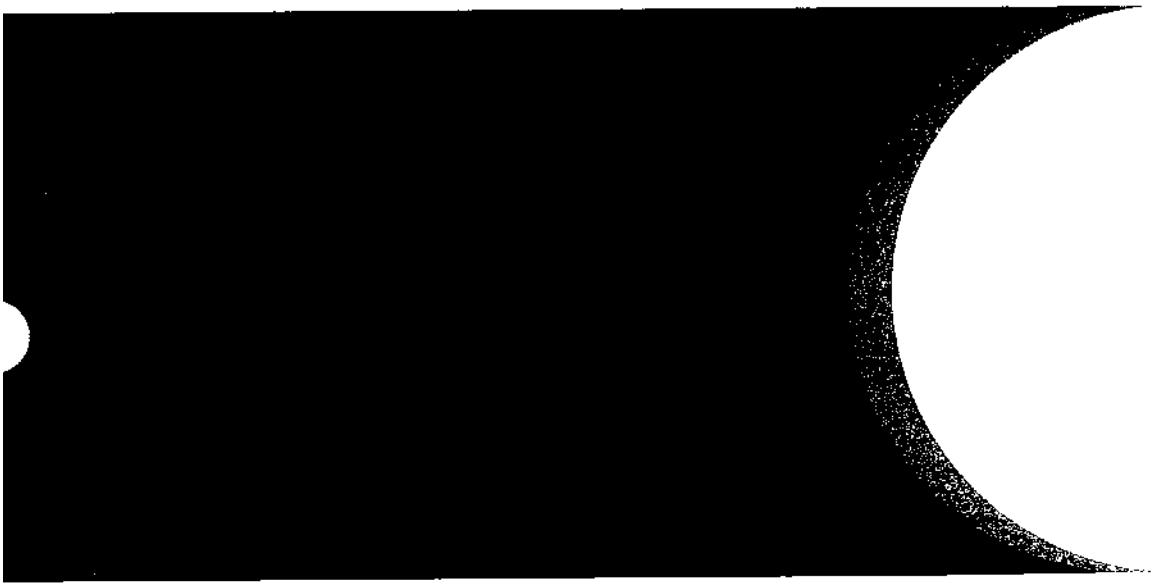
John Deere
540D Skidder
548D Grapple Skidder
Repair



TECHNICAL MANUAL

TM-1438 (Apr-88)

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 diagnostics. Repair sections tell how to repair the components. Diagnostic 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.

Binders, binder labels, and tab sets can be ordered by John Deere dealers direct from the John Deere Distribution Service Center.

This manual is part of a total product support program.

FOS Manuals-reference

Technical Manuals-machine service

Component Manuals-component service

Fundamentals of Service (FOS) Manuals cover basic theory of operation, fundamentals of troubleshooting, general maintenance, and basic types of failures and their causes. FOS Manuals are for training new personnel and for reference by experienced technicians.

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

Component Technical Manuals are concise service guides for specific components. Component technicals manuals are written as stand-alone manuals covering multiple machine applications.

053;TMIFC 190188

JOHN DEERE DEALERS

IMPORTANT: Please remove this page and route through your service department.

This is a complete revision for TM-1438, 540D Skidder and 548D Grapple Skidder.

Binder and tabs from old manual may be saved and used with this bound manual.

The new pages are dated (Apr-88). Listed below is a brief explanation of "WHAT" was changed and "WHY" it was changed.

This manual was revised:

1. Inspection procedure group added in Section I.
2. Repair story for seals in oscillating support.
3. Cross section drawing of planetary pack added.
4. Engine repair story is removed. For complete repair information, see the component technical manual.
5. Repair story for new park brake seals and installation of seals with brake on unit.
6. Main pump repair story is removed. For complete repair information see the component technical manual.
7. Artwork for blade and grapple control valve revised to include external seal design for the spools.
8. Pressure control valve (priority valve) setting change to 8600 ± 345 kPa (85 ± 3.4 bar) (1250 ± 50 psi).
9. General updating.

T64;TM1438 DCS 250588

540D SKIDDER
548D GRAPPLE SKIDDER
TECHNICAL MANUAL
TM-1438 (APR-88)

SECTION AND GROUP CONTENTS

NOTE: This manual covers repair. For operation and tests, see TM-1439, Operation and Tests.

Continued on next page

All information, illustrations and specifications contained in this technical 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.

T64;1438 M1 250588

T64;1438 M2 250588

HANDLE FLUIDS SAFELY—AVOID FIRES

When you work around fuel, do not smoke or work near heaters or other fire hazards.

Store flammable fluids away from fire hazards. Do not incinerate or puncture pressurized containers.

Make sure machine is clean of trash, grease, and debris.

Do not store oily rags; they can ignite and burn spontaneously.

AB6;TS227 053;FLAME 050188

PREVENT BATTERY EXPLOSIONS

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

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

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

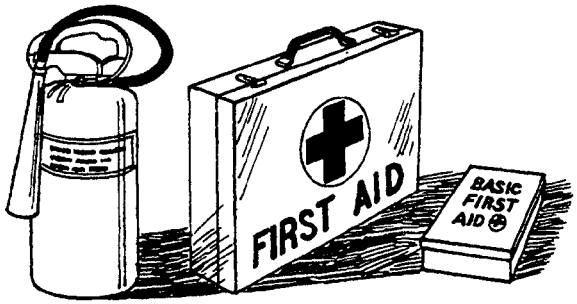
ABT;TS204 053;SPARKS 050188

PREPARE FOR EMERGENCIES

Be prepared if 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.



AB6;TS186 053;FIRE2 080785

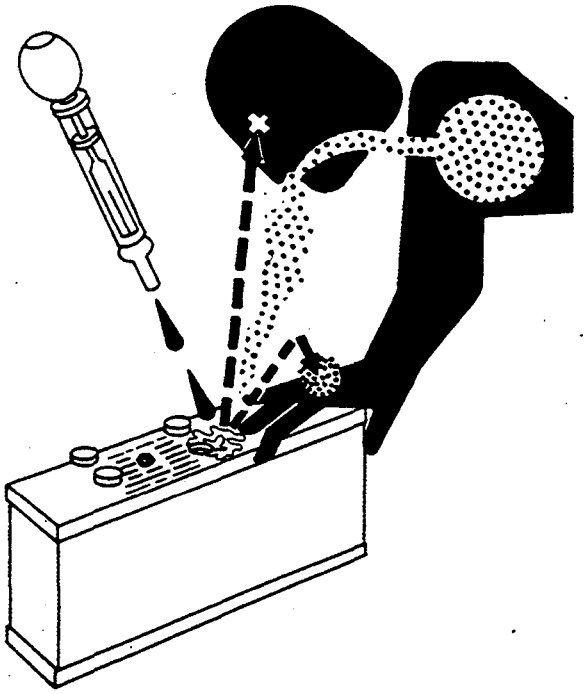
PREVENT ACID BURNS

Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into eyes.

