# JOHN DEERE
## WORLDWIDE COMMERCIAL & CONSUMER EQUIPMENT DIVISION

## Garden Tractors
## GT225, GT235, GT235E and GT245

TM1756 MARCH 2005

# TECHNICAL MANUAL

JOHN DEERE

North American Version
Litho in U.S.A.

# INTRODUCTION

## Manual Description

This technical manual is written for an experienced technician and contains sections that are specifically for this product. It is a part of a total product support program.

The manual is organized so that all the information on a particular system is kept together. The order of grouping is as follows:

- Table of Contents
- Specifications and Information
- Identification Numbers
- Tools and Materials
- Component Location
- Schematics and Harnesses
- Theory of Operation
- Operation and Diagnostics
- Diagnostics
- Tests and Adjustments
- Repair
- Other

***NOTE: Depending on the particular section or system being covered, not all of the above groups may be used.***

The bleed tabs for the pages of each section will align with the sections listed on this page. Page numbering is consecutive from the beginning of the Safety section through the last section.

We appreciate your input on this manual. If you find any errors or want to comment on the layout of the manual please contact us.

**Safety**

**Specifications and Information**

**Engine - Kohler**

**Engine - Briggs & Stratton**

**Engine - Kawasaki (FH580V)**

**Engine - Kawasaki (FH601V)**

**Electrical**

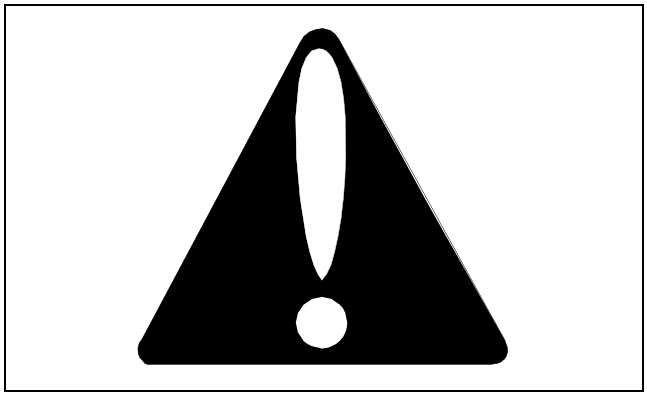
**Power Train - Hydrostatic**

**Steering**

**Attachments**

**Miscellaneous**

## Recognize Safety Information



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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.

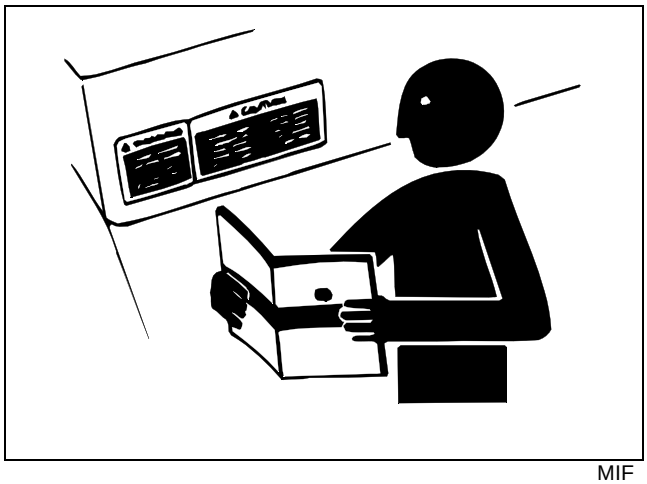
Follow recommended precautions and safe servicing practices.

## 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



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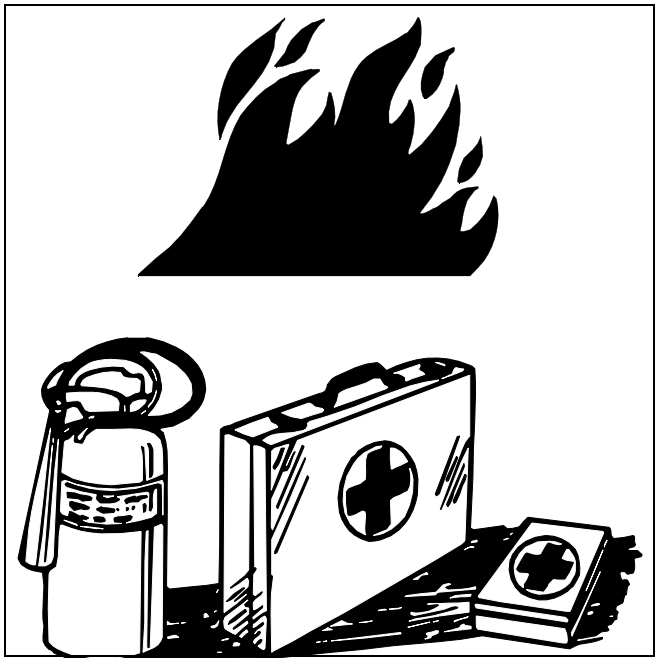
Replace missing or damaged safety signs. See the machine operator's manual for correct safety sign placement.

## Handle Fluids Safely - Avoid Fires

### Be Prepared For Emergencies



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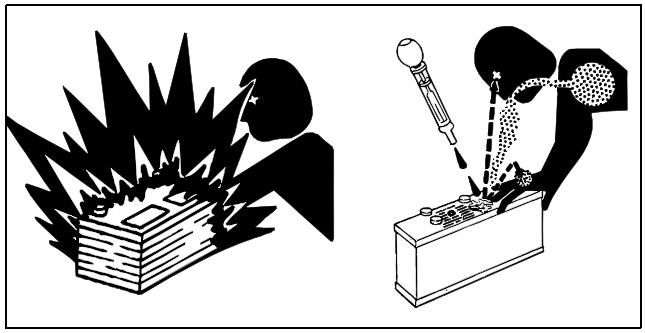
- When you work around fuel, do not smoke or work near heaters or other fire hazards.
- Store flammable fluids away from fire hazards. Do not incinerate or puncture pressurized containers.
- Make sure machine is clean of trash, grease, and debris.
- Do not store oily rags; they can ignite and burn spontaneously.
- 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



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## 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).

## 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. Use proper jump start procedure.

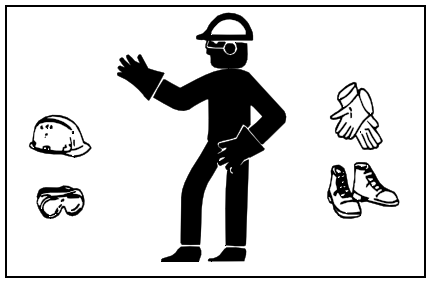
**If you spill acid on yourself:**

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.
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.

## Wear Protective Clothing



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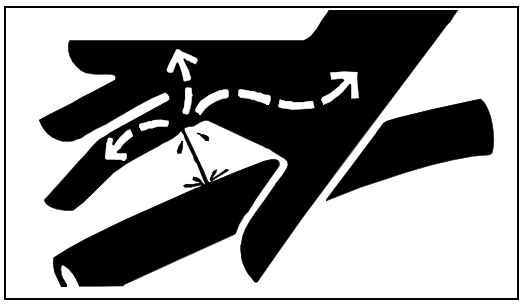
Wear close fitting clothing and safety equipment appropriate to the job.

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.

## Use Care Around High-Pressure Fluid Lines

**Avoid High-Pressure Fluids**



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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**

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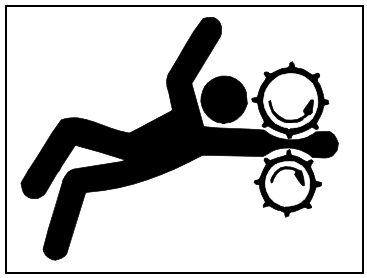
Flammable spray can be generated by heating near pressurized fluid lines, resulting in severe burns to yourself and bystanders. Do not heat by welding, soldering, or using a torch near pressurized fluid lines or other flammable materials. Pressurized lines can be accidentally cut when heat goes beyond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

## Service Machines Safely



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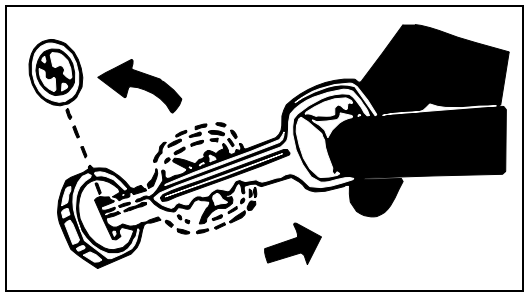
Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing, or necklace when you work near machine tools or moving parts. If these items were to get caught, severe injury could result.

