zinc plated without any lubrication.*

CAUTION: Use only metric tools on metric hardware. Other tools may not fit properly. Tool may slip and cause injury.

DO NOT use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical property class.

Fasteners should be replaced with the same or higher property class. If higher property class fasteners are used, these should only be tightened to the strength of the original.

Make sure fastener threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

OUT3035,TORQUE2 –19–19JUL04–1/1

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Additional Metric Cap Screw Torque Values

CAUTION: Use only metric tools on metric hardware. Other tools may not fit properly. They may slip and cause injury.

Check tightness of cap screws periodically. Torque values listed are for general use only. Do not use these values if a different torque value or tightening procedure is listed for a specific application.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical grade.

Fasteners should be replaced with the same or higher grade. If higher grade fasteners are used, these should only be tightened to the strength of the original.

Make sure fastener threads are clean and you properly start thread engagement. This will prevent them from failing when tightening.

Tighten cap screws having lock nuts to approximately 50 percent of amount shown in chart.

T6873AA

T6873AA –UN–18OCT88

T6873AB

T6873AB –UN–18OCT88

T6873AC

T6873AC –UN–18OCT88

Continued on next page

04T,90,M170 –19–29SEP99–1/2

METRIC CAP SCREW TORQUE VALUES[a]						
	T-Bolt		H-Bolt		M-Bolt	
Nominal Dia	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft
8	29	21	20	15	10	7
10	63	46	45	33	20	15
12	108	80	88	65	34	25
14	176	130	137	101	54	40
16	265	195	206	152	78	58
18	392	289	294	217	118	87
20	539	398	392	289	167	125
22	735	542	539	398	216	159
24	931	687	686	506	274	202
27	1372	1012	1029	759	392	289
30	1911	1410	1421	1049	539	398
33	2548	1890	1911	1410	735	542
36	3136	2314	2401	1772	931	687
[a]Torque tolerance is ±10%.						

04T,90,M170 –19–29SEP99–2/2

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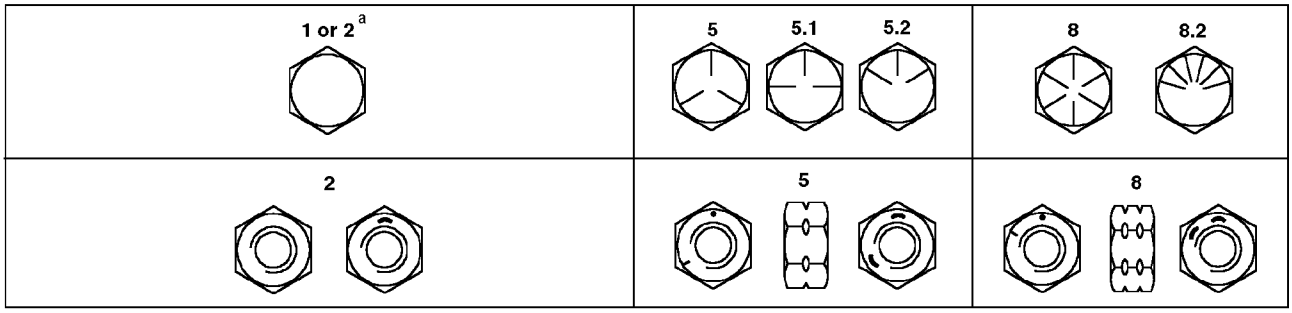
Unified Inch Bolt and Cap Screw Torque Values



