



Count on it.

Form No. 3402-253 Rev A

Operator's Manual

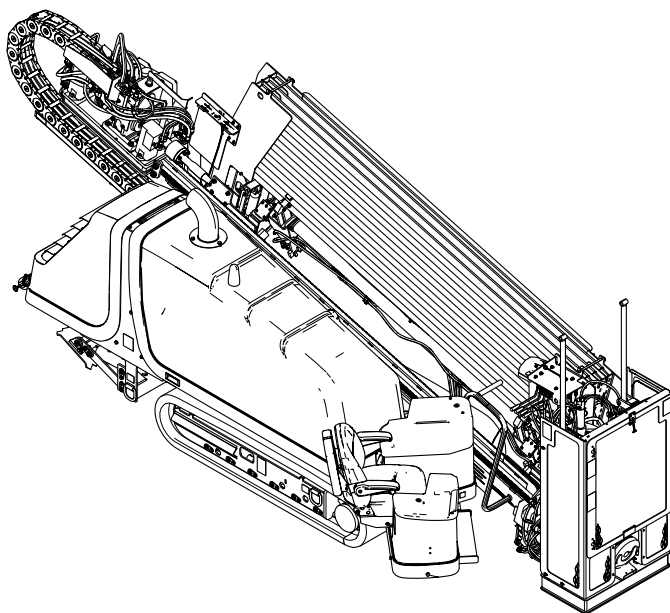
2024 Directional Drill

Model No. 23800A—Serial No. 315000001 and Up

Model No. 23800C—Serial No. 315000001 and Up

Model No. 23800TE—Serial No. 315000001 and Up

Model No. 23800W—Serial No. 315000001 and Up



G021953



This product complies with all relevant European directives; for details, please see the separate product specific Declaration of Conformity (DOC) sheet.

⚠ WARNING

CALIFORNIA Proposition 65 Warning

This product contains a chemical or chemicals known to the State of California to cause cancer, birth defects, or 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.

Because in some areas there are local, state, or federal regulations requiring that a spark arrester be used on the engine of this machine, a spark arrester is available as an option. If you require a spark arrester, contact your Authorized Toro Service Dealer.

Genuine Toro spark arresters are approved by the USDA Forestry Service.

Important: It is a violation of California Public Resource Code Section 4442 to use or operate the engine on any forest-covered, brush-covered, or grass-covered land without a spark arrester muffler maintained in working order, or the engine constricted, equipped, and maintained for the prevention of fire. Other states or federal areas may have similar laws.

The enclosed *Engine Owner's Manual* is supplied for information regarding the US Environmental Protection Agency (EPA) and the California Emission Control Regulation of emission systems, maintenance, and warranty. Replacements may be ordered through the engine manufacturer.

For radio frequency compliance information, refer to your *Compliance Statement Addendum* that pertains to your country.

Labeled power ratings are supplied by the engine manufacturer in accordance with SAE testing and gross/net power rating standards (J1940, J1995, J1349).

Introduction

This machine is a directional drill intended for underground drilling and pullback operation for utility lines including: electrical, gas, communication, water, etc. It is designed to operate a wide variety of attachments each of which perform a specialized function.

Read this information carefully to learn how to operate and maintain your product properly and to avoid injury and product damage. You are responsible for operating the product properly and safely.

You may contact Toro directly at www.Toro.com for product safety and operation training materials, accessory information, help finding a dealer, or to register your product.

Whenever you need service, genuine Toro parts, or additional information, contact an Authorized Service Dealer or Toro Customer Service and have the model and serial numbers of your product ready. [Figure 1](#) identifies the location of the model and serial numbers on the product. Write the numbers in the space provided.

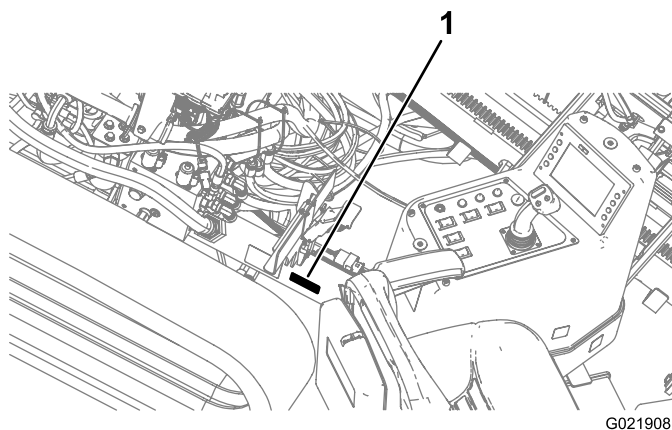


Figure 1

1. Model and serial number location

Model No. _____

Serial No. _____

This manual identifies potential hazards and has safety messages identified by the safety alert symbol ([Figure 2](#)), which signals a hazard that may cause serious injury or death if you do not follow the recommended precautions.