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



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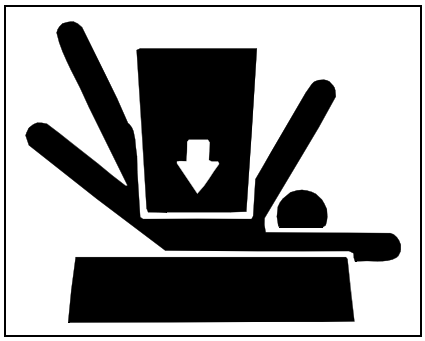
**Before working on the machine:**

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.

## Using 120 Volt Electric Outlet System Safely

- 120 Volt electric outlet system is an on-board high-voltage generator. Failure to observe all safety messages may result in property damage, injury or death.
- Do not use 120 Volt electric outlet system as a backup for a main power source, such as in a house that is powered by a utility company. Doing so may cause a power backfeed that could electrocute utility workers or others who contact power lines.
- Do not use 120 Volt electric outlet system in an enclosed area. Engine gives off carbon monoxide. Breathing carbon monoxide can cause illness, unconsciousness or death.
- Do not use 120 Volt electric outlet system in wet conditions.
- Do not use 120 Volt electric outlet system if it does not pass all safety system tests.
- A ground fault occurs when, instead of following its normal safe path, electricity passes through a person’s body to the ground. Ground fault circuit interrupter (GFCI) shuts off power to receptacle if it detects a ground fault.
- GFCI receptacle protects against ground faults. It does not protect against current overloads, short circuits or shocks.
- Do not use 120 Volt electric outlet system if electric power is lost and cannot be restored by resetting GFCI or 120 Volt electric outlet system.
- Do not use 120 Volt electric outlet system with hood open.
- Do not modify 120 Volt electric outlet system in any way.
- Perform only service functions described in this manual. For all other service, see a John Deere dealer.
- Use only John Deere approved replacement parts.
- Do not connect a battery charger to 120 Volt electric outlet system. Connecting this way may damage certain types of battery chargers.

## Support Machine Properly and Use Proper Lifting Equipment



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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.

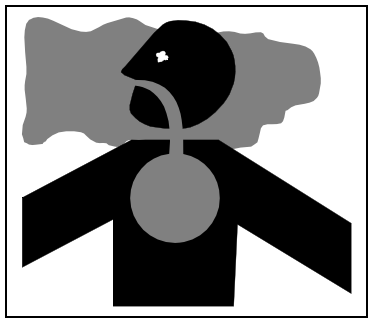
## Using High Pressure Washers

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



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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

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

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

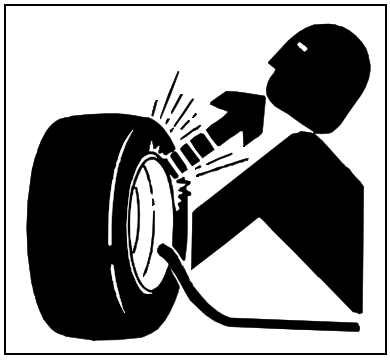
## Avoid Harmful Asbestos Dust

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



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

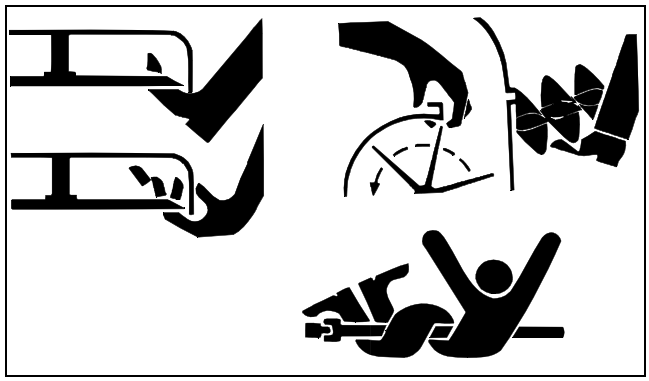
Do not attempt to mount a tire unless you have the proper equipment and experience to perform the job.

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



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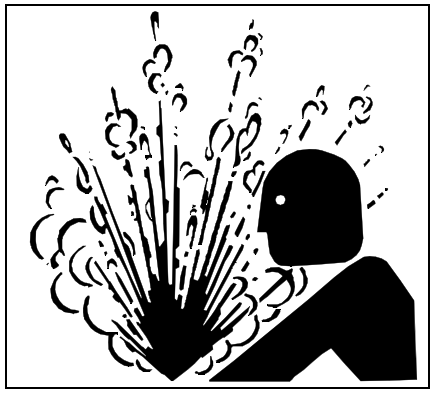
Keep hands and feet away while machine is running. Shut off power to service, lubricate or remove mower blades, augers or PTO shafts.

## Service Cooling System Safely



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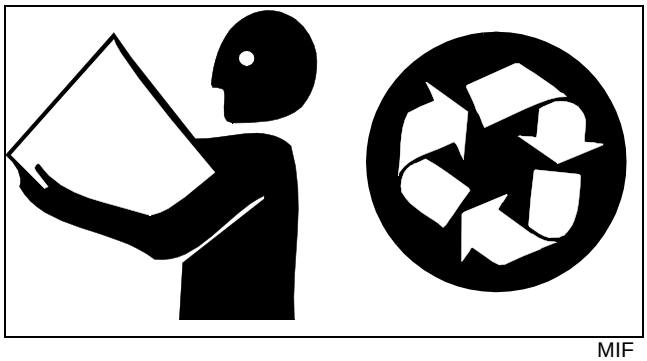
Explosive release of fluids from pressurized cooling system can cause serious burns.

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

## Handle Chemical Products Safely



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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 include 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


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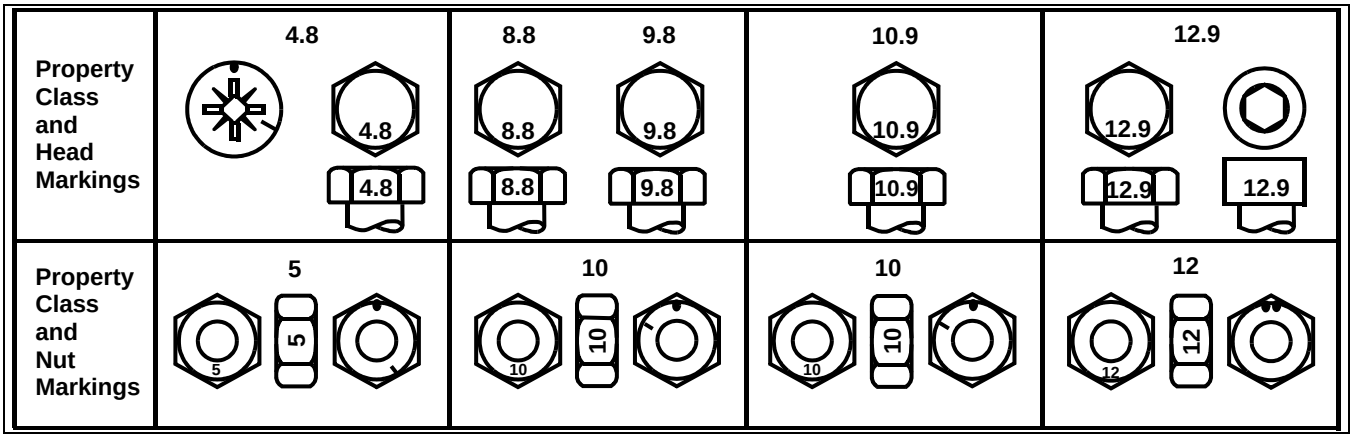
Before returning machine to customer, make sure machine is functioning properly, especially the safety systems. Install all guards and shields.