Avoid the hazard by:
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling or dripping electrolyte.
5. Use proper jump start procedure.

If you spill acid on yourself:
1. Flush your skin with water.
2. Apply baking soda or lime to help neutralize the acid.
3. Flush your eyes with water for 10-15 minutes. Get medical attention immediately.

If acid is swallowed:
1. Drink large amounts of water or milk.
2. Then drink milk of magnesia, beaten eggs, or vegetable oil.
3. Get medical attention immediately.

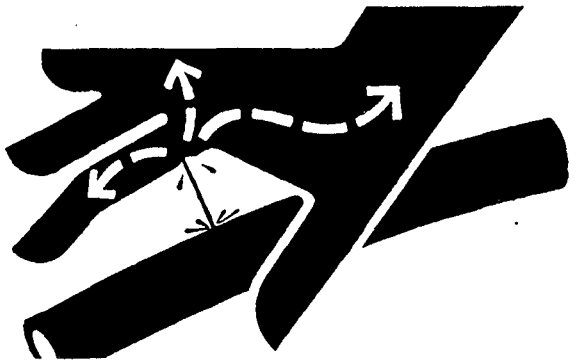


AB6;TS203 053;POISON 211287

AVOID HIGH-PRESSURE FLUIDS

Escaping fluid under pressure can penetrate the skin causing serious injury. Relieve pressure before unhooking hydraulic or other lines. Tighten all connections before applying pressure. Keep hands and body away from pinholes and nozzles which eject fluids under high pressure. Use a piece of cardboard to search for leaks.

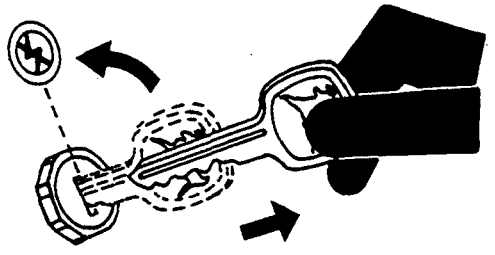
If ANY fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type injury or gangrene may result.



AB6;X9811 053;FLUID 180987

PARK MACHINE SAFELY

Before working on the machine:
- Lower all equipment to the ground.
- Stop the engine and remove the key.
- Disconnect the battery ground strap.
- Hang a "DO NOT OPERATE" tag in operator station.

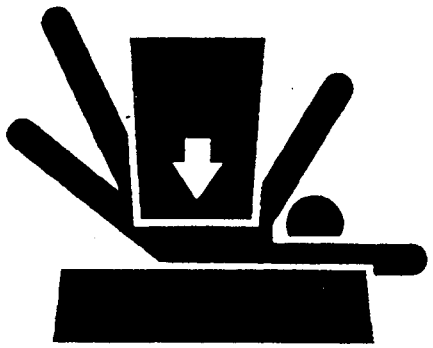


AB6;TS230 053;PARK 050188

SUPPORT MACHINE PROPERLY

Always lower the attachment or implement to the ground before you work on the machine. If you must work on a lifted machine or attachment, securely support the machine or attachment.

Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under continuous load. Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.



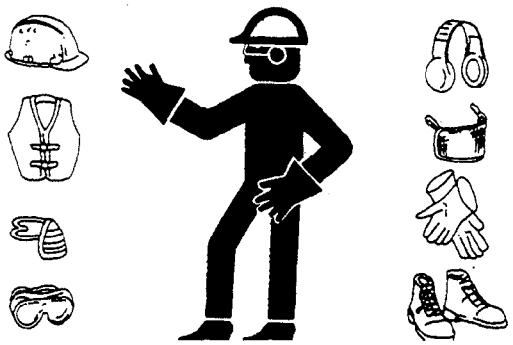
AB6;TS229 053;LOWER 211287

WEAR PROTECTIVE CLOTHING

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

Prolonged exposure to loud noise can cause impairment or loss of hearing.

Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.

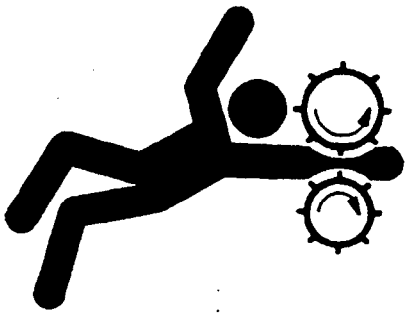


AB6;TS206 053;WEAR 230487

SERVICE MACHINE SAFELY

Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing, or necklace when you work near machine tools or moving parts. If these items were to get caught, severe injury could result.

Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.



AB6;TS228 053;LOOSE 211287

WORK IN VENTILATED AREA

Engine exhaust fumes can cause sickness or death. If it is necessary to run an engine in an enclosed area, remove the exhaust fumes from the area with an exhaust pipe extension.

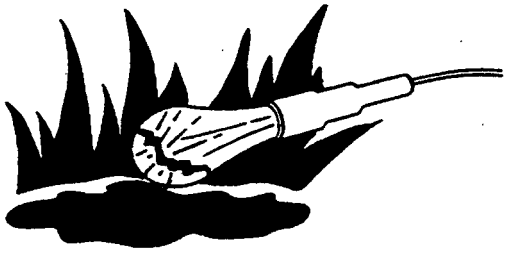
If you do not have an exhaust pipe extension, open the doors and get outside air into the area.

AB6;TS220 053;AIR 050188

UNDERSTAND CORRECT SERVICE

Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

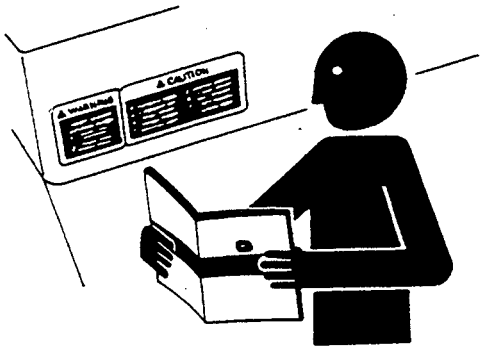
Catch draining fuel, oil, or other fluids in suitable containers. Do not use food or beverage containers that may mislead someone into drinking from them. Wipe up spills at once.