Top—SAE Grade and Head Markings; Bottom—SAE Grade and Nut Markings

UNIFIED INCH BOLT AND CAP SCREW TORQUE VALUES—Tolerance is ±10% unless otherwise specified								
	Grade 1 (No Mark)		Grade 2[a] (No Mark)		Grade 5, 5.1 or 5.2		Grade 8 or 8.2	
Thread Size	Lubricated[b] Nm (lb-ft)	Dry[c] Nm (lb-ft)	Lubricated[b] Nm (lb-ft)	Dry[c] Nm (lb-ft)	Lubricated[b] Nm (lb-ft)	Dry[c] Nm (lb-ft)	Lubricated[b] Nm (lb-ft)	Dry[c] Nm (lb-ft)
1/4	3.8 (2.8)	4.7 (3.5)	6 (4.4)	7.5 (5.5)	9.5 (7)	12 (9)	13.5 (10)	17 (12.5)
5/16	7.7 (5.7)	9.8 (7.2)	12 (9)	15.5 (11.5)	19.5 (14.5)	25 (18.5)	28 (20.5)	35 (26)
3/8	13.5 (10)	17.5 (13)	22 (16)	27.5 (20)	35 (26)	44 (32.5)	49 (36)	63 (46)
7/16	22 (16)	28 (20.5)	35 (26)	44 (32.5)	56 (41)	70 (52)	80 (59)	100 (74)
1/2	34 (25)	42 (31)	53 (39)	67 (49)	85 (63)	110 (80)	120 (88)	155 (115)
9/16	48 (35.5)	60 (45)	76 (56)	95 (70)	125 (92)	155 (115)	175 (130)	220 (165)
5/8	67 (49)	85 (63)	105 (77)	135 (100)	170 (125)	215 (160)	240 (175)	305 (225)
3/4	120 (88)	150 (110)	190 (140)	240 (175)	300 (220)	380 (280)	425 (315)	540 (400)
7/8	190 (140)	240 (175)	190 (140)	240 (175)	490 (360)	615 (455)	690 (510)	870 (640)
1	285 (210)	360 (265)	285 (210)	360 (265)	730 (540)	920 (680)	1030 (760)	1300 (960)
1-1/8	400 (300)	510 (375)	400 (300)	510 (375)	910 (670)	1150 (850)	1450 (1075)	1850 (1350)
1-1/4	570 (420)	725 (535)	570 (420)	725 (535)	1280 (945)	1630 (1200)	2050 (1500)	2600 (1920)
1-3/8	750 (550)	950 (700)	750 (550)	950 (700)	1700 (1250)	2140 (1580)	2700 (2000)	3400 (2500)
1-1/2	990 (730)	1250 (930)	990 (730)	1250 (930)	2250 (1650)	2850 (2100)	3600 (2650)	4550 (3350)

[a] Grade 2 applies for hex cap screws (not hex bolts) up to 6 in. (152 mm) long. Grade 1 applies for hex cap screws over 6 in. (152 mm) long, and for all other types of bolts and screws of any length.

[b] "Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings.

[c] "Dry" means plain or zinc plated without any lubrication.

DO NOT use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical grade.

Fasteners should be replaced with the same or higher grade. If higher grade fasteners are used, these should only be tightened to the strength of the original.

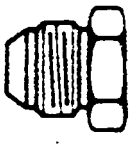
Make sure fastener threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

OUT3035,TORQUE1 –19–14JAN04–1/1

Service Recommendations for 37° Flare and 30° Cone Seat Connectors

1. Inspect flare and flare seat. They must be free of dirt or obvious defects.
2. Defects in tube flare cannot be repaired. Overtightening a defective flared fitting will not stop leaks.
3. Align tube with fitting before attempting to start nut.
4. Lubricate male threads with hydraulic fluid or petroleum jelly.
5. Index angle fittings and tighten by hand.
6. Tighten fitting or nut to torque value shown on torque chart. Do not allow hoses to twist when tightening fittings.



T6234AC –UN–18OCT88

STRAIGHT FITTING OR SPECIAL NUT TORQUE CHART		
Thread Size	**N•m**	**lb-ft**
3/8 - 24 UNF	8	6
7/16 - 20 UNF	12	9
1/2 - 20 UNF	16	12
9/16 - 18 UNF	24	18
3/4 - 16 UNF	46	34
7/8 - 14 UNF	62	46
1-1/16 - 12 UN	102	75
1-3/16 - 12 UN	122	90
1-5/16 - 12 UN	142	105
1-5/8 - 12	190	140
1-7/8 - 12 UN	217	160
NOTE: Torque tolerance is ± 10%.		