**Table of Contents**

## Fastener Torques

### Metric Fastener Torque Values

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| | 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 | |
| SIZE | 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 | 4.8 | 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.

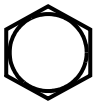
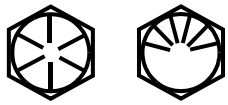
When bolt and nut combination fasteners are used, torque values should be applied to the NUT instead of the bolt head.

Tighten toothed or serrated-type locknuts 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** | **No Marks**  **1 or 2[b]** |  **5** **5.1** **5.2** |  **8** **8.2** | |
| **SAE Grade and Nut Markings** | **No Marks**  **2** |  **5** |  **8** | |

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| | Grade 1 | | | | Grade 2b | | | | 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 | |
| SIZE | 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.

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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 locknuts 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

## General Information

## Gasoline

**4 - Cycle Engines**

**CAUTION: Avoid Injury! Gasoline is HIGHLY FLAMMABLE, handle it with care. DO NOT refuel machine while: indoors, always fill gas tank outdoors; machine is near an open flame or sparks; engine is running, STOP engine; engine is hot, allow it to cool sufficiently first; smoking.**
**Help prevent fires: fill gas tank to bottom of filler neck only; be sure fill cap is tight after fueling; clean up any gas spills IMMEDIATELY; keep machine clean and in good repair - free of excess grease, oil, debris, and faulty or damaged parts; any storage of machines with gas left in tank should be 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. To prevent fire or explosion caused by STATIC ELECTRIC DISCHARGE during fueling:•ONLY use a clean, approved POLYETHYLENE PLASTIC fuel container and funnel WITHOUT any metal screen or filter.**

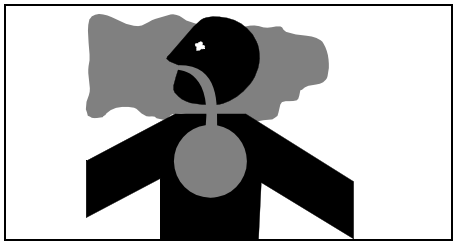
**To avoid engine damage:**

- DO NOT mix oil with gasoline;
- **ONLY use clean, fresh unleaded gasoline with an octane rating (anti-knock index) of 87 or higher**;
- Fill gas tank at the end of each day's operation to help prevent condensation from forming inside a partially filled tank;
- Keep up with specified service intervals.

Use of alternative oxygenated, gasohol blended, unleaded gasoline is acceptable as long as:

- The ethyl or grain alcohol blends DO NOT exceed 10% by volume or
- Methyl tertiary butyl ether (MTBE) blends DO NOT exceed 15% by volume

RFG (reformulated) gasoline is acceptable for all machines designed for use of regular unleaded fuel. Older machines (that were designed for leaded fuel) may see some accelerated valve and seat wear.



MIF

**CAUTION: Avoid Injury! California Proposition 65 Warning: Gasoline engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.**

## Gasoline Storage

**IMPORTANT: Avoid damage! Keep all dirt, scale, water or other foreign material out of gasoline.**

Keep gasoline stored in a safe, protected area. Storage of gasoline in a clean, properly marked (“UNLEADED GASOLINE”) POLYETHYLENE PLASTIC container WITHOUT any metal screen or filter is recommended. DO NOT use de-icers to attempt to remove water from gasoline or depend on fuel filters to remove water from gasoline. Use a water separator installed in the storage tank outlet. BE SURE to properly discard unstable or contaminated gasoline. When storing the machine or gasoline, it is recommended that you add **John Deere Gasoline Conditioner and Stabilizer (TY15977)** or an equivalent to the gasoline. BE SURE to follow directions on container and to properly discard empty container.

## Engine Oil - North America

Use the appropriate oil viscosity based on the expected air temperature range during the period between recommended oil changes. Operating outside of these recommended oil air temperature ranges may cause premature engine failure.

The following John Deere oil is PREFERRED:

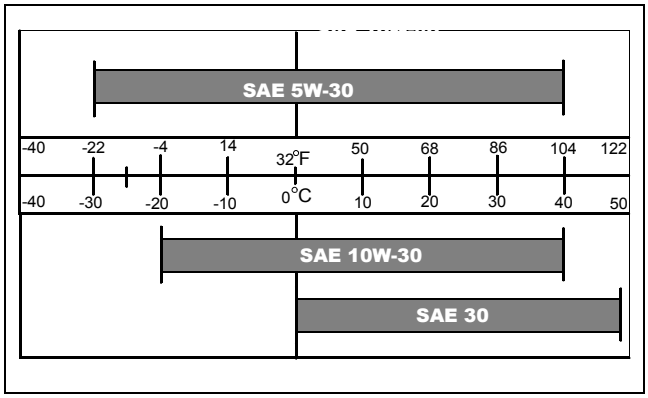
- **TORQ-GARD SUPREME® - SAE 5W-30.**

The following John Deere oils are **also recommended**, based on their specified temperature range:

- **TURF-GARD® - SAE 10W-30;**
- **PLUS-4® - SAE 10W-30;**
- **TORQ-GARD SUPREME® - SAE 30.**

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

- SAE 5W-30 - API Service Classification SG or higher;
- SAE 10W-30 - API Service Classification SG or higher;
- SAE 30 - API Service Classification SC or higher.




## Engine Oil - Europe

Use the appropriate oil viscosity based on their expected air temperature range during the period between recommended oil changes. Operating outside of these recommended oil air temperature ranges may cause premature engine failure.

The following John Deere oils are PREFERRED:

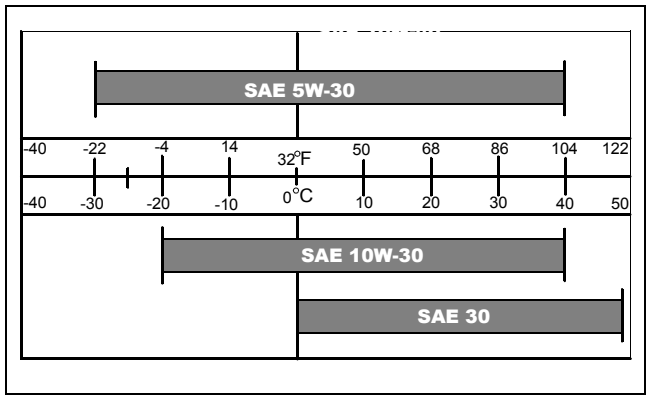
- **TORQ-GARD SUPREME® - SAE 5W-30;**
- **UNI-GARD™ - SAE 5W-30.**

The following John Deere oils are **also recommended**, based on their specified temperature range:

- **TORQ-GARD SUPREME® - SAE 10W-30;**
- **UNI-GARD™ - SAE 10W-30;**
- **TORQ-GARD SUPREME® - SAE 30**
- **UNI-GARD™ - SAE 30.**

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

- CCMC Specification G4 or higher.




## Engine Break - In Oil

**IMPORTANT: Avoid damage! ONLY use a quality break-in oil in rebuilt or remanufactured engines for the first 5 hours (maximum) of operation. DO NOT use oils with heavier viscosity weights than SAE 5W-30 or oils meeting specifications API SG or SH, these oils will not allow rebuilt or remanufactured engines to break-in properly.**

The following John Deere oil is PREFERRED:

- John Deere **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.

The following John Deere oil is **also recommended as a break-in engine oil**:

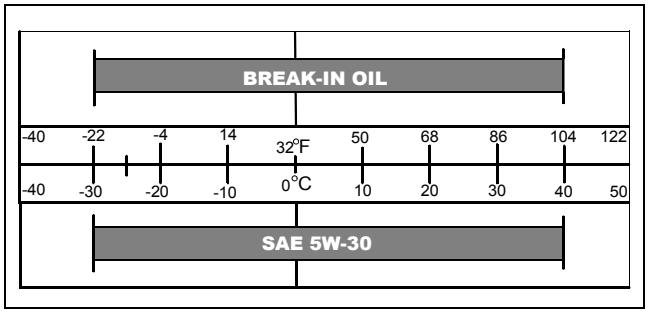
- **TORQ-GARD SUPREME® - SAE 5W-30.**

If the above recommended John Deere oils are not available, use a break-in engine oil meeting the following specification during the first 5 hours (maximum) of operation:

- SAE 5W-30 - API Service Classification SE or higher.

