

415 and 455 Lawn and Garden Tractors

TECHNICAL MANUAL



**John Deere
Worldwide Commercial and
Consumer Equipment Division**

TM1836 (Apr2000)



RECOGNIZE SAFETY INFORMATION



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

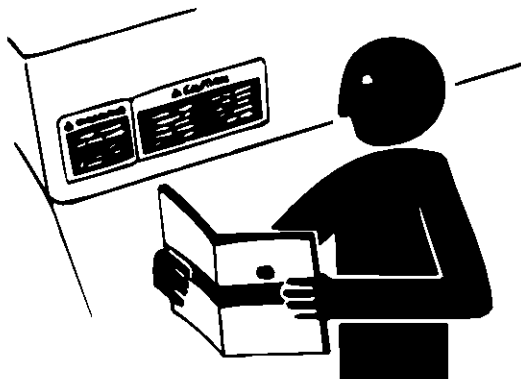
Follow recommended precautions and safe servicing practices.

Understand Signal Words

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

DANGER or **WARNING** safety signs are located near specific hazards. General precautions are listed on **CAUTION** safety signs. **CAUTION** also calls attention to safety messages in this manual.

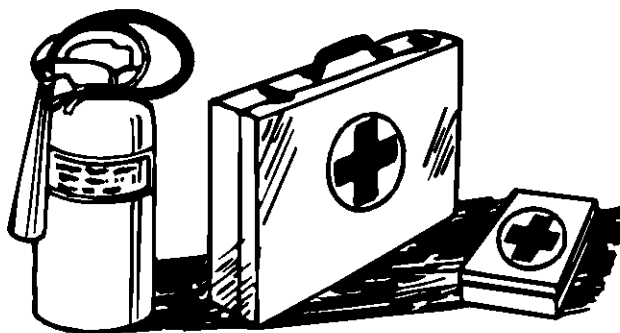
REPLACE SAFETY SIGNS



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

HANDLE FLUIDS SAFELY—AVOID FIRES

Be Prepared for Emergencies



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.

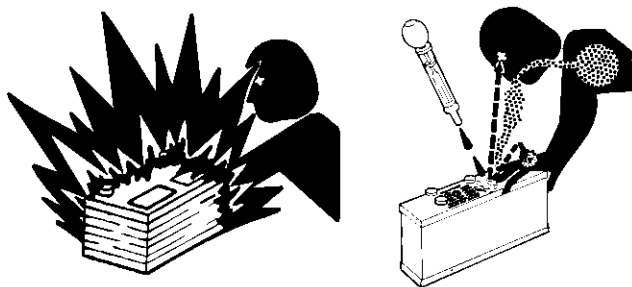
Do not store oily rags; they can ignite and burn spontaneously.

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.

USE CARE IN HANDLING AND SERVICING BATTERIES



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

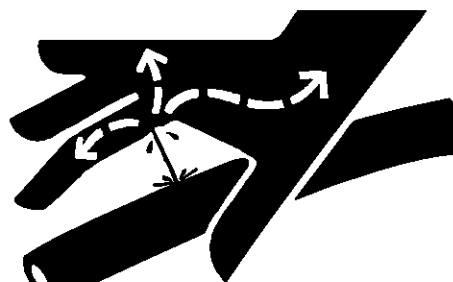
Prevent Acid Burns

- 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 acid burns 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. Using 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.
 4. 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.

USE CARE AROUND HIGH-PRESSURE FLUID LINES



Avoid High-Pressure Fluids



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

Avoid injury from escaping fluid under pressure by stopping the engine and relieving pressure in the system before disconnecting or connecting 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.

Avoid Heating Near Pressurized Fluid Lines

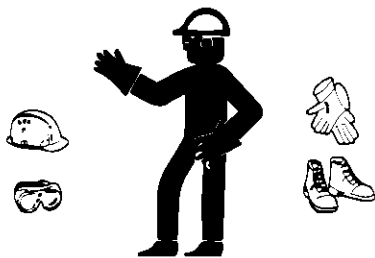


Flammable spray can be generated by heating near pressurized fluid lines, resulting in severe burns to yourself and bystanders. Do not heat by welding, soldering, or using a torch near pressurized fluid lines or other flammable materials. Pressurized lines can be accidentally cut when heat goes beyond the immediate flame area.