AB6;TS223 053;LIGHT 230288

REPLACE SAFETY SIGNS

Replace missing or damaged safety signs. See the machine operator's manual for correct safety sign placement.

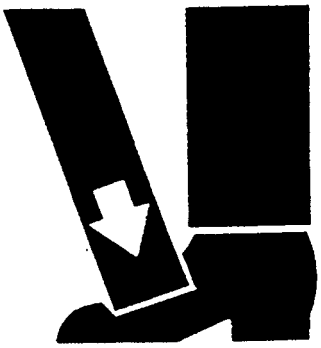


AB6;TS201 053;SIGNS1 221287

USE PROPER LIFTING EQUIPMENT

Lifting heavy components incorrectly can cause severe injury or machine damage.

Follow recommended procedure for removal and installation of components in the manual.

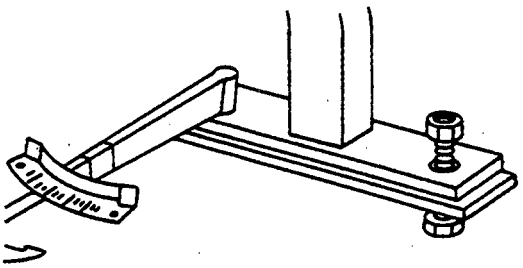


AB6;TS226 053;LIFT 050188

KEEP ROPS INSTALLED PROPERLY

Make certain all parts are reinstalled correctly if the roll-over protective structure (ROPS) is loosened or removed for any reason. Tighten mounting bolts to proper torque.

The protection offered by ROPS will be impaired if ROPS is subjected to structural damage, is involved in an overturn incident, or is in any way altered by welding, bending, drilling, or cutting. A damaged ROPS should be replaced, not reused.



AB6;TS212 053;ROPS3 230487

SERVICE TIRES SAFELY

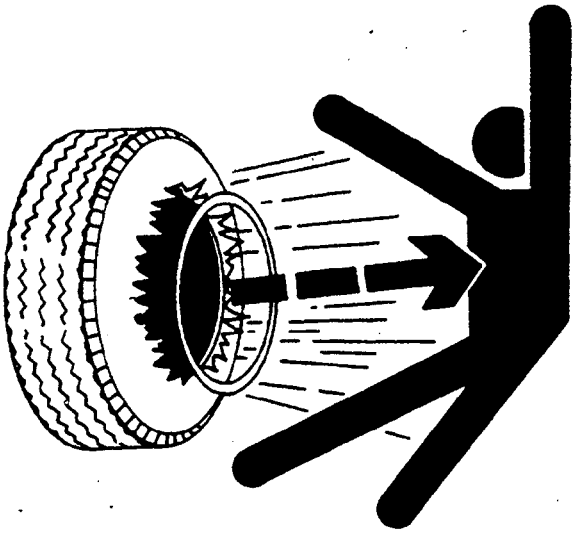
Explosive separation of a tire and rim parts can cause serious injury or death.

Do not attempt to mount a tire unless you have the proper equipment and experience to perform the job.

Always maintain the correct tire pressure. Do not inflate the tires above the recommended pressure.

When inflating tires, use a clip-on chuck and extension hose long enough to allow you to stand to one side and NOT in front of or over the tire assembly. Use a safety cage if available.

Check wheels for low pressure, cuts, bubbles, damaged rims or missing lug bolts and nuts.



AB6;TS211 053;RIM 211287

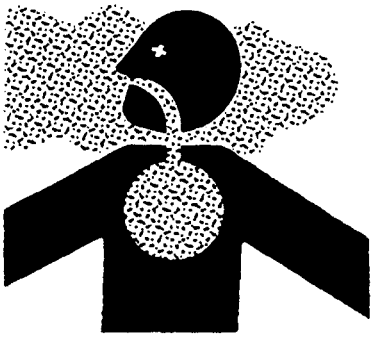
AVOID HARMFUL ASBESTOS DUST

Avoid breathing dust that may be generated when handling components containing asbestos fibers. Inhaled asbestos fibers may cause lung cancer.

Components in John Deere products that may contain asbestos fibers are brake pads, brake band and lining assemblies, clutch plates, and some gaskets. The asbestos used in these components is usually found in a resin or sealed in some way. Normal handling is not hazardous as long as airborne dust containing asbestos is not generated.

Avoid creating dust. Never use compressed air for cleaning. Avoid brushing or grinding of asbestos containing materials. When servicing, wear an approved respirator. A special vacuum cleaner is recommended to clean asbestos. If not available, wet the asbestos containing materials with a mist of oil or water.

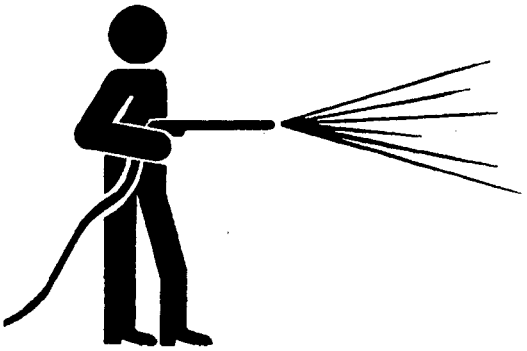
Keep bystanders away from the area.



AB6;TS220 053;DUST 140488

WORK IN CLEAN AREA

Before starting a job:
- Clean work area and machine.
- Make sure you have all necessary tools to do your job.
- Have the right parts on hand.
- Read all instructions thoroughly; do not attempt shortcuts.



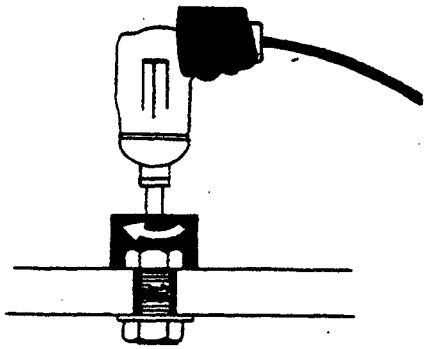
AB6;T6642E J 053;CLEAN 190188

USE TOOLS PROPERLY

Use tools appropriate to the work. Makeshift tools, parts, and procedures will not make good repairs.

Use pneumatic and electric tools only to loosen threaded parts and fasteners. Never use such tools to tighten fasteners, especially on light alloy parts.