- SAE 5W-30 - CCMC Specification G4 or higher.

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




## Hydrostatic Transmission 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: Avoid damage! Use only the oils recommended. HY-GARD® - JDM J20C can be mixed with 5W30 or 10W30 in this application.**

**Use LOW VISCOSITY HY - GARD® oil.**

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

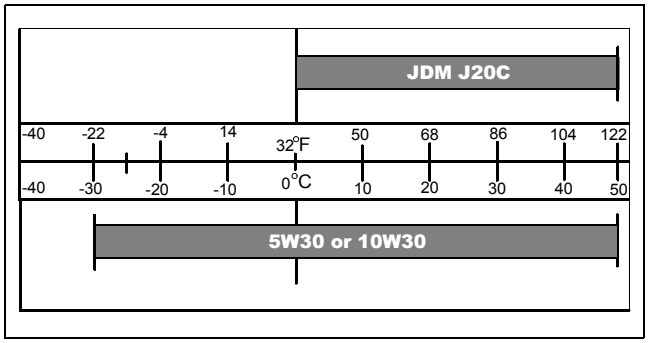
- **HY-GARD® - JDM J20C**.

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

- **5W30 or 10W30.**

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 J20C.




## Anti-Corrosion Grease

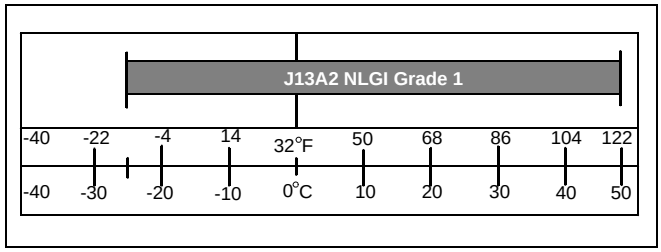
This anti-corrosion grease is formulated to provide the best protection against absorbing moisture, which is one of the major causes of corrosion. This grease is also superior in its resistance to separation and migration.

The following anti-corrosion grease is PREFERRED:

- DuBois MPG-2® Multi-Purpose Polymer Grease - M79292.

Other greases may be used if they meet or exceed the following specifications:

- John Deere Standard JDM J13A2, NLGI Grade 1.




## Alternative Lubricants

Conditions in certain geographical areas outside the United States and Canada may require different lubricant recommendations than the ones printed in this technical manual or the operator's manual. Consult with your John Deere Dealer, or Sales Branch, to obtain the alternative lubricant recommendations.

**IMPORTANT: Avoid damage! Use of alternative lubricants could cause reduced life of the component.**

If alternative lubricants are to be used, it is recommended that the factory fill be thoroughly removed before switching to any alternative lubricant.

## Synthetic Lubricants

Synthetic lubricants may be used in John Deere equipment if they meet the applicable performance requirements (industry classification and/or military specification) as shown in this manual.

The recommended air temperature limits and service or lubricant change intervals should be maintained as shown in the operator's manual.

Avoid mixing different brands, grades, or types of oil. Oil manufacturers blend additives in their oils to meet certain specifications and performance requirements. Mixing different oils can interfere with the proper functioning of these additives and degrade lubricant performance.

## Lubricant Storage

All machines operate at top efficiency only when clean lubricants are used. Use clean storage containers to handle all lubricants. Store them in an area protected from dust, moisture, and other contamination. Store drums on their sides. Make sure all containers are properly marked as to their contents. Dispose of all old, used containers and their contents properly.

## Mixing Of Lubricants

In general, avoid mixing different brands or types of lubricants. Manufacturers blend additives in their lubricants to meet certain specifications and performance requirements. Mixing different lubricants can interfere with the proper functioning of these additives and lubricant properties which will downgrade their intended specified performance.

## Chassis Grease

Use the following grease based on the air temperature range. Operating outside of the recommended grease air temperature range may cause premature failures.

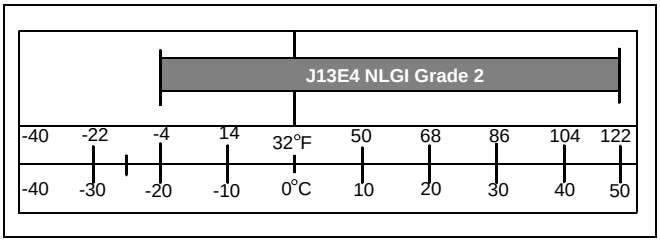
**IMPORTANT: Avoid damage! ONLY use a quality grease in this application. DO NOT mix any other greases in this application. DO NOT use any BIO-GREASE in this application.**

The following John Deere grease is PREFERRED:

- **HIGH-TEMPERATURE EP GREASE® - JDM J13E4, NLGI Grade 2.**
- **GREASE-GARD™ - JDM J13E4, NLGI Grade 2.**

Other greases may be used if above preferred John Deere grease is not available, provided they meet the following specification:

- John Deere Standard JDM J13E4, NLGI Grade 2.




## Oil Filters

**IMPORTANT: Avoid damage! Filtration of oils is critical to proper lubrication performance. Always change filters regularly.**

The following John Deere oil filters are PREFERRED:

- Automotive And Light Truck Engine Oil Filters.

Most John Deere filters contain pressure relief and anti-drainback valves for better engine protection.

Other oil filters may be used if above recommended John Deere oil filters are not available, provided they meet the following specification:

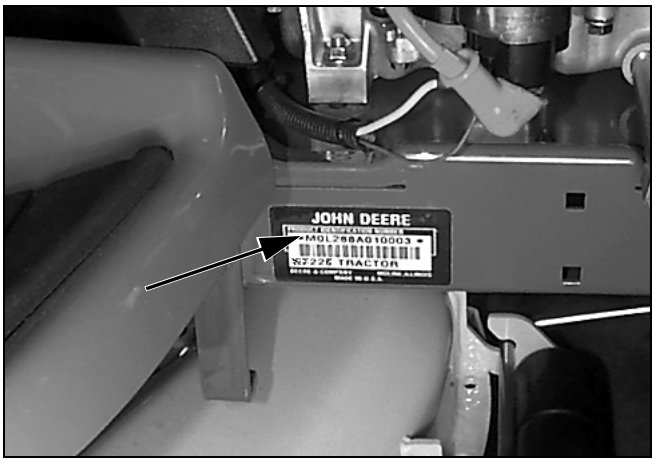
- ASTB Tested In Accordance With SAE J806.

## Serial Number Locations

### Product Identification Number (PIN)

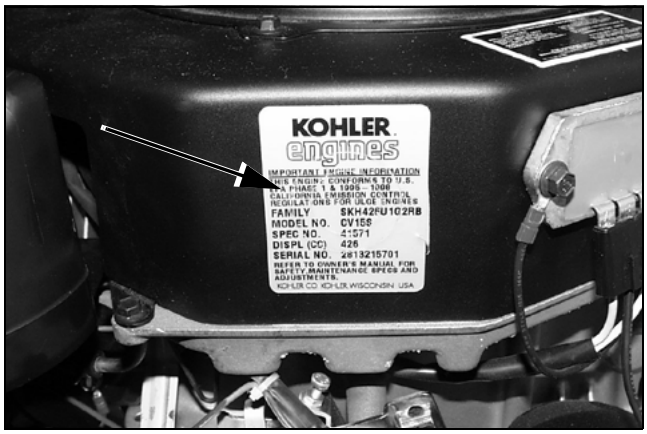
When ordering parts or submitting a warranty claim, it is IMPORTANT that you include the product identification number and the component product identification numbers.

The location of identification numbers and component product identification numbers are shown.