Figure 2

1. Safety alert symbol

This manual uses 2 words to highlight information.

Important calls attention to special mechanical information and **Note** emphasizes general information worthy of special attention.

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Safety

Improper use or maintenance by the operator or owner can result in injury. To reduce the potential for injury, comply with these safety instructions, and pay attention to the safety alert symbol, which means **Caution, Warning, or Danger**—“personal safety instruction.” **Failure to comply with the instructions may result in personal injury or death.**

Important: This machine was manufactured according to the appropriate regulatory standards in effect at the time of manufacture. Modifying this machine in any way may cause it to be out of compliance with those standards and with the instructions in this *Operator's Manual*. Modifications to this machine should only be made by either the manufacturer or an Authorized Toro Dealer.

This product is capable of amputating hands and feet. Follow all safety instructions to avoid serious injury or death.

The owner/user can prevent and is responsible for accidents or injuries occurring to people, or damage to property.

Important: Before operating in an area with high-voltage lines or cables, contact a “One-Call System Directory” service. In the USA, call 811 or your local utility company. If you do not know your local utility company's phone number, call the national number (USA and Canada only) at 1-888-258-0808. Also, contact any utility companies that are not participants of the “One-Call System Directory” service. Please refer to [Drilling Near Utility Lines \(page 6\)](#) for more information.

Training

- Read the *Operator's Manual* and other training material.
Note: If the operator(s) or mechanic(s) cannot read English, it is the owner's responsibility to explain this material to them.
- Become familiar with the safe operation of the equipment, operator controls, and safety signs.
- All operators and mechanics should be trained. The owner is responsible for training the users.
- Do not let children or untrained people operate or service the equipment. Local regulations may restrict the age of the operator.

Preparation

- Evaluate the terrain to determine what accessories and attachments are needed to properly and safely perform the job. Only use accessories and attachments approved by the manufacturer.
- Wear appropriate clothing; including a hard hat, safety glasses, long pants, electrically insulated safety shoes (rubber boots), electrically insulated gloves, and hearing protection.

Important: Long hair, loose clothing or jewelry may get tangled in moving parts.

- Inspect the area where the equipment is to be used and ensure that all objects are removed from the machine before use.
- Use extra care when handling fuels. They are flammable and vapors are explosive.
 - Use only an approved container.
 - Do not remove the fuel cap or add fuel with the engine running. Allow the engine to cool before refueling. Do not smoke near the machine when the engine is running.
 - Do not refuel or drain the machine indoors.
- Check that the operator's presence controls, safety switches, and shields are attached and functioning properly. Do not operate the machine unless they are functioning properly.

General Operation

- Do not run the engine in an enclosed area.
- Do not operate while children, pets, or untrained people are nearby.
- Do not operate the machine with damaged guards, shields, or without safety protective devices in place.
- Ensure that all interlocks are attached, adjusted properly, and functioning properly.
- Ensure that you wear electrically insulated safety boots and gloves.
- Do not change the engine governor setting or overspeed the engine.
- Keep away from moving machine parts and pipes.
- Do not operate the machine when under the influence of alcohol or drugs.
- Do not leave the machine running unattended. Stop the engine and remove the key before leaving.
- Locate the pinch-point areas marked on the machine and attachments and keep hands and feet away from these areas.
- Lightning can cause severe injury or death. If lightning is seen or thunder is heard in the area, do not operate the machine; seek shelter.

Driving Safety

You drive the machine to and from the work site with the use of a tethered remote. When driving the machine, observe the following safety precautions:

- Operate the drive pendant alongside the machine outside of the danger zone (Figure 3).
- Keep all bystanders away while moving the machine.
- Do not carry passengers on the machine.
- Watch for the turning-radius sweep of the drill frame, as the center of the turning radius is the end of the track.
- Moving the machine with the tethered remote can be erratic; move slowly when using the remote for movement.

- Use care when loading or unloading the machine onto a trailer.
- Watch for traffic when crossing roadways.
- Check for overhead clearances (i.e. branches, doorways, electrical wires) before driving under any objects and do not contact them.
- When driving on a slope, the operator should be up-slope from the machine.

The following illustration displays the safe distance that all individuals must maintain while moving the machine.