Use only replacement parts meeting John Deere specifications.

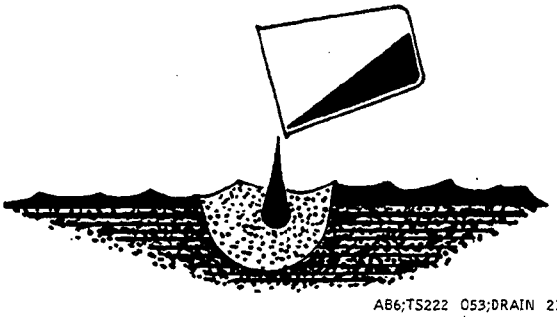


AB6;TS221 053;REPAIR 211287

DISPOSE FLUIDS PROPERLY

Be mindful of the environment and ecology. Before you drain fluids, find out the proper way to dispose of the oil.

Do not pour oil onto the ground, down a drain, or into a stream, pond, or lake. Consult local ordinances that govern the disposal of wastes.



AB6;TS222 053;DRAIN 211287

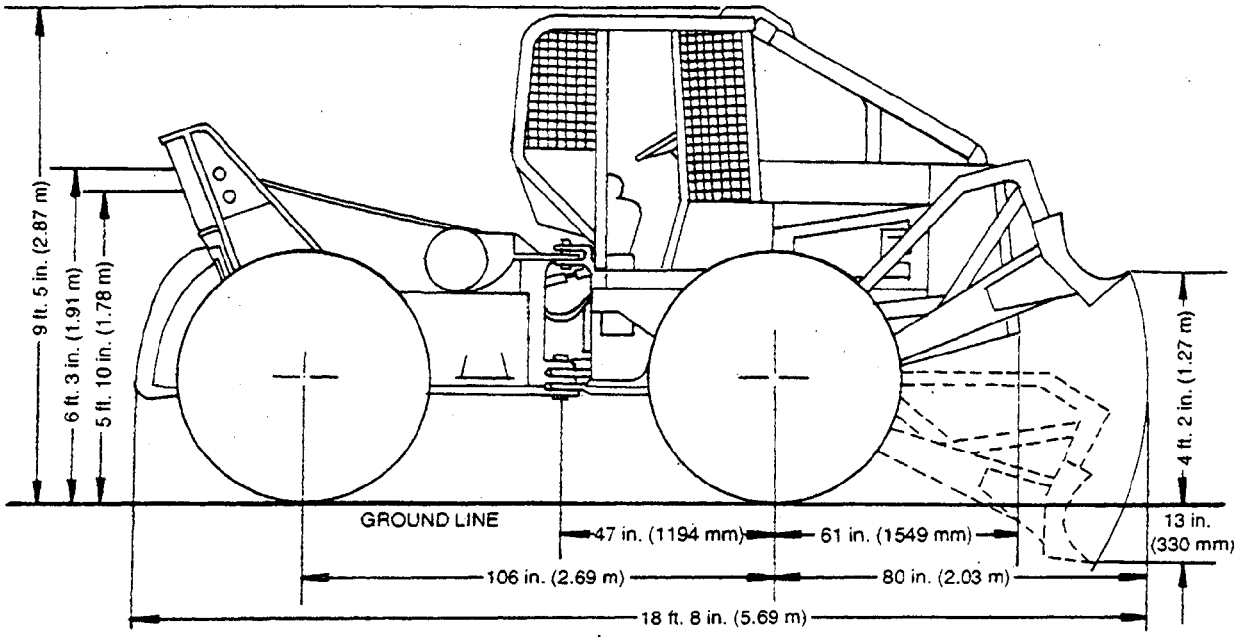
LIVE WITH SAFETY

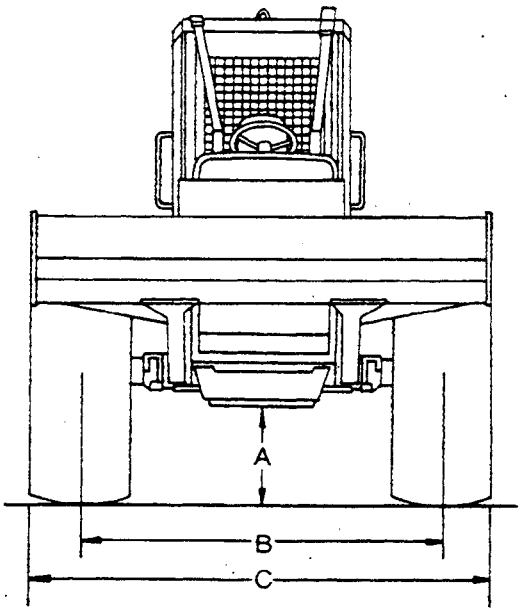
Before returning machine to customer, make sure machine is functioning properly, especially the safety systems. Install all guards and shields.

AB6;TS231 053;LIVE 050188

540D SKIDDER

NOTE: Machine equipped with 18.4 x 26 tires and adjustable arch.





TIRE SIZE	A GROUND CLEARANCE	B WHEEL TREAD	C OVERALL WIDTH
18.4-26	1 ft. 6.5 in. (470 mm)	76 in. (1.93 m)	7 ft. 11 in. (2.41 m)
18.4-34	1 ft. 10 in. (559 mm)	76.6 in. (1.95 m)	7 ft. 11 in. (2.41 m)
23.1-26	1 ft. 9 in. (533 mm)	82.1 in. (2.09 m)	8 ft. 10 in. (2.69 m)
28L-26	1 ft. 9.5 in. (546 mm)	85.4 in. (2.17 m)	9 ft. 6 in. (2.90 m)

87A;T6793AE 05T;115 K61 120488

540D SKIDDER—CONTINUED

Specifications and design subject to change without notice. Wherever applicable, specifications are in accordance with SAE Standards. Except where otherwise noted, these specifications are based on a unit with 18.4-26, 10 PR tires, full fuel tank, 175-lb. (80 kg) operator and standard equipment.

Rated Power @ 2200 rpm:	**SAE**	**DIN 70 020**
Net	100 hp (75 kW)	75 kW
Gross	105 hp (78 kW)	

Net engine power is with standard equipment including air cleaner, exhaust system, alternator, and cooling fan, at standard conditions per SAE J1349 and DIN 70 020, using No.2-D fuel @ 35 API gravity. No derating is required up to 10,000 feet (3050 m) altitude. Gross power is without cooling fan.