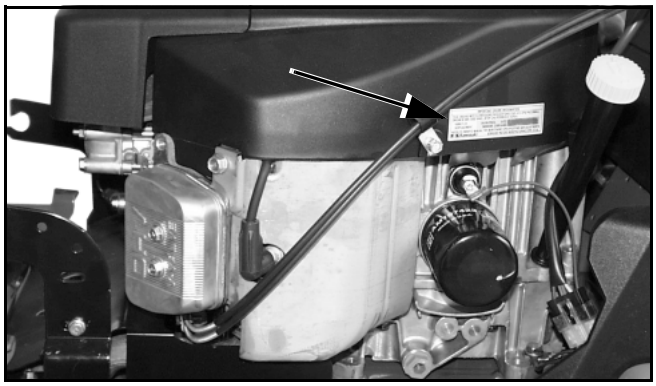

M99748

### Engine Identification Number - Kohler



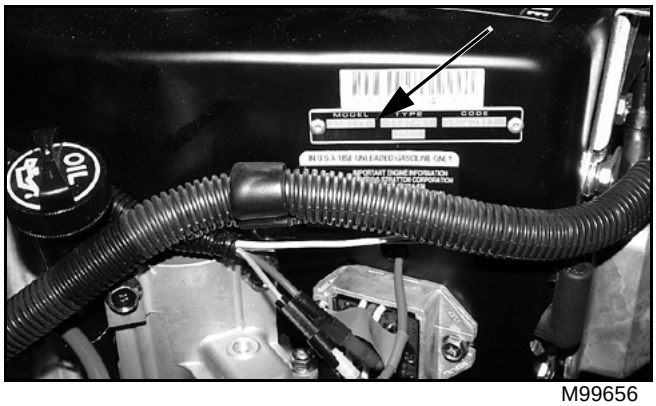

M99653

### Engine Identification Number - Kawasaki



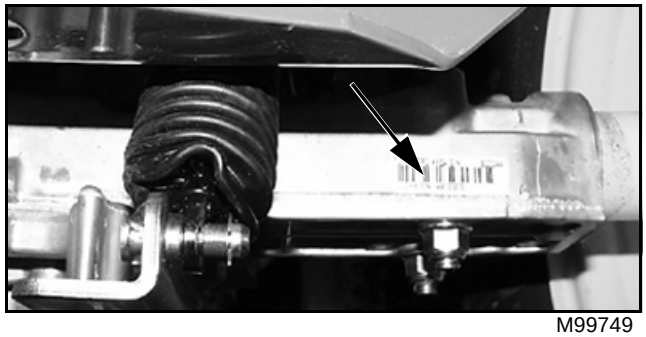
MX16331

### Engine Identification Number - Briggs & Stratton




M99656

### Hydrostatic Transaxle Identification Number



M99749

**Table of Contents**

# ENGINE - KOHLER SPECIFICATIONS

## Specifications

## General Specifications

| | |
|---|---|
| Engine Use | GT225 |
| Make | Kohler |
| Model Number | Command 15 QT / CV15S-41571 |
| Power | 11.19 kW (15.0 hp) |
| Displacement | 426 cm3 (26.0 cu in.) |
| Cylinders | 1 |
| Stroke/Cycle | 4 |
| Valves | Overhead Valves |
| Bore | 90 mm (3.55 in.) |
| Stroke | 67 mm (2.64 in.) |
| Compression Ratio | 2:1 Cranking - 8.5:1 Running |
| Compression Release | Automatic/Centrifugal |
| Crankshaft Type | Vertical (Counterbalanced) |
| Lubrication | Pressurized Gerotor Pump 0 - 413 kPa (0 - 60 psi) |
| Oil Filter | Single Element, Full Flow, Spin-On Filter |
| Crankcase Oil Capacity w/o Oil Filter) | 1.3 L (1.4 qt) |
| Crankcase Oil Capacity w/ Oil Filter | 1.8 L (1.9 qt) |
| Cooling System | Air Cooled |
| Air Cleaner | Paper w/ Outer Foam Element |
| Muffler | Horizontal Discharge Below Frame |
| Maximum Angle of Operation (With Full Crankcase) Continuous (All Directions) | 20° |
| Maximum Angle of Operation (With Full Crankcase) Intermittent (All Directions) | 35° |
| Fuel Filter | Replaceable (In-Line Type) |
| Fuel Shut-Off Solenoid | Replaceable (Below Carburetor Float Bowl) |
| Weight | 39.54 kg (87 lbs) |

## Tests and Adjustments Specifications

| | |
|---|---|
| Valve Adjustment | None (Hydraulic Lifters) |
| Oil Pressure (at 3350 rpm) | 69 - 517 kPa (10 - 75 psi) |
| (Minimum at 1250 rpm) | 28 kPa (4 psi) |
| Crankcase Vacuum (Minimum At Operating Temp.) | 102 mm (4.0 in.) |
| Automatic Compression Release Minimum Lift | 0.76 - 1.02 mm (0.030 - 0.040 in.) |
| Ignition Module Air Gap | 0.25 mm (0.010 in.) |
| Fuel/Air System: | |
| Carburetor Slow Idle Mixture Screw Initial Setting | Lightly Seat, Then 1 Turn Out |
| Fuel Pressure (Minimum) | 6.12 kPa (0.90 psi) |
| Fuel Flow (Minimum, 15 Seconds) | 30 ml (1.0 US oz) |
| Slow Idle Speed | 1550 ± 100 rpm |
| Fast Idle Speed | 3350 ± 50 rpm |
| Spark Plug Type | Champion RC12YC |
| Spark Plug Gap | 1.0 mm (0.040 in.) |
| Torque | 40 N•m (30 lb-ft) |

## Repair Specifications

**Cylinder Head**

| | |
|---|---|
| Cylinder Head Flatness (Maximum Warp) | 0.076 mm (0.003 in.) |

**Push Rod**

| | |
|---|---|
| Maximum Bend | 0.76 mm (0.030 in.) |

**Valves and Valve Lifters**

| | |
|---|---|
| Hydraulic Lifter Clearance | 0.0124 - 0.0501 mm (0.0005 - 0.0020 in.) |
| Intake Valve-to-Guide Clearance | 0.038 - 0.076 mm (0.0015 - 0.0030 in.) |
| Intake Valve Stem OD | 6.982 - 7.000 mm (0.275 - 0.276 in.) |
| Oversize | 7.232 - 7.250 mm (0.284 - 0.285 in.) |
| Intake Valve Guide ID: | |
| New | 7.038 - 7.058 mm (0.277 - 0.278 in.) |
| Maximum | 7.134 mm (0.281 in.) |
| Oversize | 7.288 - 7.308 mm (0.287 - 0.288 in.) |
| Exhaust Valve-to-Guide Clearance | 0.050 - 0.088 mm (0.002 - 0.0035 in.) |
| Exhaust Valve Stem OD | 6.970 - 6.988 mm (0.274 - 0.275 in.) |
| Oversize | 7.220 - 7.238 mm (0.284 - 0.285 in.) |
| Exhaust Valve Guide ID: | |
| New | 7.038 - 7.058 mm (0.277 - 0.278 in.) |
| Maximum | 7.159 mm (0.282 in.) |
| Oversize | 7.238 - 7.308 mm (0.285 - 0.288 in.) |
| Valve Guide Reamer: | |
| Standard | 7.048 mm (0.2775 in.) |
| Oversize (0.25 mm) | 7.298 mm (0.2873 in.) |
| Intake Valve Lift (Minimum - Engine Cold) | 8.96 mm (0.353 in.) |
| Exhaust Valve Lift (Minimum - Engine Cold) | 9.14 mm (0.360 in.) |
| Valve Face Angle | 45° |
| Valve Seat Angle | 44.5° |
| Valve Margin (Minimum) | 1.5 mm (0.059 in.) |
| Valve Stem Bend (Maximum) | 0.076 mm (0.003 in.) |

**Rocker Arms**

| | |
|---|---|
| Rocker Arm Bearing ID: | |
| New | 15.837 - 16.127 mm (0.63 - 0.64 in.) |
| Wear Limit | 15.727 mm (0.619 in.) |