USE SAFE SERVICE PROCEDURES

Wear Protective Clothing

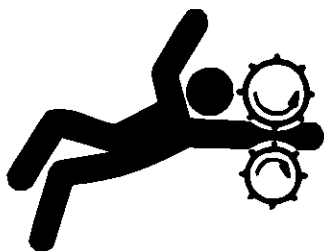


Wear close fitting clothing and safety equipment appropriate to the job.

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.

Operating equipment safely requires the full attention of the operator. Do not wear radio or music headphones while operating machine.

Service Machines Safely



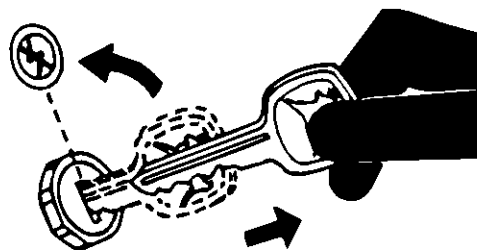
Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing, or necklace when you work near machine tools or moving parts. If these items were to get caught, severe injury could result.

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

Use Proper Tools

Use tools appropriate to the work. Makeshift tools and procedures can create safety hazards. Use power tools only to loosen threaded parts and fasteners. For loosening and tightening hardware, use the correct size tools. **DO NOT** use U.S. measurement tools on metric fasteners. Avoid bodily injury caused by slipping wrenches. Use only service parts meeting John Deere specifications.

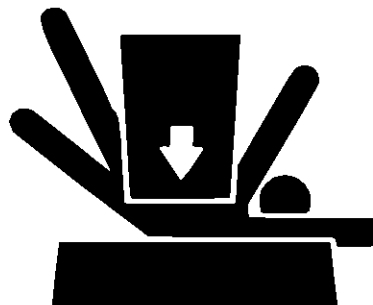
Park Machine Safely



Before working on the machine:

1. Lower all equipment to the ground.
2. Stop the engine and remove the key.
3. Disconnect the battery ground strap.
4. Hang a "DO NOT OPERATE" tag in operator station.

Support Machine Properly and Use Proper Lifting Equipment



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.

Lifting heavy components incorrectly can cause severe injury or machine damage. Follow recommended procedure for removal and installation of components in the manual.

Work in Clean Area

Before starting a Job:

1. Clean work area and machine.
2. Make sure you have all necessary tools to do your job.
3. Have the right parts on hand.
4. Read all instructions thoroughly; do not attempt shortcuts.

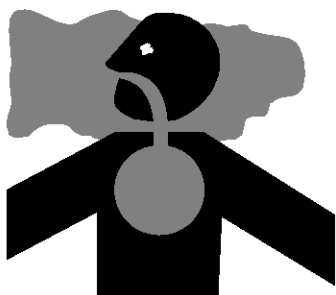
Using High—Pressure Washers

Directing pressurized water at electronic/electrical components or connectors, bearings, hydraulic seals, fuel injection pumps or other sensitive parts and components may cause product malfunctions. Reduce pressure and spray at a 45 to 90 degree angle.

Illuminate Work Area Safely

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.

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.

WARNING: California Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

Gasoline engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

Remove Paint Before Welding or Heating

Avoid potentially toxic fumes and dust. Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch. Do all work outside or in a well ventilated area. Dispose of paint and solvent properly. Remove paint before welding or heating. 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.

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 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 material containing asbestos. When servicing, wear an approved respirator. A special vacuum cleaner is recommended to clean asbestos. If not available, apply a mist of oil or water on the material containing asbestos. Keep bystanders away from the area.