Engine: John Deere 4-276T

Type	4-stroke cycle, turbocharged diesel
Bore and stroke	4.19 x 5.00 in. (106.5 x 127 mm)
No. of cylinders	4
Displacement	276 cu. in. (4.524 L)
Maximum net torque @ 1300 rpm	290 lb-ft (393 Nm) (40 kg-m)
Cooling fan	Blower
Compression ratio	16.8 to 1
Lubrication	Pressure system w/full-flow filter
Electrical system	12-volt w/42 amp alternator
Battery	Reserve capacity: 180 minutes

Differentials:
Front and rear ..... Full differentials w/hydraulic lock

Engine Clutch Disconnect:
Hand-operated, spring-loaded, dry disk. Single plate, 12 in. (305 mm).

Transmission:
Power Shift with planetary gears, hydraulically actuated wet-disk clutches and brakes; provides 8 speeds forward—4 reverse. Controlled by single lever on console.

Travel Speeds (2200 engine rpm, no tire slip):

	mph	**km/h**
Forward	1.6-17.4	2.6-28.0
Reverse	2.1-5.8	3.4-9.3

Drive Axles:
Four-wheel drive with inboard planetary gears on all axles. Front axle oscillates 15 degrees above and below horizontal. Travel at tire center line 20 in. (508 mm).

Steering: Power
Articulated frame hydraulically actuated by two double-acting cylinders with cushioned stops. Steering system has hydraulic pressure priority.

Outside clearance circle w/o blade	34 ft. 4 in. (10.46 m)
Outside clearance circle w/blade	35 ft. 0 in. (10.67 m)

Brakes:
Service ..... Hydraulic, power-actuated, pedal-controlled wet disk brakes located in axle.
Parking, winching and emergency stop ..... Hand-operated mechanical wet-disk brake located on driveline for braking front and rear axles. Hydraulic release.

Hydraulic System:
Closed center, constant pressure. Variable-displacement pump driven from crankshaft ..... 25 gpm (95 L/min), 2000 psi (13 790 kPa) (140.6 kg/cm²) @ 2200 engine rpm. Full-flow filtration. Oil-to-air cooler.

Hydraulic Cylinders:	**Rod Dia.**	**Bore**	**Stroke**
Blade lift cylinders (2)	1.50 in. (38.1 mm)	3.50 in. (89 mm)	14.25 in. (362 mm)
Steering cylinders (2)	1.75 in. (44.5 mm)	2.75 in. (70 mm)	14.37 in. (365 mm)

Cylinder rods are ground, heat-treated, chrome-plated and polished.

Blade: Hydraulic control

Width	6 ft. 11 in. (2.11 m)
Max. lift above ground level	4 ft. 2 in. (1.27 m)
Max. drop below ground level	13 in. (330 mm)
Height (ends)	1 ft. 9 in. (533 mm)
Height (center)	2 ft. 3 in. (686 mm)

Cable Arch:

Horizontal roller	6 in. (152 mm) dia.
Vertical rollers (through-hardened steel)	4.5 in. (114 mm) dia.
Working height settings (top of horizontal roller to ground):	
Lower	5 ft. 10 in. (1.78 m)
Upper	6 ft. 3 in. (1.91 m)

Winch:
Live mechanical drive; hydraulically actuated clutch and brakes, single lever control.
Winch capacities*

½-in. (12.7 mm) cable	223 ft. (68 m)
⅝-in. (15.8 mm) cable	146 ft. (45 m)
¾-in. (19.1 mm) cable	103 ft. (31.4 m)

*Calculated—no allowance made for loose or uneven spooling.

Linepull:**

Bare drum	26,700 lb. (119 kN) (12 100 kg)
Full drum	18,100 lb. (81 kN) (8200 kg)

**Based on winch clutch capacity and .75 in. (19 mm) cable.

Line speed (2200 rpm) and .75 in. (19 mm) cable:

Bare drum	126 fpm (38.3 m/min)
Full drum	176 fpm (53.6 m/min)

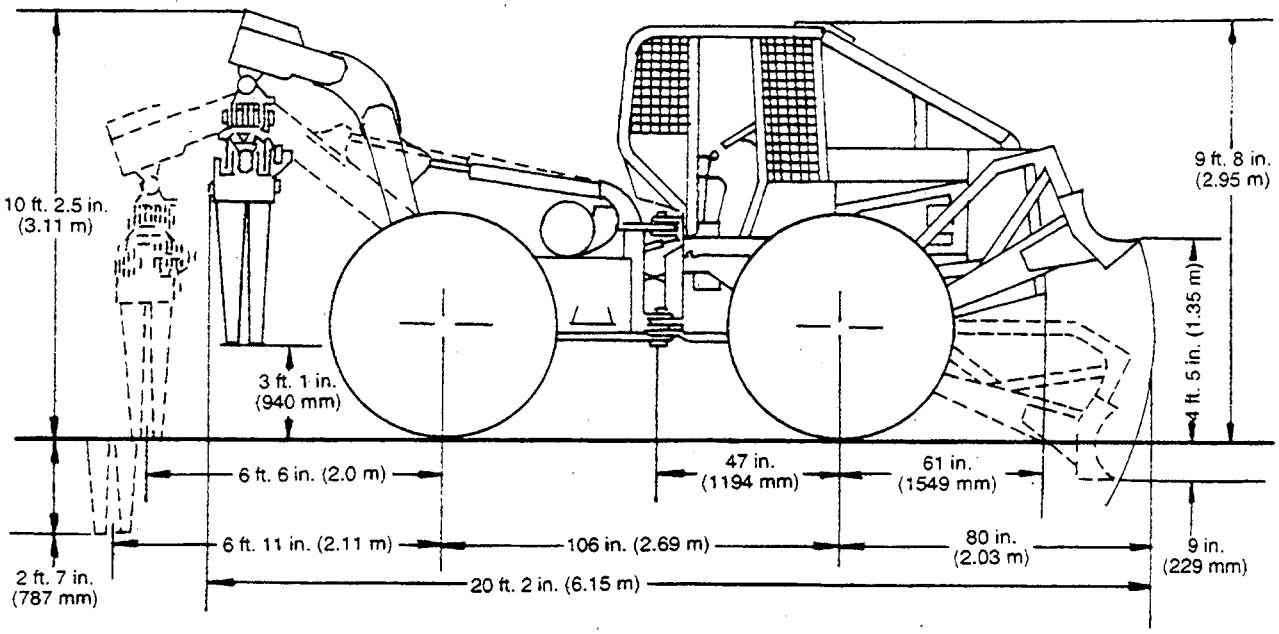
Tires:
18.4-26, 10 PR, steel-ply, LS2
18.4-34, 10 PR, steel-ply, LS2
23.1-26, 10 PR, steel-ply, LS2
28L-26, 10 PR, steel-ply, LS2
28L-26, 10 PR, steel-ply, LS3