**Rocker Shaft**

| | |
|---|---|
| Rocker Shaft OD: | |
| New | 15.837 - 16.127 mm (0.63 - 0.64 in.) |
| Wear Limit | 15.727 mm (0.619 in.) |

**Crankshaft**

| | |
|---|---|
| End Play | 0.0575 - 0.4925 mm (0.0023 - 0.0194 in.) |

**Crankshaft Bore ID (Crankcase Half):**
**New . . . . . 44.965 - 45.003 mm (1.7703 - 1.7718 in.)**
**Maximum . . . . . 45.016 mm (1.7723 in.)**
**(Clearance (New) . . . . . 0.03 - 0.09 mm (0.0012 - 0.0035 in.)**
**Crankshaft Bore (Oil Pan Half):**
**New . . . . . 44.965 - 45.003 mm (1.7703 - 1.7718 in.)**
**Maximum . . . . . 45.016 mm (1.7723 in.)**
**Clearance (New) . . . . . 0.03 - 0.09 mm (0.0012 - 0.0035 in.)**
**Main Bearing Journal OD (Flywheel End):**
**New . . . . . 44.913 - 44.935 mm (1.7682 - 1.7691 in.)**
**Minimum . . . . . 44.84 mm (1.765 in.)**
**Maximum Taper. . . . . 0.022 mm (0.0009 in.)**
**Maximum Out-of-Round. . . . . 0.025 mm (0.0010 in.)**
**Main Bearing Journal OD (Oil Pan End):**
**New . . . . . 41.915 - 41.935 mm (1.6502 - 1.6510 in.)**
**Minimum . . . . . 41.86 mm (1.648 in.)**
**Maximum Taper. . . . . 0.020 mm (0.0008 in.)**
**Maximum Out-of-Round. . . . . 0.025 mm (0.0010 in.)**
**Connecting Rod Journal OD:**
**New . . . . . 38.958 - 38.970 mm (1.5338 - 1.5343 in.)**
**Minimum . . . . . 38.94 mm (1.5328 in.)**
**Maximum Taper. . . . . 0.012 mm (0.0005 in.)**
**Maximum Out-of-Round. . . . . 0.025 mm (0.0010 in.)**
**Crankshaft Total Indicated Runout (TIR):**
**PTO End (In Engine). . . . . 0.15 mm (0.0059 in.)**
**Entire Crankshaft (In Bench V-Blocks). . . . . 0.10 mm (0.0039 in.)**

**Camshaft**

**End Play (with shims) . . . . . 0.076 - 0.127 mm (0.003 - 0.005 in.)**
**Clearance . . . . . 0.025 - 0.063 mm (0.0010 - 0.0025 in.)**
**Bore ID:**
**New . . . . . 20.000 - 20.025 mm (0.7874 - 0.7884 in.)**
**Maximum . . . . . 20.038 mm (0.7889 in.)**
**Bearing Journal OD:**
**New . . . . . 19.962 - 19.975 mm (0.7859 - 0.7864 in.)**
**Minimum . . . . . 19.959 mm (0.7858 in.)**

**Balance Shaft**

**End Play . . . . . 0.0575 - 0.3625 mm (0.0023 - 0.0143 in.)**
**Clearance . . . . . 0.025 - 0.063 mm (0.0009 - 0.0025 in.)**
**Bore ID:**
**New . . . . . 20.000 - 20.025 mm (0.7874 - 0.7884 in.)**
**Maximum . . . . . 20.038 mm (0.7889 in.)**
**Balance Shaft Bearing Surface (Journal) OD:**
**New . . . . . 19.962 - 19.975 mm (0.7859 - 7864 in.)**
**Minimum . . . . . 19.959 mm (0.7858 in.)**

**Cylinder Bore, Piston and Rings**

**Cylinder Bore ID:**
**New . . . . . 90.000 - 90.025 mm (3.5433 - 3.5443 in.)**

| | |
|---|---|
| Maximum | 90.63 mm (3.5681 in.) |
| Maximum Out-of-Round | 0.12 mm (0.0047 in.) |
| Maximum Taper | 0.05 mm (0.0020 in.) |
| Piston-to-Cylinder Clearance | 0.031 - 0.043 mm (0.0012 - 0.0016 in.) |
| Piston-To-Pin Clearance | 0.006 - 0.017 mm (0.0002 - 0.0007 in.) |
| Piston Pin Bore ID: | |
| New | 19.006 - 19.012 mm (0.7483 - 0.7485 in.) |
| Maximum | 19.025 mm (0.7490 in.) |
| Piston Pin OD: | |
| New | 18.995 - 19.000 mm (0.7478 - 0.7480 in.) |
| Minimum | 18.994 mm (0.7478 in.) |
| Top Compression Ring-To-Groove Side Clearance | 0.060 - 0.105 mm (0.0023 - 0.0041 in.) |
| Middle Compression Ring-To-Groove Side Clearance | 0.040 - 0.085 mm (0.0015 - 0.0002 in.) |
| Oil Control Ring-To-Groove Side Clearance | 0.176 - 0.026 mm (0.0069 - 0.0010 in.) |
| Top and Center Compression Ring End Gap: | |
| New Bore | 0.27 - 0.51 mm (0.010 - 0.020 in.) |
| Used Bore (Maximum) | 0.77 mm (0.030 in.) |
| Piston Thrust Face OD: | |
| New | 89.951 - 89.969 mm (3.5413 - 3.5420 in.) |
| Minimum | 89.824 mm (3.5363 in.) |
| Piston Thrust Face-To-Cylinder Bore Clearance: | |
| New | 0.031 - 0.043 mm (0.0012 - 0.0016 in.) |

**Connecting Rod**

| | |
|---|---|
| Crankshaft (Big End) Clearance: | |
| New | 0.030 - 0.055 mm (0.0012 - 0.0022 in.) |
| Maximum | 0.07 mm (0.0025 in.) |
| Side | 0.18 - 0.41 mm (0.007 - 0.016 in.) |
| Piston Pin Clearance | 0.015 - 0.028 mm (0.0006 - 0.0011 in.) |
| Piston Pin End ID: | |
| New | 19.015 - 19.023 mm (0.7486 - 0.7489 in.) |
| Maximum | 19.036 mm (0.7495 in.) |

**Governor**

| | |
|---|---|
| Crankcase Control Arm Bore ID: | |
| New | 6.025 - 6.050 mm (0.2372 - 0.2382 in.) |
| Maximum | 6.063 mm (0.2387 in.) |
| Control Arm OD: | |
| New | 5.975 - 6.000 mm (0.2352 - 0.2362 in.) |
| Minimum | 5.962 mm (0.2347 in.) |
| Crankcase Bore-To-Control Arm Clearance | 0.025 - 0.075 mm (0.0010 - 0.0030 in.) |
| Gear Shaft OD: | |
| New | 5.990 - 6.000 mm (0.2358 - 0.2362 in.) |
| Minimum | 5.977 mm (0.2353 in.) |
| Gear Shaft-To- Gear Bore Clearance | 0.015 - 0.140 mm (0.0006 - 0.0055 in.) |

**Oil Pump**

| | |
|---|---|
| Relief Valve Spring Free Length | 25.19 mm (0.99 in.) |
| Oil Pump Cover-to-Rotor Clearance | 0.076 mm (0.003 in.) |

## Torque Specifications (Alphabetical)

***NOTE: Use appropriate torque wrench which will read within the inch pound range given, or convert inch pounds to foot pounds as follows: Inch-pounds ³ 12 = Foot-pounds***