SERVICE TIRES SAFELY



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

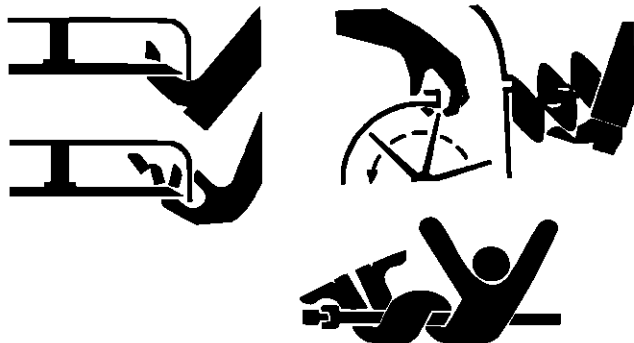
Do not attempt to mount a tire unless you have the proper equipment and experience to perform the job. Always maintain the correct tire pressure. Do not inflate the tires above the recommended pressure. Never weld or heat a wheel and tire assembly. The heat can cause an increase in air pressure resulting in a tire explosion. Welding can structurally weaken or deform the wheel.

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.



AVOID INJURY FROM ROTATING BLADES, AUGERS AND PTO SHAFTS



Keep hands and feet away while machine is running. Shut off power to service, lubricate, or remove mower blades, augers, or PTO shafts.

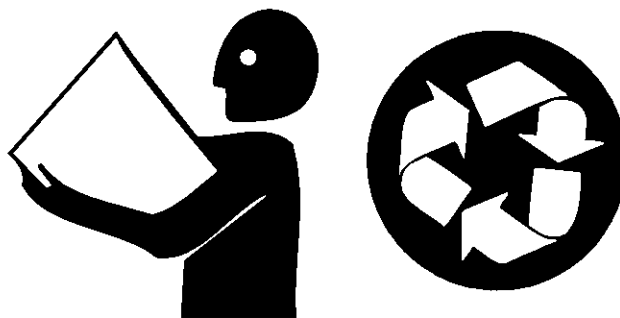
SERVICE COOLING SYSTEM SAFELY



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

Shut off machine. Remove filler cap only when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.

HANDLE CHEMICAL PRODUCTS SAFELY



Direct exposure to hazardous chemicals can cause serious injury. Potentially hazardous chemicals used with John Deere equipment include such items as lubricants, coolants, paints, and adhesives.

A Material Safety Data Sheet (MSDS) provides specific details on chemical products: physical and health hazards, safety procedures, and emergency response techniques. Check the MSDS before you start any job using a hazardous chemical. That way you will know exactly what the risks are and how to do the job safely. Then follow procedures and recommended equipment.

Dispose of Waste Properly

Improperly disposing of waste can threaten the environment and ecology. Potentially harmful waste used with John Deere equipment includes such items as oil, fuel, coolant, brake fluid, filters, and batteries. Use leakproof containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them. Do not pour waste onto the ground, down a drain, or into any water source. Inquire on the proper way to recycle or dispose of waste from your local environmental or recycling center, or from your John Deere dealer.

LIVE WITH SAFETY



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

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METRIC FASTENER TORQUE VALUES



Property Class and Head Markings	4.8		8.8		9.8		10.9		12.9	
Property Class and Nut Markings	5		10		10		10		12	

TS1163

SIZE	Class 4.8				Class 8.8 or 9.8				Class 10.9				Class 12.9			
	Lubricated ^a		Dry ^a		Lubricated ^a		Dry ^a		Lubricated ^a		Dry ^a		Lubricated ^a		Dry ^a	
	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
M6	48	3.5	6	4.5	9	6.5	11	8.5	13	9.5	17	12	15	11.5	19	14.5
M8	12	8.5	15	11	22	16	28	20	32	24	40	30	37	28	47	35
M10	23	17	29	21	43	32	55	40	63	47	80	60	75	55	95	70
M12	40	29	50	37	75	55	95	70	110	80	140	105	130	95	165	120
M14	63	47	80	60	120	88	150	110	175	130	225	165	205	150	260	109
M16	100	73	125	92	190	140	240	175	275	200	350	225	320	240	400	300
M18	135	100	175	125	260	195	330	250	375	275	475	350	440	325	560	410
M20	190	140	240	180	375	275	475	350	530	400	675	500	625	460	800	580
M22	260	190	330	250	510	375	650	475	725	540	925	675	850	625	1075	800
M24	330	250	425	310	650	475	825	600	925	675	1150	850	1075	800	1350	1000
M27	490	360	625	450	950	700	1200	875	1350	1000	1700	1250	1600	1150	2000	1500
M30	675	490	850	625	1300	950	1650	1200	1850	1350	2300	1700	2150	1600	2700	2000
M33	900	675	1150	850	1750	1300	2200	1650	2500	1850	3150	2350	2900	2150	3700	2750
M36	1150	850	1450	1075	2250	1650	2850	2100	3200	2350	4050	3000	3750	2750	4750	3500

DO NOT use these hand torque values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only and include a ±10% variance factor. Check tightness of fasteners periodically. DO NOT use air powered wrenches.