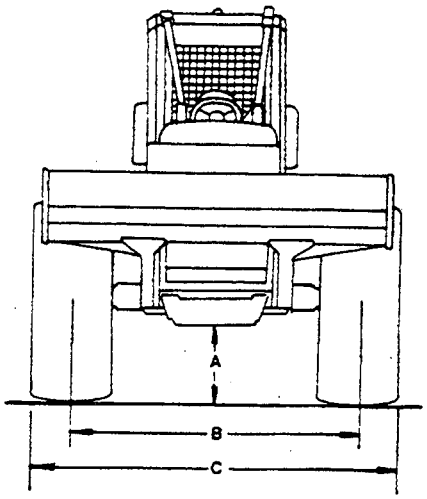
Capacities:	**U.S.**	**Liters**
Fuel tank	41 gal.	155.2
Cooling system	7.7 gal.	29.2
Engine lubrication, including filter	15 qt.	14.2
Transmission and hydraulic system	9 gal.	34.1
Front differential	4.5 gal.	17
Rear differential	4.5 gal.	17
Winch	1.8 gal.	6.8

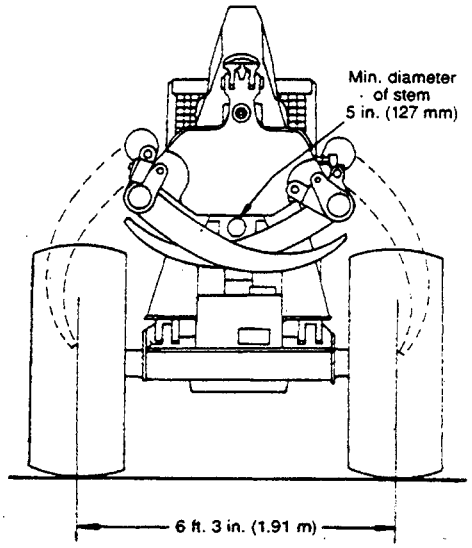
SAE Operating Weight w/Blade	16,200 lb. (7348 kg)
SAE Operating Weight w/o Blade	14,970 lb. (6790 kg)

87A;T6793AF 05T;115 K62 120488

548D/7411 GRAPPLE SKIDDER







Tip closure force . . . . . 6300 lb. (28 kN) (2858 kg)
Enclosure area, tips meeting . . . . . 8 sq. ft. (0.74 m²)

		S3 SERIES AXLES		S4 SERIES AXLES	
TIRE SIZE	A GROUND CLEARANCE	B WHEEL TREAD	C OVERALL WIDTH	B WHEEL TREAD	C OVERALL WIDTH
18.4-34	1 ft. 10 in. (559 mm)	76.6 in. (1.95 m)	7 ft. 11 in. (2.41 m)	N/A*	N/A
23.1-26	1 ft. 9 in. (533 mm)	80.8 in. (2.05 m)	8 ft. 9 in. (2.67 m)	80.2 in. (2.04 m)	8 ft. 8 in. (2.64 m)
28L-26	1 ft. 9.5 in. (546 mm)	N/A	N/A	87.5 in. (2.22 m)	9 ft. 8 in. (2.95 m)

* N/A= not available

NOTE: Machine equipped with 18.4 x 34 tires, grapple positioned with cylinders fully retracted and tongs tip to tip.

87A;T6793AD 05T;115 K63 220488

548D/7411 GRAPPLE SKIDDER—CONTINUED

Specifications and design are subject to change without notice. Wherever applicable, specifications are in accordance with SAE Standards. Except where otherwise noted, these specifications are based on a unit with 18.4-34, 10 PR tires, full fuel tank, 175-lb. (80 kg) operator and standard equipment.

Rated Power @ 2200 rpm:	SAE	DIN 70 020
Net	100 hp (75 kW)	75 kW
Gross	105 hp (78 kW)	

Net engine power is with standard equipment including air cleaner, exhaust system, alternator, and cooling fan, at standard conditions per SAE J1349 and DIN 70 020, using No.2-D fuel @ 35 API gravity. No derating is required up to 10,000 feet (3050 m) altitude. Gross power is without cooling fan.

Engine: John Deere 4-276T

Type	4-stroke cycle, turbocharged diesel
Bore and stroke	4.19 x 5.00 in. (106.5 x 127 mm)
No. of cylinders	4
Displacement	276 cu. in. (4.524 L)
Maximum net torque @ 1300 rpm	290 lb-ft (393 Nm) (40 kg-m)
Cooling fan	Blower
Compression ratio	16.8 to 1
Lubrication	Pressure system w/full-flow filter
Electrical system	12-volt w/42-amp alternator
Battery	Reserve capacity: 180 minutes

Differentials:
Front and rear ..... Full differentials w/hydraulic lock

Engine Clutch Disconnect:
Hand-operated, spring-loaded, dry disk. Single plate, 12 in. (305 mm).

Transmission:
Power Shift with planetary gears, hydraulically actuated wet-disk clutches and brakes; provides 8 speeds forward—4 reverse. Controlled by single lever on console.

Travel Speeds (2200 engine rpm, no tire slip):

	mph	km/h
Forward	1.8-19.8	2.9-31.9
Reverse	2.3-6.6	3.7-10.6

Drive Axles:
Four-wheel drive with inboard planetary gears on all axles. Front axle oscillates 15 degrees above and below horizontal. Travel at tire center line 20 in. (508 mm).

Steering: Power
Articulated frame hydraulically actuated by two double-acting cylinders with cushioned stops. Steering system has hydraulic pressure priority.
Outside clearance circle w/o blade ..... 34 ft. 4 in. (10.46 m)
Outside clearance circle w/blade ..... 35 ft. 0 in. (10.67 m)

Brakes:
Service ..... Hydraulic, power-actuated, pedal-controlled wet-disk brakes located in axle.
Parking, winching and emergency stop ..... Hand-operated mechanical wet-disk brake located on driveline for braking front and rear axles. Hydraulic release.

Hydraulic System:
Closed center, constant pressure. Variable-displacement pump driven from crankshaft ..... 25 gpm (95 L/min), 2000 psi (13 790 kPa) (140.6 kg/cm²) @ 2200 engine rpm. Full-flow filtration. Oil-to-air cooler.