T82,BHMA,EL –19–29SEP99–1/1

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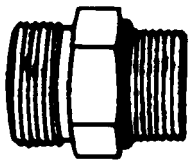
Service Recommendations for O-Ring Boss Fittings

Straight Fitting

1. Inspect O-ring boss seat for dirt or defects.
2. Lubricate O-ring with petroleum jelly. Place electrical tape over threads to protect O-ring. Slide O-ring over tape and into O-ring groove of fitting. Remove tape.
3. Tighten fitting to torque value shown on chart.



T6243AE –UN–18OCT88

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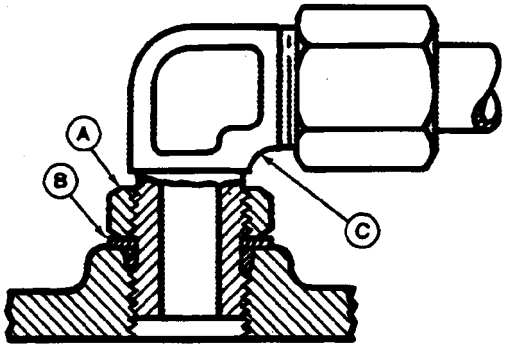
04T,90,K66 –19–29SEP99–1/2

Angle Fitting

1. Back-off lock nut (A) and back-up washer (B) completely to head-end (C) of fitting.
2. Turn fitting into threaded boss until back-up washer contacts face of boss.
3. Turn fitting head-end counterclockwise to proper index (maximum of one turn).

NOTE: Do not allow hoses to twist when tightening fittings.

4. Hold fitting head-end with a wrench and tighten locknut and back-up washer to proper torque value.



T6520AB –UN–18OCT88

STRAIGHT FITTING OR SPECIAL NUT TORQUE CHART		
Thread Size	**N•m**	**lb-ft**
3/8-24 UNF	8	6
7/16-20 UNF	12	9
1/2-20 UNF	16	12
9/16-18 UNF	24	18
3/4-16 UNF	46	34
7/8-14 UNF	62	46
1-1/16-12 UN	102	75
1-3/16-12 UN	122	90
1-5/16-12 UN	142	105
1-5/8-12 UN	190	140
1-7/8-12 UN	217	160
NOTE: Torque tolerance is ± 10%.		

04T,90,K66 –19–29SEP99–2/2

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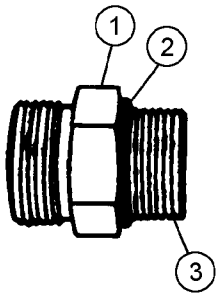
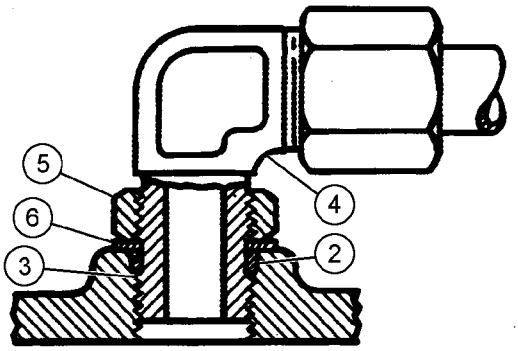
O-Ring Boss Fittings In Aluminum Housing Service Recommendations—Excavators





T196315

T196315 –UN–17NOV03

O-Ring Boss Straight and Adjustable Fittings

1—Straight Fitting
2—O-Ring
3—Stud End
4—Adjustable Fitting
5—Hex Nut
6—Backup Washer

O-RING BOSS STRAIGHT OR ADJUSTABLE FITTING STUD END NUT WITH METRIC THREAD IN ALUMINUM HOUSING TORQUE VALUES—Tolerance is ± 10% unless otherwise specified		
Thread Size mm	**Hex Nut Size mm**	**Nm (lb-ft)**
M12 x 1.5	17	39 (29)
M14 x 1.5	19	39 (29)
M16 x 1.5	22	55 (41)
M22 x 1.5	27	75 (55)
M27 x 2	32	110 (81)
M30 x 2	36	141 (104)
M33 x 2	41	165 (122)
M38 x 2	46	165 (122)
M42 x 2	50	275 (203)