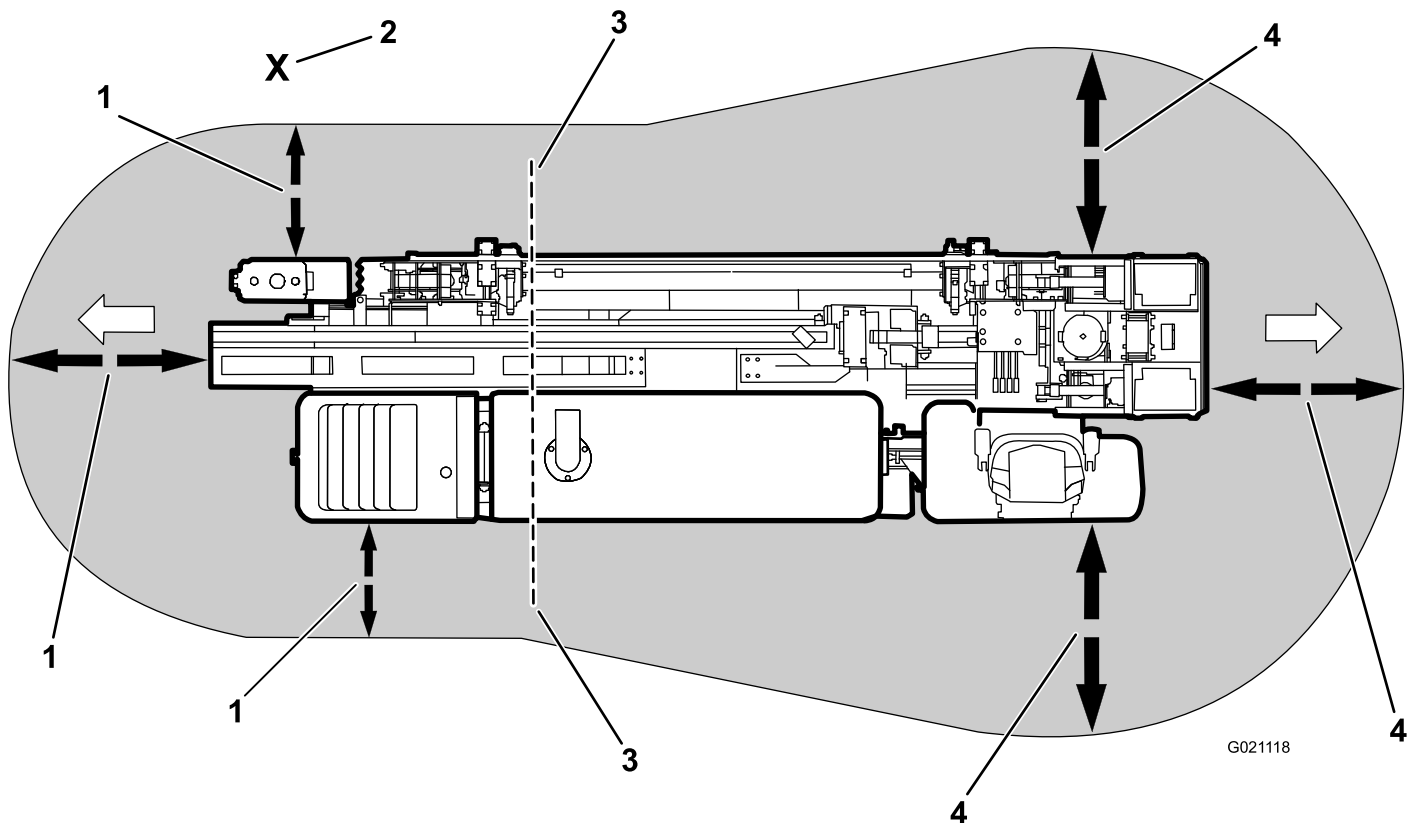


Figure 3
Driving Danger Zone

1. 1.8 m (6 ft) safety distance
2. Operator

3. Turning-radius center
4. 2.4 m (8 ft) safety distance

Drilling Safety

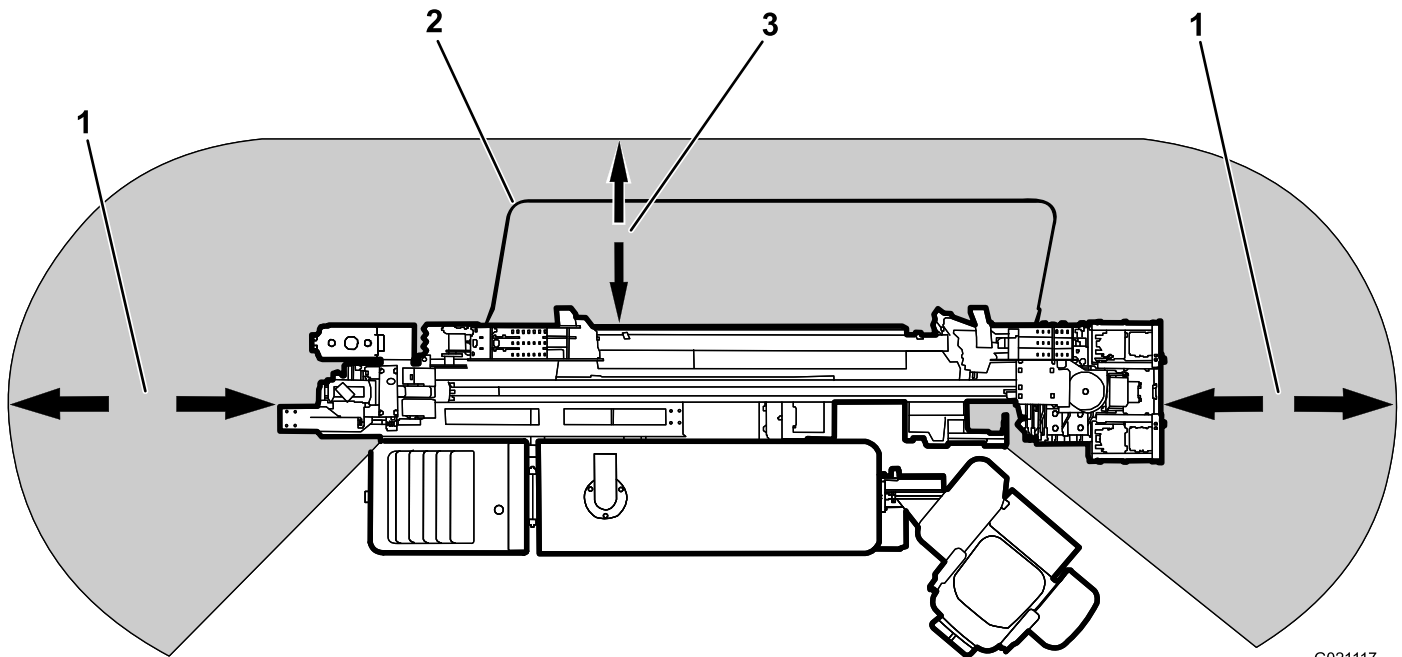
- Always lower the safety bar before drilling ([Figure 4](#)).
- Ensure that no one approaches a pipe while it is spinning. The pipe can snag on clothing and cause amputation or death. Always engage the Exit-side Lockout before anyone approaches the front of the machine, bit, reamer, or pipe.

Drilling Danger Zone

The danger zone is the area within and around the machine where a person is exposed to the risk of injury. This proximity includes where a person can be reached by operational movement of the machine, its working devices, auxiliary equipment, or swinging/falling equipment.

Note: The danger zone defines the amount of space needed for safe drilling operation, including movement of the carriage.

The following illustration displays the safe distance that must be kept by all individuals while drilling.



G021117

Figure 4
Drilling Danger Zone

1. 3 m (10 ft) safety distance
2. Safety bar

3. 1.8 m (6 ft) safety distance

Drilling Near Utility Lines

When working near buried utility lines, safety precautions must be taken.

Important: Before operating in an area with high-voltage lines or cables, contact a “One-Call System Directory” service. In the USA, call 811 or your local utility company. If you do not know your local utility company’s phone number, call the national number (USA and Canada only) at 1-888-258-0808. Also, contact any utility companies that are not participants of the “One-Call System Directory” service. Please refer to [Drilling Near Utility Lines \(page 6\)](#) for more information.

Utility Line Color

Refer to the following table for the proper utility line and the corresponding utility line color (USA and Canada).