**Air Cleaner Base Nut . . . . . 9.9 N•m (88 lb-in.)**
**Cylinder Head Cap Screw:**
**Initial . . . . . 20 N•m (177 lb-in.)**
**Final . . . . . 41 N•m (30 lb-ft)**
**Connecting Rod Cap Screws:**
**8 mm Straight Shank Bolt . . . . . 22.7 N•m (200 lb-in.)**
**Step Down Shank Bolt . . . . . 14.7 N•m (130 lb-in.)**
**6 mm Straight Shank Bolt . . . . . 11.3 N•m (100 lb-in.)**
**Engine Mounting Cap Screws . . . . . 32 N•m (24 lb-ft)**
**Fan Cap Screw . . . . . 9.9 N•m (88 lb-in.)**
**Flywheel Cap Screw . . . . . 68 N•m (50 lb-ft)**
**Fuel Pump/Cover Screw:**
**New Installation (Thread Forming) . . . . . 9.0 N•m (80 lb-in.)**
**Replacement . . . . . 7.3 N•m (65 lb-in.)**
**Fuel Bowl Nut . . . . . 4.0 N•m (35 lb-in.)**
**Governor Arm Clamp Nut . . . . . 10 N•m (89 lb-in.)**
**Governor Control Panel Screw . . . . . 9.9 N•m (88 lb-in.)**
**Ignition Module Screw:**
**New Installation (Thread Forming) . . . . . 6.2 N•m (55 lb-in.)**
**Replacement . . . . . 4.0 N•m (35 lb-in.)**
**Muffler Nut. . . . . 24.4 N•m (216 lb-in.)**
**Oil Filter . . . . . 7.4 N•m (65 lb-in.)**
**Oil Filter Drain Plug . . . . . 8.15 N•m (72.5 lb-in.)**
**Oil Pan Cap Screw . . . . . 24.4 N•m (216 lb-in.)**
**Oil Pressure Switch . . . . . 7.9 N•m (70 lb-in.)**
**Oil Pump Cover Screw:**
**New Installation (Thread Forming) . . . . . 6.2 N•m (55 lb-in.)**
**Replacement . . . . . 4.0 N•m (35 lb-in.)**
**PTO Clutch to Engine Mounting Cap Screw . . . . . 75 N•m (55 lb-ft)**
**Rocker Arm Pivot Cap Screw . . . . . 14 N•m (124 lb-in.)**
**Spark Plug . . . . . 40 N•m (30 lb-ft)**
**Starting Motor Mounting Cap Screws . . . . . 24 N•m (216 lb-in.)**
**Stator Cap Screw . . . . . 4.0 N•m (35 lb-in.)**
**Throttle Plate Cap Screw . . . . . 10.7 N•m (95 lb-in.)**
**Valve Cover Cap Screw:**
**New Installation (Thread Forming) . . . . . 10.7 N•m (95 lb-in.)**
**Replacement . . . . . 7.3 N•m (65 lb-in.)**
**Voltage Regulator/Rectifier . . . . . 7.3 N•m (65 lb-in.)**

## Special or Required Tools

**Special or Required Tools**

| Tool Name | Tool No. | Tool Use |
|---|---|---|
| Reaming Tool (7.05 mm) | D20020WI | Used to clean or size valve guides |
| Reaming Tool (7.25 mm) | JDG705 | Used to bore oversize valve guide |
| Valve Spring Compressor | JDM70 | Used to remove and install valve springs |
| Drill Bit | 6.4 mm (0.25 in.) | Throttle and choke adjustment |
| Dial Indicator | | Automatic compression relief test, valve inspection, crankshaft end play |
| Digital Pulse Tachometer | JT07270 | Slow and/or fast idle adjustment |
| Photo Tachometer | JT05719 | Slow and/or fast idle adjustment |
| Spark Plug Ground | JDM74A5 | Used to prevent accidental engine starting during tests |
| Cylinder Leak Tester | JT035029 | Cylinder leak test |
| U-Tube Manometer Test Kit; or,<br>Crankcase Vacuum Test Kit | JT05697<br>JT03503 | Crankcase vacuum check |
| Oil Pressure Test Adapter<br>w/ O-ring (required only on engines without test ports)<br>Connector<br>Hose Assembly<br>Coupler<br>Gauge, 0 - 700 kPa (0 - 100 psi) | JT07262<br><br><br>JT05487<br>JT03017<br>JT03262<br>JT07034 | Oil pressure test |
| Lapping Tool | | Valve lapping |

## Other Materials

**Other Material**

| Part No. | Part Name | Part Use |
|---|---|---|
| M79292 | MPG-2® Multipurpose Grease | Apply to engine crankshaft |
| | SCOTCH-BRITE® Abrasive Sheets/Pads | Clean cylinder head |
| | Valve Guide Cleaner | Clean valve guides |
| | Lithium Base Grease | Pack oil seals |
| | Mineral Spirits | Clean armature |
| | Valve Lap Compound | Lap valves |
| TY15130 / 595 | LOCTITE® Form-in-Place Gasket | Rocker arm cover mating surfaces |

MPG-2® is a registered trademark of DuBois USA

SCOTCH-BRITE® is a registered trademark of the 3M Co.

LOCTITE® is a registered trademark of the Loctite Corp.

## Diagnostics

## Engine Will Start

**CAUTION: Avoid Injury! BE AWARE! The engine may start to rotate at any time. Keep hands away from all moving parts when testing.**

***NOTE: To test specific electrical components, see Electrical section and refer to either Diagnostics or Tests and Adjustments for further guidance.***

### Symptom: Engine Will Not Crank

**(1) Is battery voltage 12.4 volts or higher?**

**Yes -** Go to next step.

**No -** Charge battery and perform no-load test. Go to next step.

**(2) Is battery voltage 12.4 volts or higher?**

**Yes -** Go to next step.

**No -** Replace battery.

**(3) Does starter solenoid click when ignition switch is turned to START position?**

**Yes -** Check starter motor.

**No -** Check electrical system.

**CAUTION: Avoid Injury! DO NOT rotate engine with starter if the spark plugs are removed. Gasoline spray from the open cylinders may be ignited by ignition spark and cause an explosion or fire.**

***NOTE: Perform a visual inspection first to determine if battery cables are tight and not corroded and if battery is of sufficient size to turn the engine over at minimum cranking speed of 350 rpm.***

### Symptom: Engine Cranks But Will Not Start

**(1) Is battery voltage 12.4 volts or higher?**

**Yes -** Go to next step.

**No -** Charge battery and perform no-load test. Go to next step.

**(2) Is battery voltage 12.4 volts or higher?**

**Yes -** Go to next step.

**No -** Replace battery.

### Symptom: Engine Cranks But Will Not Start

**(3) Does fuel shutoff solenoid click when ignition switch is turned to START/RUN?**

**Yes -** Go to next step.

**No -** Defective fuel shutoff solenoid, switch or wiring. See Electrical section.

**(4) Does engine crank slow?**

**Yes -** Remove spark plugs and turn the engine over by hand. Go to next step.

**No -** Go to step 6.

**(5) Is the engine hard to turn over by hand?**

**Yes -** Pistons or other internal components binding.

**No -** Starter motor defective. Repair or replace as needed.

**(6) Is the choke operating properly?**

**Yes -** Go to next step.

**No -** Adjust choke cable. See “Choke Cable Adjustment” on page 26.

**(7) Do spark plugs have strong blue spark?**

**Yes -** Go to next step.

**No -** Possible defective spark plugs, magneto shorted to ground, flywheel magnet weak, or ignition coil air gap not adjusted. See Electrical section.

**(8) Are tappets adjusted properly.**

**Yes -** Go to next step.

**No -** Adjust. See “Cylinder Leak Test” on page 28.

**(9) Is engine getting fuel?**

**Yes -** Check air leaner, fuel mixture, contaminated fuel, or possible stuck float needle.

**No -** Check fuel shutoff valve, fuel lines, fuel pump, and engine vacuum. See “Fuel Flow Tests” on page 32, or “Crankcase Vacuum Test” on page 31.

## Tests and Adjustments

### Throttle Cable Adjustment

**Reason:**

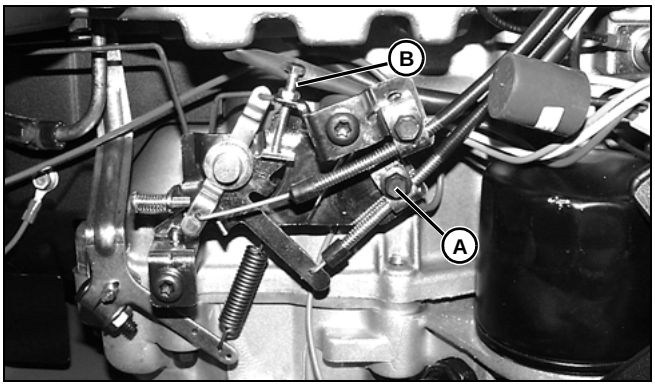
To make sure the throttle cable moves the throttle and choke control lever through its full range of movement.