Capacities:	U.S.	Liters
Fuel tank	41 gal.	155
Cooling system	7.7 gal.	29.2
Engine lubrication, including filter	15 qt.	14.2
Transmission and hydraulic system	16 gal.	60.6
Front differential	4.5 gal.	17
Rear differential	4.5 gal.	17
Winch	1.8 gal.	6.8

Blade: Hydraulic control

Width	6 ft. 11 in. (2.11 m)
Max. lift above ground level	4 ft. 5 in. (1.35 m)
Max. drop below ground level	9 in. (229 mm)
Height (ends)	1 ft. 9 in. (533 mm)
Height (center)	2 ft. 3 in. (686 mm)

Winch:
Live mechanical drive; hydraulically actuated clutch and brakes, single-lever control.
Winch capacities*

½-in. (12.7 mm) cable	223 ft. (68 m)
⅝-in. (15.8 mm) cable	146 ft. (45 m)
¾-in. (19.1 mm) cable	103 ft. (31.4 m)

*Calculated—no allowance made for loose or uneven spooling.

Linepull:**

Bare drum	26,700 lb. (119 kN) (12 100 kg)
Full drum	18,100 lb. (81 kN) (8200 kg)

**Based on winch clutch capacity and .75 in. (19 mm) cable.

Line speed (2200 rpm) and .75 in. (19 mm) cable:

Bare drum	126 fpm (38.3 m/min)
Full drum	176 fpm (53.6 m/min)

Hydraulic Cylinders:	Rod Dia.	Bore	Stroke
Blade lift cylinders (2)	1.50 in. (38.1 mm)	3.50 in. (89 mm)	14.25 in. (362 mm)
Steering cylinders (2)	1.75 in. (44.5 mm)	2.75 in. (70 mm)	14.37 in. (365 mm)
Grapple boom cylinders (2)	2.00 in. (51 mm)	4.00 in. (102 mm)	29.8 in. (757 mm)
Grapple tong cylinder (1)	2.25 in. (57 mm)	5.25 in. (133 mm)	16.8 in. (427 mm)

Cylinder rods are ground, heat-treated, chrome-plated and polished.

Tires:
18.4-34, 10 PR, steel-ply, LS2
23.1-26, 10 PR, steel-ply, LS2
28L-26, 10 PR, steel-ply, LS2
28L-26, 10 PR, steel-ply, LS3

SAE Operating Weight w/Blade ..... 18,040 lb. (8183 kg)
SAE Operating Weight w/o Blade ..... 16,815 lb. (7627 kg)

87A;T6793AG 05T;115 K64 210488

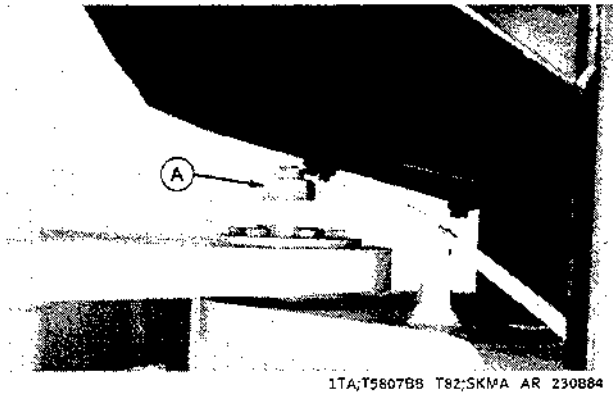
HARDWARE TORQUE SPECIFICATIONS

Check cap screws and nuts to be sure they are tight. If hardware is loose, tighten to torque shown on the following charts unless a special torque is specified.

T82;SKMA AT 270286

TIGHTEN UPPER FRAME PIVOT PIN

Annually or every 1000 hours, tighten upper frame pivot pin nut (A) to 1000 lb-ft (1350 N·m).



1TA;T5807BB T82;SKMA AR 230884

METRIC SERIES TORQUE CHART

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

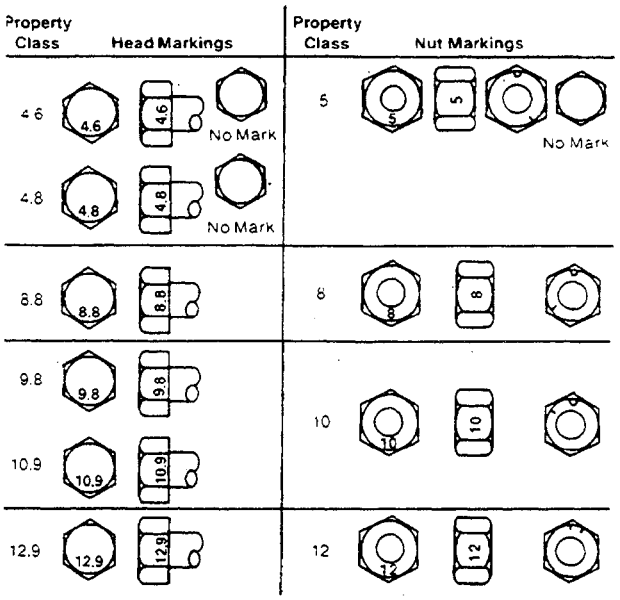
Check tightness of cap screws periodically. Torque values listed are for general use only. Do not use these values if a different torque value or tightening procedure is listed for a specific application.

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.