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

Fasteners should be replaced with the same grade. Make sure fastener threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

When bolt and nut combination fasteners are used, torque values should be applied to the NUT instead of the bolt head.












Tighten toothed or serrated-type lock nuts to the full torque value.

^a "Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated (yellow dichromate - Specification JDS117) without any lubrication.

Reference: JDS—G200.

INCH FASTENER TORQUE VALUES



SAE Grade and Head Markings	1 or 2 ^b No Marks 	5  5.1  5.2 	8  8.2 
SAE Grade and Nut Markings	2 No Marks 	5  	8  

TS1162

SIZE	Grade 1				Grade 2 ^b				Grade 5, 5.1 or 5.2				Grade 8 or 8.2			
	Lubricated ^a		Dry ^a		Lubricated ^a		Dry ^a		Lubricated ^a		Dry ^a		Lubricated ^a		Dry ^a	
	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	3.7	2.8	4.7	3.5	6	4.5	7.5	5.5	9.5	7	12	9	13.5	10	17	12.5
5/16	7.7	5.5	10	7	12	9	15	11	20	15	25	18	28	21	35	26
3/8	14	10	17	13	22	16	27	20	35	26	44	33	50	36	63	46
7/16	22	16	28	20	35	26	44	32	55	41	70	52	80	58	100	75
1/2	33	25	42	31	53	39	67	50	85	63	110	80	120	90	150	115
9/16	48	36	60	45	75	56	95	70	125	90	155	115	175	130	225	160
5/8	67	50	85	62	105	78	135	100	170	125	215	160	215	160	300	225
3/4	120	87	150	110	190	140	240	175	300	225	375	280	425	310	550	400
7/8	190	140	240	175	190	140	240	175	490	360	625	450	700	500	875	650
1	290	210	360	270	290	210	360	270	725	540	925	675	1050	750	1300	975
1-1/8	470	300	510	375	470	300	510	375	900	675	1150	850	1450	1075	1850	1350
1-1/4	570	425	725	530	570	425	725	530	1300	950	1650	1200	2050	1500	2600	1950
1-3/8	750	550	950	700	750	550	950	700	1700	1250	2150	1550	2700	2000	3400	2550
1-1/2	1000	725	1250	925	990	725	1250	930	2250	1650	2850	2100	3600	2650	4550	3350

DO NOT use these hand torque values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only and include a ±10% variance factor. Check tightness of fasteners periodically. DO NOT use air powered wrenches.

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

Fasteners should be replaced with the same grade. Make sure fastener threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

When bolt and nut combination fasteners are used, torque values should be applied to the **NUT** instead of the bolt head.

Tighten toothed or serrated-type lock nuts to the full torque value.

^a "Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated (yellow dichromate - Specification JDS117) without any lubrication.

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

Reference: JDS—G200.

ENGINE OIL SPECIFICATIONS

DIESEL ENGINE OIL

IMPORTANT: DO NOT USE GALVANIZED CONTAINERS—diesel fuel stored in galvanized containers reacts with zinc coating in the container to form zinc flakes. If fuel contains water, a zinc gel will also form. The gel and flakes will quickly plug fuel filters and damage fuel injectors and fuel pumps.

It is recommended that diesel fuel be stored **ONLY** in a clean, approved **POLYETHYLENE PLASTIC** container **WITHOUT** any metal screen or filter. This will help prevent any accidental sparks from occurring. Store fuel in an area that is well ventilated to prevent possible igniting of fumes by an open flame or spark, this includes any appliance with a pilot light.