Utility Line	Utility Line Color
Electric	Red
Telecommunication, alarm or signal, cables, or conduit	Orange
Natural gas, oil, steam, petroleum, or other gaseous or flammable material	Yellow
Sewer and drain	Green
Drinking water	Blue
Reclaimed water, irrigation, and slurry lines	Purple
Temporary survey markings	Pink
Proposed excavation limits	White

Electrical Line Safety

⚠ WARNING

Do not leave the seat of the machine if the machine is charged with electricity.

If you leave the seat of the machine or touch any part of the machine when it is charged with electricity, serious injury or death could result.

In the event of an electric strike that charges the machine, the Zap-Alert Electric Strike alarm system will sound for as long as the machine is charged with power.

Note: Immediately contact the proper emergency and utility authorities to secure the area in the case that the machine is charged and you cannot leave the seat of the machine.

Note: It is possible to strike a utility line without the machine becoming charged.

- The alarm will sound if the drill contacts an electrical power source.
- It is likely (but not always the case) that the power-source interrupter or breaker will trip, but to ensure your safety, consider that the machine may be conducting electricity.
- Do not attempt to leave the machine.

Note: You will be safe as long as you do not leave the seat of the machine.

- Touching any part of the machine may ground you.
- Do not allow another individual to touch or approach the machine when charged.
- The alarm may sound if a communication line is broken, but until you are certain, you must consider the alarm to be an electric strike.

Gas Line Safety

⚠ WARNING

If you damage a gas line, an immediate explosion and fire hazard could occur. Leaking gas is both flammable and explosive and may cause serious injury or death.