DIA.	WRENCH SIZE	4.6		4.8		8.8		9.8		10.9		12.9	
		OIL	DRY	OIL	DRY	OIL	DRY	OIL	DRY	OIL	DRY	OIL	DRY
		N·m(lb-ft)	N·m(lb-ft)	N·m(lb-ft)	N·m(lb-ft)	N·m(lb-ft)	N·m(lb-ft)	N·m(lb-in)	N·m(lb-in)	N·m(lb-ft)	N·m(lb-ft)	N·m(lb-ft)	N·m(lb-ft)
M5	8mm	1.5(1)	2.5(1.5)	2.5(1.5)	3.0(2)	4.5(3.5)	6.0(4.5)	5.0(3.5)	7.0(5)	6.5(4.5)	9.0(6.5)	7.5(5.5)	10.0(7.5)
M6	10mm	3.0(2)	4.0(3)	4.0(3)	5.5(4)	7.5(5.5)	10.0(7.5)	8.5(6)	12.0(9)	11.0(8)	15.0(11)	13.0(9.5)	18.0(13)
M8	13mm	7.0(5)	9.5(7)	10.0(7.5)	13.0(10)	18.0(13)	25(18)	21.0(15)	30(22)	25(18)	35(26)	30(22)	45(33)
M10	16mm	14.0(10)	19.0(14)	20.0(15)	25(18)	35(26)	50(37)	40(30)	55(41)	55(41)	75(55)	65(48)	85(63)
M12	18mm	25(18)	35(26)	35(26)	45(33)	65(48)	85(63)	70(52)	100(74)	95(70)	130(97)	110(81)	150(111)
M14	21mm	40(30)	50(37)	55(41)	75(55)	100(74)	140(103)	115(85)	155(114)	150(111)	205(151)	175(129)	240(177)
M16	24mm	60(44)	80(59)	85(63)	115(85)	160(118)	215(159)	180(133)	245(180)	235(173)	315(232)	275(203)	370(273)
M18	27mm	80(59)	110(81)	115(85)	160(118)	225(166)	305(225)			320(236)	435(321)	375(277)	510(376)
M20	30mm	115(85)	160(118)	165(122)	225(166)	320(236)	435(321)			455(356)	620(457)	535(395)	725(535)
M22	33mm	160(118)	215(159)	225(167)	305(225)	435(321)	590(435)			620(457)	840(620)	725(535)	985(726)
M24	36mm	200(148)	275 (203)	285(210)	390(288)	555(409)	750(553)			790(583)	1070(789)	925(682)	1255(926)
M27	41mm	295(218)	400 (295)	415(306)	565(417)	810(597)	1100(811)			1155(852)	1565(1154)	1350(996)	1835(1353)
M30	46mm	400(295)	545(402)	565(417)	770(568)	1100(811)	1495(1103)			1570(1158)	2130(1571)	1835(1353)	2490(1837)
M33	51mm	545(402)	740(546)	770(568)	1050(774)	1500(1106)	2035(1500)			2135(1575)	2900(2139)	2500(1844)	3390(2500)
M36	55mm	700(516)	950(700)	990(730)	1345(992)	1925(1420)	2610(1925)			2740(2021)	3720(2744)	3205(2364)	4355(3212)

AB6;TS234, TS235 053;TORQ4. 220188

INCH SERIES TORQUE CHART

Check tightness of cap screws periodically.

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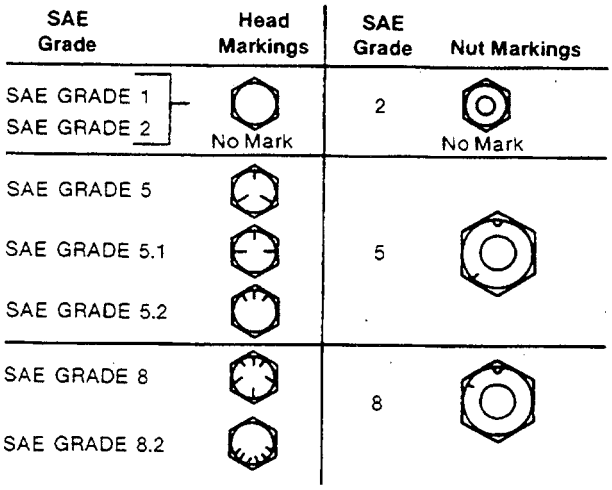
Make sure fastener threads are clean and you properly start thread engagement. This will prevent them from failing when tightening.

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



DIA.	WRENCH SIZE	SAE GRADE 1		SAE GRADE 2		SAE GRADE 5		SAE GRADE 8	
		OIL	DRY	OIL	DRY	OIL	DRY	OIL	DRY
		N·m(lb-in)	N·m(lb-in)	N·m(lb-in)	N·m(lb-in)	N·m(lb-in)	N·m(lb-in)	N·m(lb-in)	N·m(lb-in)
#6		0.5(4.5)	0.7(6)	0.8(7)	1(10)	1.4(12)	1.7(15)		
#8		0.9(8)	1.2(11)	1.5(13)	2(18)	2.4(21)	3.2(28)		
#10		1.4(12)	1.8(16)	2(19)	2.8(25)	3.4(30)	4.6(41)		
#12		2(19)	2.8(25)	3.4(30)	4.5(40)	5.4(48)	7.3(65)		
		N·m(lb-ft)	N·m(lb-ft)	N·m(lb-ft)	N·m(lb-ft)	N·m(lb-ft)	N·m(lb-ft)	N·m(lb-ft)	N·m(lb-ft)
1/4	7/16	3.5(2.5)	4(3.0)	5(4.0)	7(5.0)	8(6.0)	11(8.0)	12(8.5)	16(12)
5/16	1/2	7(5.0)	9(6.5)	10(7.5)	14(10.0)	16(12.0)	23(17.0)	24(18.0)	33(24)
3/8	9/16	12(8.5)	16(12.0)	19(14.0)	24(18.0)	30(22.0)	41(30)	41(30)	54(40)
7/16	5/8	19(14.0)	26(19.0)	30(22.0)	41(30)	47(35)	68(50)	68(50)	95(70)
1/2	3/4	24(21.0)	41(30)	47(35)	61(45)	75(55)	102(75)	102(75)	142(105)
9/16	13/16	41(30)	54(40)	68(50)	88(65)	108(80)	142(105)	149(110)	203(150)
5/8	15/16	54(40)	75(55)	88(65)	122(90)	149(110)	197(145)	203(150)	278(205)
3/4	1-1/8	102(75)	136(100)	163(120)	217(160)	258(190)	353(260)	366(270)	495(365)
7/8	1-5/16	163(120)	224(165)	163(120)	224(165)	414(305)	563(415)	590(435)	800(590)
1	1-1/2	244(180)	332(245)	244(180)	332(245)	624(460)	848(625)	881(650)	1193(880)
1-1/8	1-11/16	346(255)	468(345)	346(255)	468(345)	780(575)	1058(780)	1248(920)	1695(1250)
1-1/4	1-7/8	488(360)	664(490)	488(360)	665(490)	1098(810)	1492(1100)	1763(1300)	2393(1765)
1-3/8	2-1/16	637(470)	868(640)	637(470)	868(640)	1438(1061)	1953(1440)	2312(1705)	3140(2315)
1-1/2	2-1/4	848(625)	1153(850)	848(625)	1153(850)	1912(1410)	2590(1910)	3065(2260)	4163(3070)

AB6;TS236, TS237 053;TORQ3. 220188