IMPORTANT: Keep all dirt, scale, water or other foreign material out of fuel.

Keep fuel in a safe, protected area and in a clean, properly marked ("**DIESEL FUEL**") container. **DO NOT** use deicers to attempt to remove water from fuel. **DO NOT** depend on fuel filters to remove water from fuel. It is recommended that a water separator be installed in the storage tank outlet. **BE SURE** to properly discard unstable or contaminated diesel fuel and/or their containers when necessary.



BREAK-IN ENGINE OIL—DIESEL



IMPORTANT: ONLY use this specified break-in oil in rebuilt or remanufactured engines for the first **100 hours (maximum)** of operation. **DO NOT** use SAE 15W-40 oil or oils meeting CCMC Specification D5—these oils will not allow rebuilt or remanufactured engines to break-in properly.

The following John Deere oil is **PREFERRED**:

- **BREAK-IN ENGINE OIL.**

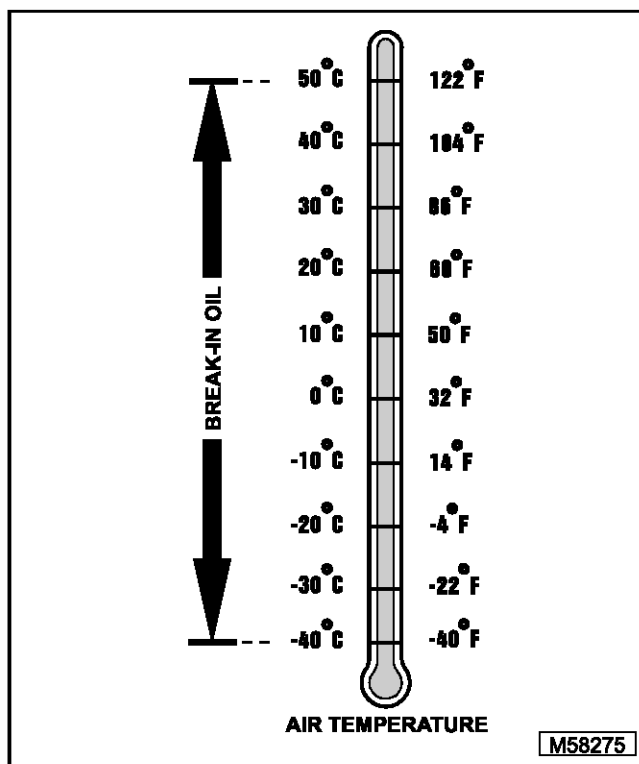
John Deere BREAK-IN ENGINE OIL is formulated with special additives for aluminum and cast iron type engines to allow the power cylinder components (pistons, rings, and liners as well) to “wear-in” while protecting other engine components, valve train and gears, from abnormal wear. Engine rebuild instructions should be followed closely to determine if special requirements are necessary.

John Deere BREAK-IN ENGINE OIL is also recommended for non-John Deere engines, both aluminum and cast iron types.

If above preferred John Deere oil is not available, use a break-in engine oil meeting the following specification during the first 100 hours of operation:

- CCMC Specification D4 or higher.

IMPORTANT: After the break-in period, use the John Deere oil that is recommended for this engine.



HYDROSTATIC TRANSMISSION AND HYDRAULIC OIL

HYDROSTATIC TRANSMISSION AND HYDRAULIC OIL

Use the appropriate oil viscosity based on these air temperature ranges. Operating outside of these recommended oil air temperature ranges may cause premature hydrostatic transmission or hydraulic system failures.

IMPORTANT: Mixing of **LOW VISCOSITY HY-GARD®** and **HY-GARD®** oils is permitted. **DO NOT** mix any other oils in this transmission. **DO NOT** use engine oil or "Type F" (Red) Automatic Transmission Fluid in this transmission. **DO NOT** use **BIO-HY-GARD®** in this transmission.