**Equipment:**

- JT05719 Photo Tachometer; or,
- JT07270 Digital Pulse Tachometer

**Procedure:**

1. Start and run engine at MEDIUM idle for 5 minutes.
2. Loosen cable clamp (A) securing throttle cable.

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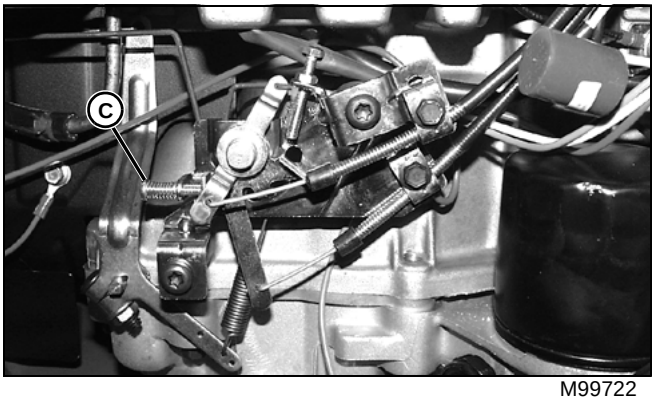
3. Place throttle lever in fast idle position.
4. Adjust fast idle screw (B) until fast idle is **3350 ± 50 rpm**. Pull throttle cable housing rearward to remove any slack in throttle cable.
5. Tighten throttle cable clamp.

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6. Move throttle lever to the slow position.
7. Adjust slow idle screw (C) to set low idle at **1550 ± 100 rpm**.
8. Move throttle lever through full range to be sure linkage is not binding.

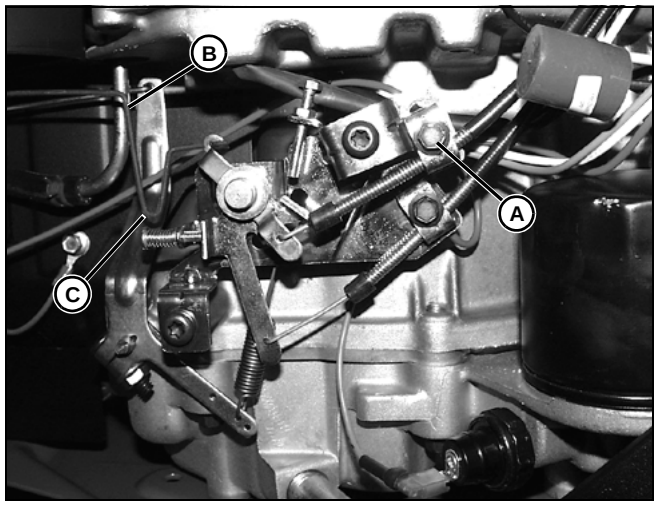
### Choke Cable Adjustment

**Reason:**

To make sure the choke plate is fully closed when the choke lever is in the full choke position. Correct adjustment also ensures choke is completely open when the choke lever is in the OFF (choke open) position.

**Procedure:**

1. Stop engine and set parking brake.
2. Remove air cleaner assembly from carburetor.
3. Move choke lever to full CHOKE position.

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4. Loosen choke cable clamp (A) and pull cable housing rearward to remove any slack in choke cable.
5. Tighten choke cable clamp.
6. Move throttle lever to full choke position.
7. Try to move choke rod (B) forward (choke rod should not move). If the choke rod moves forward, the choke plate is not fully closed. Carefully bend the choke rod at Vee bend (C) until the choke plate is fully closed.
8. Move choke lever to be sure choke linkage is not binding and choke plate fully opens when choke lever is in the OFF position.

## Governor Adjustment

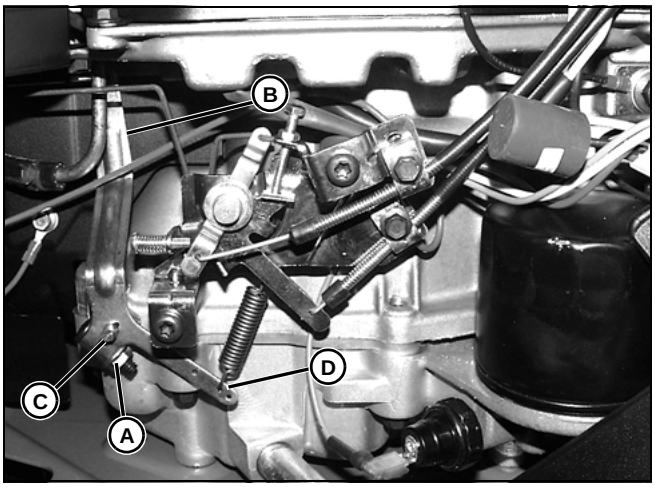
**Reason:**

To make sure the governor shaft contacts the fly-weight plunger when the engine is stopped.

***NOTE: Adjust throttle cable before adjusting governor linkage.***

**Procedure:**

1. Move throttle lever to FAST idle position.



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2. Loosen nut (A).

3. Hold top of governor arm (B) toward carburetor. Turn governor shaft (C) counter-clockwise until it stops. Hold governor shaft and tighten nut.

4. Move throttle lever through full range to be sure linkage is not binding.

5. If governor is not responding properly, check that governor spring is in correct hole (D) in governor arm, replace spring and readjust fast idle speed. If spring did not correct the problem, repair governor.

## Fast Idle Speed Adjustment

**Reason:**

To set engine fast idle rpm.

**Equipment:**

- JT05719 Photo Tachometer; or,
- JT07270 Digital Pulse Tachometer

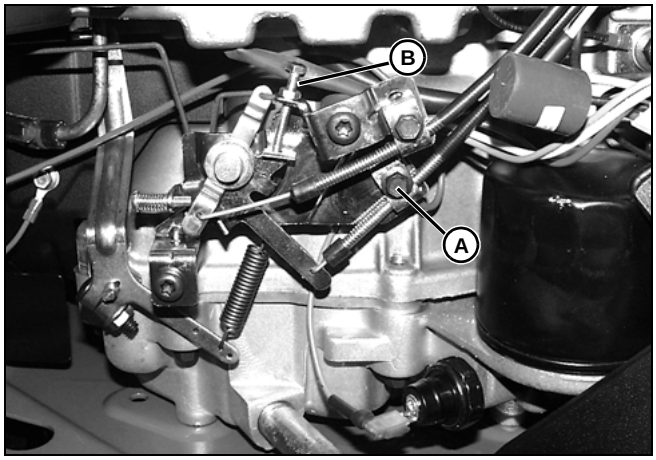
**Procedure:**

1. Move transaxle shift lever to NEUTRAL position. Lock park brake.

**CAUTION: Avoid injury! Engine will be HOT. Be careful not to burn skin.**

2. Start and run engine at MEDIUM idle for 5 minutes.

3. Loosen cable clamp (A) securing throttle cable.



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4. Place throttle lever in fast idle position.

5. Adjust fast idle screw (B) until fast idle is **3350 ± 50 rpm**. Pull throttle cable housing rearward to remove any slack in throttle cable.

6. Tighten throttle cable clamp.

7. Use a photo tachometer to check engine rpm at the blower housing screen; or,
use a digital pulse tachometer to check engine rpm at spark plug wire.

**Specifications:**

**Fast Idle Speed Setting . . . . . .3350 ± 50 rpm**

## Slow Idle Screw Adjustment

**Reason:**

To set engine slow idle stop screw. Slow idle is governed.

**Equipment:**

- JT05719 Photo Tachometer; or,
- JT07270 Digital Pulse Tachometer

**Procedure:**

1. Move transaxle to NEUTRAL. Lock park brake.

**IMPORTANT: Avoid damage! DO NOT remove air cleaner for tests**

2. Put reflective tape on blower housing screen if using a photo tachometer.