- Do not smoke while operating the machine.
- Shut off the machine and remove the key.
- Remove all individuals from the work area.
- Immediately contact the proper emergency and utility authorities to secure the area.

Water Line Safety

If you damage a water line, a potential flood hazard could occur.

- Shut off the machine and remove the key.
- Remove all individuals from the work area.
- Immediately contact the proper emergency and utility authorities to secure the area.

Communication Line Safety

Important: Refer to [Electrical Line Safety \(page 7\)](#) if a communication line is damaged.

⚠ CAUTION

If you damage the fiber-optic cable and look into the exposed highly-intense light, you may harm your eyes.

- Shut off the machine and remove the key.
- Remove all individuals from the work area.
- Immediately contact the proper emergency and utility authorities to secure the area.

Maintenance and Storage

- Do not touch parts which may be hot from operation. Allow them to cool before attempting to maintain, adjust, or service.
- Lower the thrust frame, stop the engine, and remove the key. Wait for all movement to stop before adjusting, cleaning, or repairing.
- Clean debris from attachments, drives, mufflers, and engine to help prevent fires. Clean up oil or fuel spillage.
- Let the engine cool before storing and do not store near flame.
- Do not store fuel near flames or drain indoors.
- Park the machine on level ground.
- Do not allow untrained personnel to service the machine.
- Carefully release pressure from components with stored energy.
- Keep hands and feet away from moving parts. If possible, do not make adjustments with the engine running.
- Disconnect the battery before making any repairs. Disconnect the negative terminal first and the positive last. Reconnect positive first and negative last.
- Charge batteries in an open, well ventilated area, away from spark and flames. Unplug the charger before connecting or disconnecting it from the battery. Wear protective clothing and use insulated tools.
- Battery acid is poisonous and can cause burns. Avoid contact with skin, eyes, and clothing. Protect your face, eyes, and clothing when working with a battery.
- Battery gases can explode. Keep cigarettes, sparks and flames away from the battery.
- Keep all parts in good-working condition and all hardware tightened. Replace all worn or damaged decals.
- If any maintenance or repair requires the frame to be in the raised position, secure the frame in the raised position with the hydraulic cylinder lock; refer to [Using the Cylinder Lock \(page 59\)](#).
- Keep nuts and bolts tight.
- Keep equipment in good condition.
- Do not tamper with safety devices.
- Keep the machine free of grass, leaves, or other debris build-up. Clean up oil or fuel spillage. Allow the machine to cool before storing.
- Use extra care when handling fuels. They are flammable and vapors are explosive.
 - Use only an approved container.
 - Do not remove the fuel cap or add fuel when the engine is running. Allow the engine to cool before refueling. Do not smoke.
 - Do not refuel the machine indoors.
 - Do not store the machine or fuel container inside where there is an open flame, such as near a water heater or furnace.
 - Do not fill a container while it is inside a vehicle, trunk, pick-up bed, or any surface other than the ground.
 - Keep container nozzle in contact with the tank during filling.
- Use only genuine Toro replacement parts to ensure that original standards are maintained.
- Keep your body and hands away from pin hole leaks or nozzles that eject high pressure hydraulic fluid. Use cardboard or paper to find hydraulic leaks; do not use your hands. Hydraulic fluid escaping under pressure can penetrate skin and cause injury requiring surgery within a few hours by a qualified surgeon or gangrene may result.

Noise and Vibration Levels

WARNING

The operator must wear hearing protection when operating the machine. Failure to wear hearing protection may cause hearing impairment.

Sound Pressure Level

This unit has a sound pressure level at the operator's ear of 92 dBA, which includes an Uncertainty Value (K) of 1 dBA.

Sound pressure level was determined according to the procedures outlined in EN 791.

Sound Power

This unit has a guaranteed sound power level of 113 dBA, which includes an Uncertainty Value (K) of 3.75 dBA.

The sound power level was determined according to the procedures outlined in ISO 4871.

Vibration Level

Measured vibration level for right hand = 0.3 m/s^2

Measured vibration level for left hand = 0.8 m/s^2

Measured vibration level for whole body = 0.17 m/s^2

Uncertainty Value (K) = 0.08 m/s^2

Measured values were determined according to the procedures outlined in EN ISO 20643.

Safety and Instructional Decals



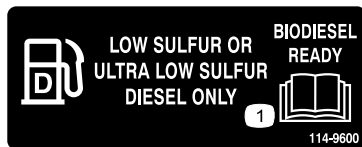
Safety decals and instructions are easily visible to the operator and are located near any area of potential danger. Replace any decal that is damaged or lost.