The following John Deere transmission and hydraulic oil is **PREFERRED**:

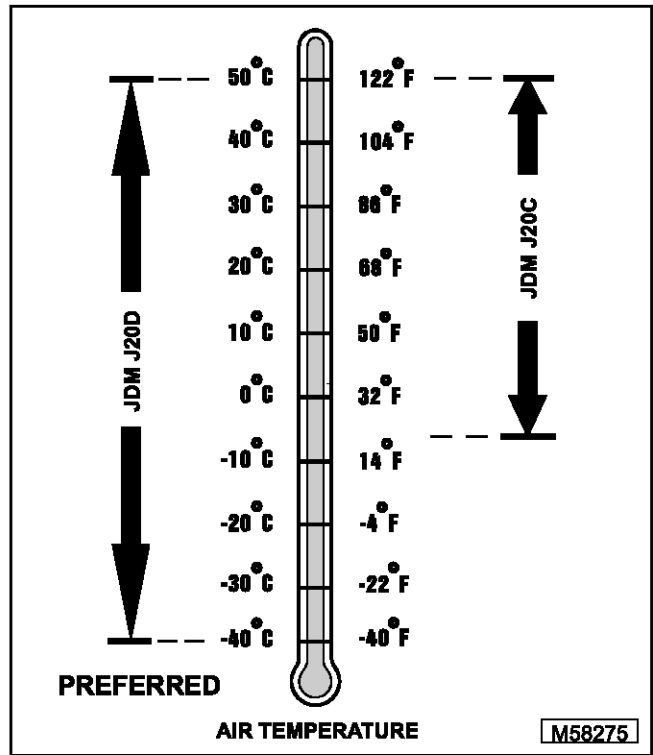
- **LOW VISCOSITY HY-GARD®—JDM J20D.**

The following John Deere oil is **also recommended** if above preferred oil is not available:

- **HY-GARD®—JDM J20C.**

Other oils may be used if above recommended John Deere oils are not available, provided they meet one of the following specifications:

- John Deere Standard JDM J20D;
- John Deere Standard JDM J20C.



COOLANT SPECIFICATIONS

DIESEL ENGINE COOLANT



The engine cooling system when filled with a proper dilution mixture of anti-freeze and deionized or distilled water provides year-round protection against corrosion, cylinder or liner pitting, and winter freeze protection down to -37°C (-34°F).

The following John Deere coolant is **PREFERRED**:

- **PRE-DILUTED DIESEL ENGINE ANTI-FREEZE/SUMMER COOLANT™ (TY16036).**

This coolant satisfies specifications for “Automobile and Light Duty Engine Service” and is safe for use in John Deere Lawn and Grounds Care/Golf and Turf Division equipment, including aluminum block gasoline engines and cooling systems.

The above preferred pre-diluted anti-freeze provides:

- adequate heat transfer
- corrosion-resistant chemicals for the cooling system
- compatibility with cooling system hose and seal material
- protection during extreme cold and extreme hot weather operations
- chemically pure water for better service life
- compliance with ASTM D4656 (JDM H24C2) specifications

If above preferred pre-diluted coolant is not available, the following John Deere concentrate is **recommended**:

- **DIESEL ENGINE ANTI-FREEZE/SUMMER COOLANT CONCENTRATE™ (TY16034).**

If either of above recommended engine coolants are available use any Automobile and Light Duty Engine Service **ethylene glycol base coolant**, meeting the following specification:

- ASTM D3306 (JDM H24C1).

Read container label completely before using and follow instructions as stated.

IMPORTANT: To prevent engine damage, **DO NOT** use pure anti-freeze or less than a 50% anti-freeze mixture in the cooling system. **DO NOT** mix or add any additives/conditioners to the cooling system in Lawn and Grounds Care/Golf and Turf Division equipment. Water used to dilute engine coolant concentrate must be of high quality—clean, clear, potable water (low in chloride and hardness—Table 1) is generally acceptable. **DO NOT** use salt water. Deionized or distilled water is ideal to use. Coolant that is not mixed to these specified levels and water purity can cause excessive scale, sludge deposits, and increased corrosion potential.