Continued on next page

O-RING BOSS STRAIGHT OR ADJUSTABLE FITTING STUD END NUT WITH INCH THREAD IN ALUMINUM HOUSING TORQUE VALUES—Tolerance is ± 10% unless otherwise specified	
Thread Size in.	**Nm (lb-ft)**
1/8	—
1/4	28 (20)
3/8	39 (29)
1/2	75 (55)
3/4	126 (93)
1	165 (122)
1-1/8	—
1-1/4	259 (191)
1-3/8	—
1-1/2	330 (243)
1-3/4	—
2	—

O-RING BOSS PLUG STUD END WITH INCH THREAD IN ALUMINUM HOUSING TORQUE VALUES—Tolerance is ± 10% unless otherwise specified	
Thread Size in.	**Nm (lb-ft)**
1/8	7.8 (5.80)
1/4	11.8 (8.70)
3/8	23 (17)
1/2	39 (29)
3/4	55 (41)
1	86 (64)
1-1/4	126 (93)
1-1/2	157 (116)
2	204 (150)

1. Inspect fitting and O-ring boss sealing surfaces and the O-ring. They must be free of dirt, scratches, nicks, or burrs. O-ring must be free of dirt, cuts, cracks, swelling or flatten condition.
2. Back the stud end hex nut (5) off as far as possible. Push backup washer (6) towards the nut to fully expose the turn down section of stud end. Washer must fit turned down section and not be too loose
3. Wrap electrical tape over threads to protect O-ring. Slide O-ring over the tape into turned down section. Remove tape. Apply hydraulic oil to the threads of stud end, turned down section, and O-ring.
4. Turn fitting into the boss by hand until face of nut or backup washer squeezes O-ring into the seat and contacts face of boss. Loosen an adjustable fitting no more than one turn for alignment.
5. Tighten straight fitting or hex nut to the torque value given. Hold body of adjustable fitting using a second wrench when tightening hex nut.

OUT3035,0000353 –19–14JAN04–2/2

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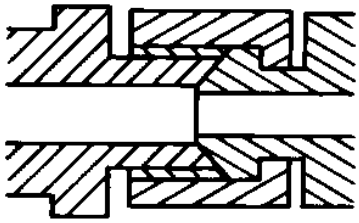
Service Recommendations For Flared Connections—Straight or Tapered Threads

1. Inspect flare and flare seat. They must be free of dirt or obvious defects.
2. Defects in the tube flare cannot be repaired. Overtightening a defective flared fitting will not stop leaks.
3. Align the tube with the fitting before attempting to start the nut.
4. Lubricate the male threads with hydraulic fluid or petroleum jelly.
5. Index angle fittings and tighten by hand.
6. Tighten fitting or nut to torque value shown on the chart. Do not allow hoses to twist when tightening fittings.

TORQUE CHART [a]				
	Straight Thread [b]		Tapered Thread	
Thread Size	N•m	lb-ft	N•m	lb-ft
1/8	15	11		
1/4	20	15	45	33
3/8	29	21	69	51
1/2	49	36	93	69
3/4	69	51	176	130
1	157	116	343	253
1-1/2	196	145	539	398
2	255	188	588	434
[a]Torque tolerance is ±10%.				
[b]With seat face.				

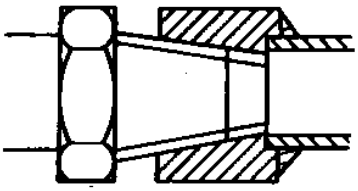
NOTE: If female thread is cast iron (control valves, brake valves motors, etc.), torque must be reduced approximately 10%.