Battery Symbols

Some or all of these symbols are on your battery

1. Explosion hazard
2. No fire, open flame, or smoking.
3. Caustic liquid/chemical burn hazard
4. Wear eye protection
5. Read the *Operator's Manual*.
6. Keep bystanders a safe distance from the battery.
7. Wear eye protection; explosive gases can cause blindness and other injuries
8. Battery acid can cause blindness or severe burns.
9. Flush eyes immediately with water and get medical help fast.
10. Contains lead; do not discard.



114-9600

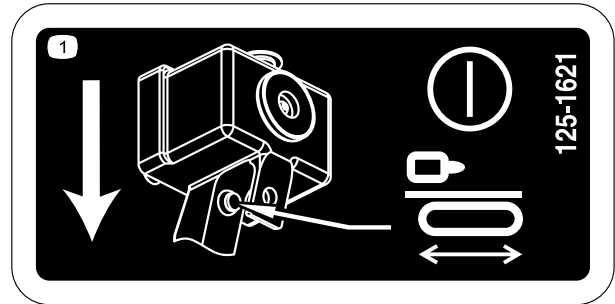
1. Read the *Operator's Manual*.

CALIFORNIA SPARK ARRESTER WARNING

Operation of this equipment may create sparks that can start fires around dry vegetation. A spark arrester may be required. The operator should contact local fire agencies for laws or regulations relating to fire prevention requirements.

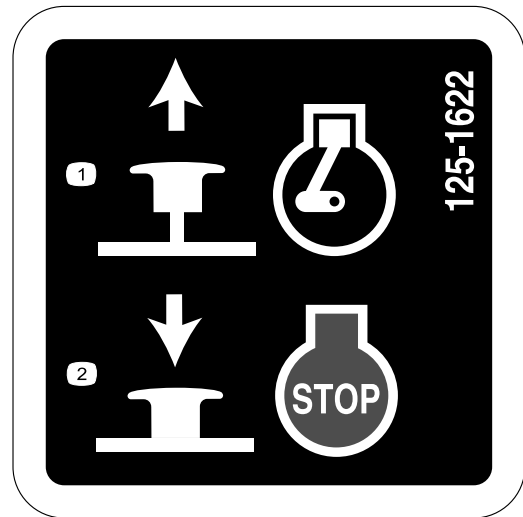
117-2718

117-2718



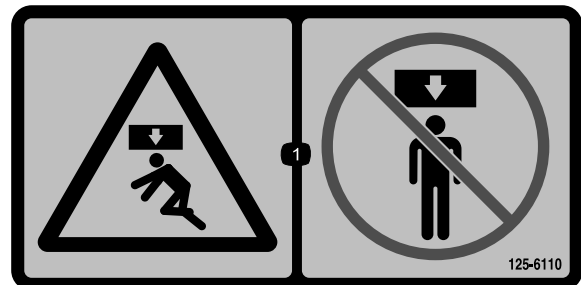
125-1621

1. Press the operator presence switch to enable machine movement.



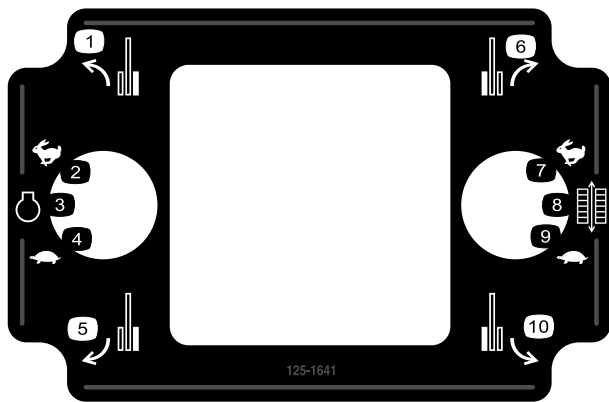
125-1622

1. Pull up to start the engine. 2. Push down to stop the engine.



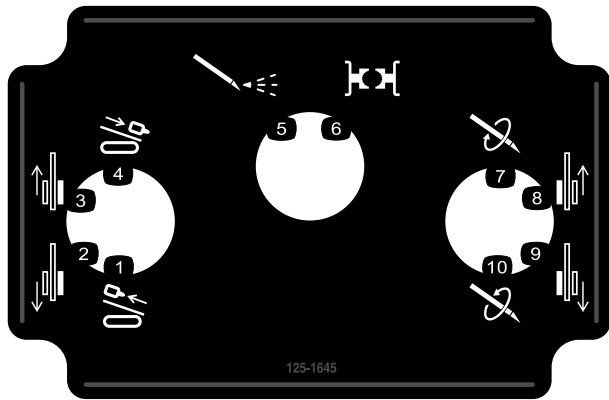
125-6110

1. Crushing hazard—do not stand under any part of the machine.



125-1641

- | | |
|-----------------|-------------------|
| 1. Forward left | 6. Forward right |
| 2. Increase rpm | 7. High |
| 3. Engine speed | 8. Track speed |
| 4. Decrease rpm | 9. Low |
| 5. Reverse left | 10. Reverse right |