Water Quality

Property	Requirements
Total Solids, Maximum	340 ppm (20 grns/gal)
Total Hardness, Max.	170 ppm (10 grns/gal)
Chloride (as Cl), Max.	40 ppm (2.5 grns/gal)
Sulfate (as SO ₄), Max.	100 ppm (5.8 grns/gal)

Mix 50 percent anti-freeze concentrate with 50 percent distilled or deionized water. This mixture and the pre-diluted mixture (TY16036) will protect the cooling system down to -37°C(-34°F) and up to 108°C (226°F).

Certain geographical areas may require lower air temperature protection. See the label on your anti-freeze container or consult your John Deere dealer to obtain the latest information and recommendations.

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SPECIFICATIONS—3TN66

GENERAL SPECIFICATIONS

Slow Idle	1650 ± 150 rpm
Fast Idle	3350 ± 100 rpm
Compression	
Minimum Pressure (Min)	2448 kPa (355 psi)
Maximum Variation between Cylinders	490 kPa (71 psi)
Minimum Cranking Speed	250 rpm
Valve Clearance (Cold)	0.20 mm (0.008 in.)
Oil Pressure	
Pressure Sensor Activates	Below 69 kPa (10 psi)
Pressure (Fast Idle Min)	294 kPa (43 psi)
Radiator Cap	
Opening Pressure	83—97 kPa (12—14 psi)
Minimum Pressure	76 kPa (11 psi)
Thermostat	
Begin Opening	71°C (160°F)
Full Open	82°C (180°F)
Fan Drive Belt Deflection with 98 N (22 lb-force)	
Applied between Fan and Crank Drive Sheave	10—15mm (0.4—0.6 in.)
Fuel Pump	
Flow (Min)	450 mL (15 oz)/15 seconds
Pressure (Min)	172 kPa (25 psi)
Throttle Lever Friction Movement	18—35 N (4—8 lb-force)



TEST AND ADJUSTMENT SPECIFICATIONS

Air Intake System Leakage

Test Pressure	34—69 kPa (5—10 psi)
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Throttle Lever Friction

Force Required for Movement	18—35 N (4—8 lb-force)
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Idle

Slow Idle	1650 ± 150 rpm
Fast Idle	3350 ± 100 rpm

Fuel Transfer Pump

Test Temperature	15—25°C (59—77°F)
Minimum Flow before Filter	450 mL (15 oz)/15 seconds
Minimum Flow at Return Hose	200 mL (7 oz)/15 seconds
Minimum Pressure	172 kPa (25 psi)
Drain-Back Test Pressure (Maximum)	103 kPa (15 psi)

TEST AND ADJUSTMENT SPECIFICATIONS (Continued)

Fuel Injection Nozzle

Opening Pressure	11722 ± 480 kPa (1700 ± 70 psi)
Leakage at 11032 kPa (1600 psi)	Minimum of 10 Seconds with No Leakage
Chatter and Spray Pattern at 11722 ± 480 kPa (1700 ± 70 psi)	
Slow Hand Lever Movement	Chatter Sound
Slow Hand Lever Movement	Fine Stream Spray Pattern
Fast Hand Lever Movement	Fine Atomized Spray Pattern



Fuel Injection Pump Timing

Injection Pump Timing	13° BTDC (Before Top Dead Center)
Distance on Outer Surface of Crankshaft Pulley for	
Every 0.1 mm (0.004 in.) of Shim Thickness	1° or 1 mm (3/64 in.)
Engine Crankshaft Position	No. 1 Cylinder on TDC Compression Stroke
Total Shim Pack Thickness (New Shims)	0.5 mm (0.020 in.)
Mounting Nut Torque	20 N•m (180 lb-in.)
Delivery Valve Fitting Torque	42 N•m (31 lb-ft)

Radiator, Bubble Test

Maximum Air Pressure into Cylinder	2448 kPa (355 psi)
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Radiator Cap Pressure

Opening Pressure	83—96 kPa (12—14 psi)
Minimum Pressure	76 kPa (11 psi)

Thermostat Opening

Begin Opening	71°C (160°F)
Full Open	82°C (180°F)
Minimum Lift Height	8 mm (0.310 in.)