T6873AE

T6873AE –UN–18OCT88

Straight Thread



T6873AD

T6873AD –UN–18OCT88

Tapered Thread

04T,90,M171 –19–28JAN92–1/1

Service Recommendations For Flat Face O-Ring Seal Fittings

1. Inspect the fitting sealing surfaces and O-ring. They must be free of dirt or defects.
2. Lubricate O-rings and install into grove using petroleum jelly to hold in place.
3. Index angle fittings and tighten by hand pressing joint together to insure O-ring remains in place.
4. Tighten fitting or nut to torque value shown on the chart. Do not allow hoses to twist when tightening fittings, use backup wrench on straight hose couplings.

IMPORTANT: Tighten fittings to 150% of listed torque value if indexing is necessary or if fitting is attached to an actuating devise.

Tighten fittings to 50% of listed torque value if used in aluminum housing.

FLAT FACE O-RING SEAL FITTING TORQUE*						
Nomial Tube O.D.		Thread Size	Swivel Nut		Bulkhead Nut	
mm	in.	in.	N•m	lb-ft	N•m	lb-ft
6.35	0.250	9/16-18	16	12	12	9
9.52	0.375	11/16-16	24	18	24	18
12.70	0.500	13/16-16	50	37	46	34
15.88	0.625	1-14	69	51	62	46
19.05	0.750	1 3/16-12	102	75	102	75
22.22	0.875	1 3/16-12	102	75	102	75
25.40	1.000	1 7/16-12	142	105	142	105
31.75	1.250	1 11/16-12	190	140	190	140
38.10	1.500	2-12	217	160	217	160
*Torque tolerance is +15 -20% unless otherwise specified.						

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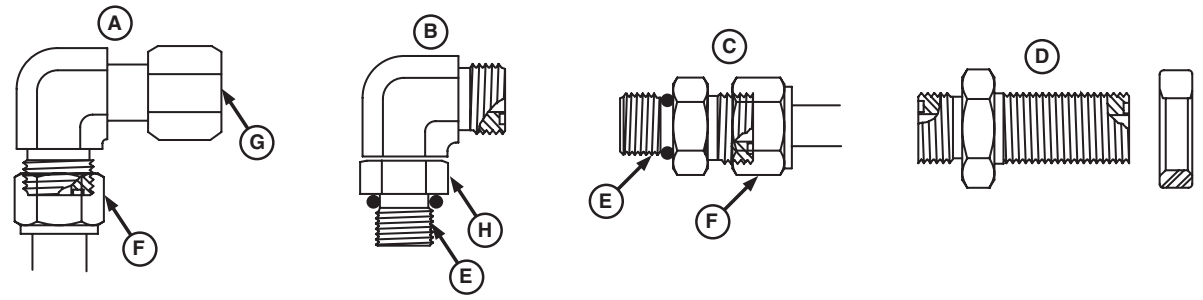
Stud End O-ring Seal Torque for Straight and Adjustable Fittings*				
Thread Size	**Straight Hex Size**	**Locknut Hex Size**	**Straight Fitting or Locknut Toque**	
Inch	**Inch**	**Inch**	**N•m**	**lb-ft**
3/8-24	5/8	9/16	12	9
7/16-20	5/8	5/8	21	15
1/2-20	3/4	11/16	26	19
9/16-18	3/4	3/4	34	25
3/4-16	7/8	15/16	73	55
7/8-14	1 1/16	1 1/16	104	76
1 1/16-12	1 1/4	1 3/8	176	130
1 3/16-12	1 3/8	1 1/2	230	170
1 5/16-12	1 1/2	1 5/8	285	210
*Torque tolerance is +15 -20% unless otherwise specified.				