125-1645

- | | |
|-----------------------------|---|
| 1. Pull back drill carriage | 6. Wrench controls on |
| 2. Reverse left track | 7. Drill spindle clockwise spin |
| 3. Forward left track | 8. Forward right track |
| 4. Forward drill carriage | 9. Reverse right track |
| 5. Drill fluid pump on | 10. Drill spindle counterclockwise spin |



125-6107

1. Crushing hazard of hand and foot—keep hands and feet away.



125-6108

1. Thrown object hazard—read the *Operator's Manual*.



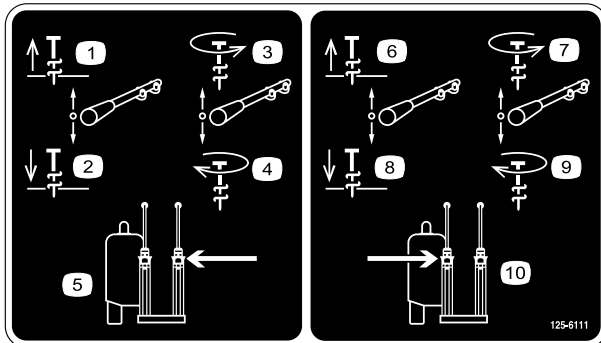
125-6109

1. Electrical shock hazard—when the Zap-Alert system is activated by a power strike, do not leave the operator's position or touch the ground and the machine at the same time; the machine will be energized with electrical power.



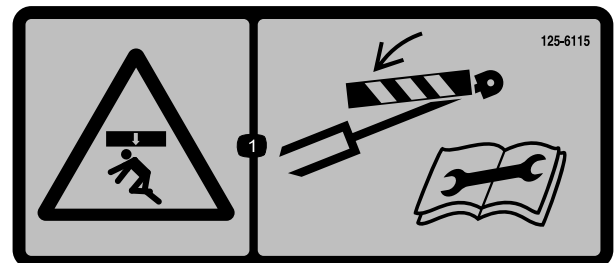
125-6114

1. Stored energy hazard—do not use tools; read the *Operator's Manual*.



125-6111

- | | |
|--------------------------------|--------------------------------|
| 1. Stake up | 6. Stake up |
| 2. Stake down | 7. Stake spin counterclockwise |
| 3. Stake spin counterclockwise | 8. Stake down |
| 4. Stake spin clockwise | 9. Stake spin clockwise |
| 5. Left stake | 10. Right stake |