Cooling System Pressure

Maximum Test Pressure	117 kPa (17 psi)
Minimum Pressure after 15 Seconds	90 kPa (14 psi)

Coolant Temperature Sensor

Continuity	107—113°C (225—235°F)
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Compression

Pressure (Min)	2448 kPa (355 psi)
Maximum Difference between Cylinders	490 kPa (71 psi)
Minimum Cranking Speed	250 rpm

Valve Clearance and Lift

Valve Clearance (Cold)	0.20 mm (0.008 in.)
Valve Lift (Intake and Exhaust)	7.5 mm (0.300 in.)

TEST AND ADJUSTMENT SPECIFICATIONS (Continued)

Fan/Alternator Drive Belt Tension

Applied Force	98 N (22 lb-force)
Deflection	10—15 mm (0.400—0.600 in.)

Engine Oil pressure

Pressure Sensor Activates	Below 69 kPa (10 psi)
Pressure (Fast Idle Min)	294 kPa (43 psi)

Camshaft End Play

Standard Clearance	0.05—0.20 mm (0.0020—0.0079 in.)
Wear Limit	0.40 mm (0.016 in.)

Timing Gear Backlash

Crankshaft Gear-to-Oil Pump Gear	0.11—0.19 mm (0.0043—0.0075 in.)
All <u>Except</u> Crankshaft Gear-to-Oil Pump Gear	0.04—0.12 mm (0.0016—0.0047 in.)
Wear Limit	0.20 mm (0.0079 in.)

Connecting Rod Side Play

Standard Clearance	0.20—0.40 mm (0.0079—0.0157 in.)
Wear Limit	0.55 mm (0.0217 in.)

Connecting Rod Bearing Clearance

Connecting Rod End Cap Screws Torque	23 N•m (203 lb-in.)
Standard Clearance	0.020—0.072 mm (0.0008—0.0028 in.)
Wear Limit	0.15 mm (0.0059 in.)

Crankshaft End Play

Standard Clearance	0.090—0.271 mm (0.004—0.011 in.)
Wear Limit	0.33 mm (0.0129 in.)

Crankshaft Main Bearing Clearance

Main Bearing Cap Cap Screw Torque	54 N•m (40 lb-ft)
Standard Clearance	0.020—0.072 mm (0.0008—0.0028 in.)
Wear Limit	0.15 mm (0.0059 in.)

REPAIR SPECIFICATIONS

Engine

Drive Shaft Coupler Screws Torque	40 N•m (30 lb-ft)
Mounting Bolts Torque	80 N•m (60 lb-ft)

Thermostat

Cover Cap Screws Torque	9 N•m (78 lb-in.)
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REPAIR SPECIFICATIONS (Continued)

Fuel Injection Pump

Mounting Nut Torque 20 N•m (180 lb-in.)

Fuel Control and Governor Linkage

Governor Shaft

OD (Minimum) 7.90 mm (0.311 in.)

Governor Shaft Bore ID

Wear Limit 8.15 mm (0.321 in.)

Clearance 0.18 mm (0.007 in.)

Sleeve

ID (Maximum) 8.20 mm (0.323 in.)

Injection Pump Camshaft OD

Wear Limit 7.90 mm (0.311 in.)

Clearance 0.15 mm (0.006 in.)



Fuel Injection Nozzles

Leak-Off Hose Nut Torque 40 N•m (30 lb-ft)

Nozzle Fitting Torque 40 N•m (30 lb-ft)

Nozzle Torque 50 N•m (37 lb-ft)

Separator Plate Nozzle Contact Surface Maximum Wear 0.10 mm (0.0039 in.)

Exhaust Manifold

Mounting Cap Screw and Nut Torque 11 N•m (97 lb-in.)

Intake Manifold

Mounting Cap Screw Torque 11 N•m (97 lb-in.)

Water Pump

Mounting Cap Screw Torque 26 N•m (19 lb-ft)

Fan Mounting Cap Screw Torque 11 N•m (96 lb-in.)

Plate-to-Housing Screw Torque 9 N•m (78 lb-in.)

Flywheel

Maximum Distortion (Flatness) 0.02 mm (0.0008 in.)

Mounting Cap Screw Torque 83 N•m (61 lb-ft)

Flywheel Plate

Mounting Cap Screw Torque 49 N•m (36 lb-ft)



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