OUO6092,00010A4 –19–02JAN08–2/2

O-Ring Face Seal Fittings With SAE Inch Hex Nut And Stud End For High Pressure Service Recommendations



H70406 –UN–12DEC01

A—90° Swivel Elbow and Tube Nut
B—90° Adjustable Stud Elbow
C—Stud Straight and Tube Nut
D—Bulkhead Union and Nut
E—Stud End
F—Tube Nut
G—Swivel Nut
H—Hex Nut

O-RING FACE SEAL FITTINGS WITH SAE INCH HEX NUT AND STUD END FOR HIGH PRESSURE, ABOVE 27 600 kPa (276 bar) (4000 psi), TORQUE VALUES—Tolerance is +15 -20% unless otherwise specified

Nominal Tube OD or Hose ID			O-Ring Face Seal Hose or Tube Swivel Nut			Bulkhead Nut	
Metric Tube OD	Inch Tube OD or Hose ID		Thread Size	Hex Size	Torque	Hex Size	Torque
mm	Dash Size	mm (in.)	in.	in.	Nm (lb-ft)	in.	Nm (lb-ft)
5	-3	4.78 (0.188)	—	—	—	—	—
6	-4	6.35 (0.250)	9/16-18	11/16	24 (18)	13/16	32 (24)
8	-5	7.92 (0.312)	—	—	—	—	—
10	-6	9.53 (0.375)	11/16-16	13/16	37 (27)	1	42 (31)
12	-8	12.70 (0.500)	13/16-16	15/16	75 (55)	1-1/8	93 (69)
16	-10	15.88 (0.625)	1-14	1-1/8	103 (76)	1-5/16	118 (87)
20	-12	19.05 (0.750)	1-3/16-12	1-3/8	152 (112)	1-1/2	175 (129)
22	-14	22.23 (0.875)	1-3/16-12	—	152 (112)	—	175 (129)
25	-16	25.40 (1.000)	1-7/16-12	1-5/8	214 (158)	1-3/4	247 (182)
32	-20	31.75 (1.250)	1-11/16-12	1-7/8	286 (211)	2	328 (242)
38	-24	38.10 (1.500)	2-12	2-1/4	326 (240)	2-3/8	374 (276)

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O-RING STRAIGHT, ADJUSTABLE, AND EXTERNAL HEX PLUG WITH SAE INCH STUD END FOR HIGH PRESSURE, ABOVE 27 600 kPa (276 bar) (4000 psi), TORQUE VALUES—Tolerance is +15 -20% unless otherwise specified			
Thread Size	**Straight Hex Size[a]**	**Adjustable Nut Hex Size**	**Steel or Gray Iron Torque**
in.	**in.**	**in.**	**Nm (lb-ft)**
3/8-24	5/8	9/16	18 (13)
7/16-20	5/8	5/8	24 (18)
1/2-20	3/4	11/16	30 (22)
9/16-18	3/4	3/4	37 (27)
3/4-16	7/8	15/16	75 (55)
7/8-14	1-1/16	1-1/16	103 (76)
1-1/16-12	1-1/4	1-3/8	177 (131)
1-3/16-12	1-3/8	1-1/2	231 (170)
1-5/16-12	1-1/2	1-5/8	270 (199)
1-5/8-12	1-3/4	1-7/8	286 (211)
1-7/8-12	2-1/8	2-1/8	326 (240)
[a] Straight hex size applies to fittings only and may not be the same as the corresponding plug of the same thread size.			

1. Inspect fitting and connector sealing surfaces and the O-rings. They must be free of dirt, scratches, nicks, and burrs. O-ring must be free of dirt, cuts, cracks, swelling or flatten condition.

2. Back the stud end hex nut off as far as possible. Push backup washer towards the nut to fully expose the turn down section. Washer must fit turned down section and not be too loose

3. Lubricate O-rings using a thin film of clean hydraulic oil or as needed, petroleum jelly to hold O-ring in place.

   Install O-ring into groove making sure it is seated at the bottom. Excess petroleum jelly will prevent seating of O-ring and cause it to pop out.

   To protect an O-ring from threads, wrap electrical tape over the threads. Slide O-ring over the tape into the turned down section. Remove the tape.

4. Turn fitting into the boss by hand until face of nut or washer squeezes the O-ring into the seat and contacts face of boss. Loosen adjustable fittings no more than one turn for alignment.

   Hold connections together while tightening nut to ensure O-ring remains in place.

5. Tighten fitting or nut to torque value shown. Use a second wrench to hold the fitting in position or to keep hose from twisting while tightening nut.

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