125-6115

1. Crushing hazard—deploy cylinder locks before performing maintenance.



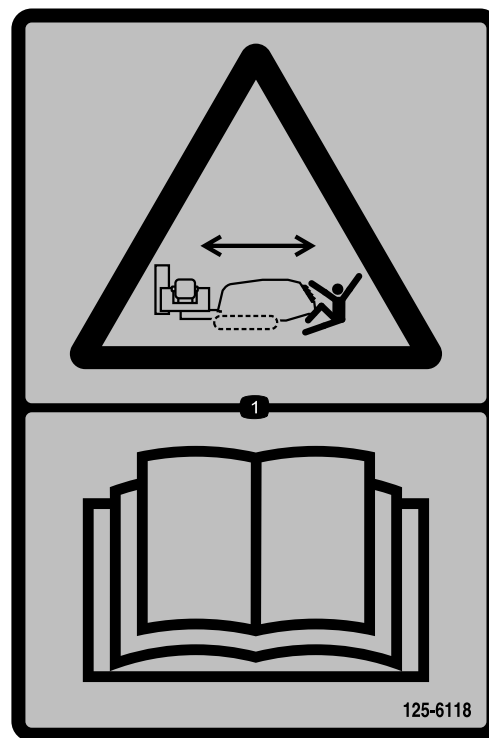
125-6116

1. Falling hazard—do not move the machine when someone is in the operator's position.



125-6117

1. Falling hazard—do not stand on the machine while it is moving.



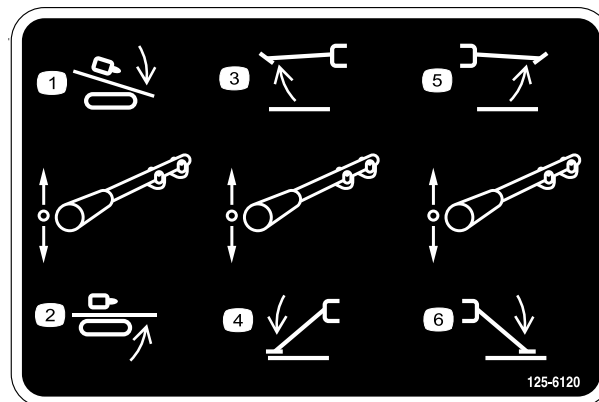
125-6118

1. Crushing hazard, machine movement—read the *Operator's Manual*.



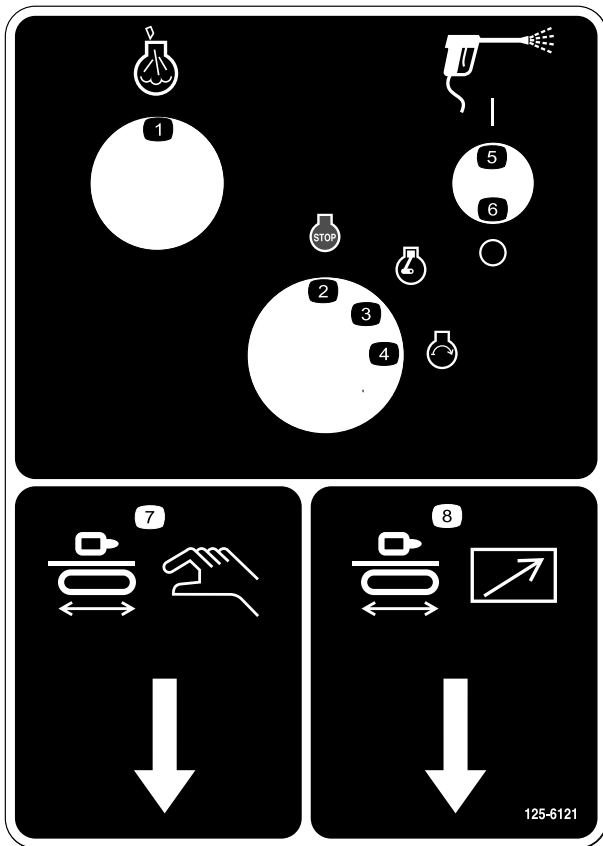
125-6119

1. Entanglement hazard—keep away from moving objects.



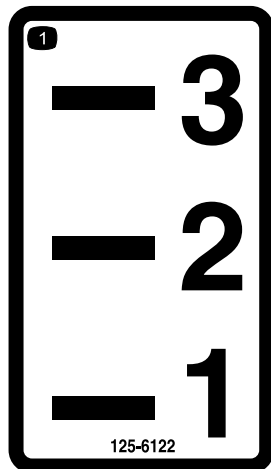
125-6120

- | | |
|--------------------------|---------------------------|
| 1. Raise drill carriage | 4. Lower left stabilizer |
| 2. Lower drill carriage | 5. Raise right stabilizer |
| 3. Raise left stabilizer | 6. Lower right stabilizer |



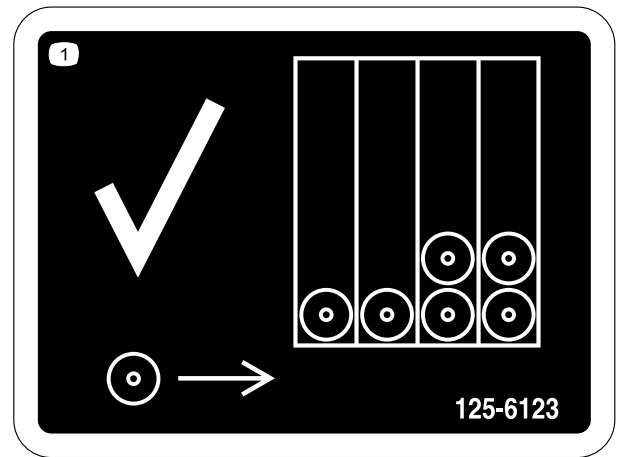
125-6121

1. Engine—heating light
2. Engine—stop
3. Engine—run
4. Engine—start
5. Fluid pump on
6. Fluid pump off
7. Drill-pendant receptacle
8. Drive-pendant receptacle



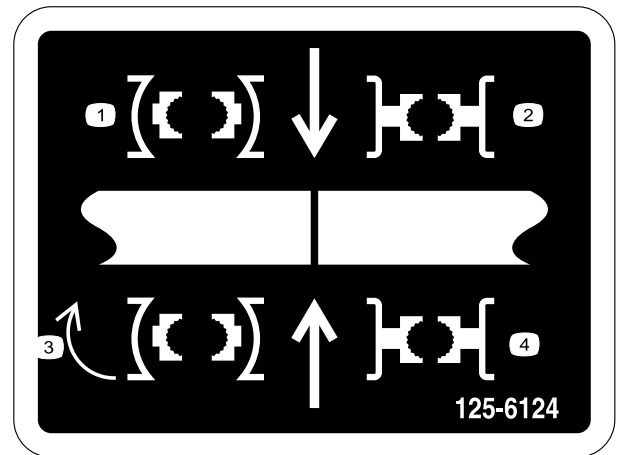
125-6122

1. Pipe row



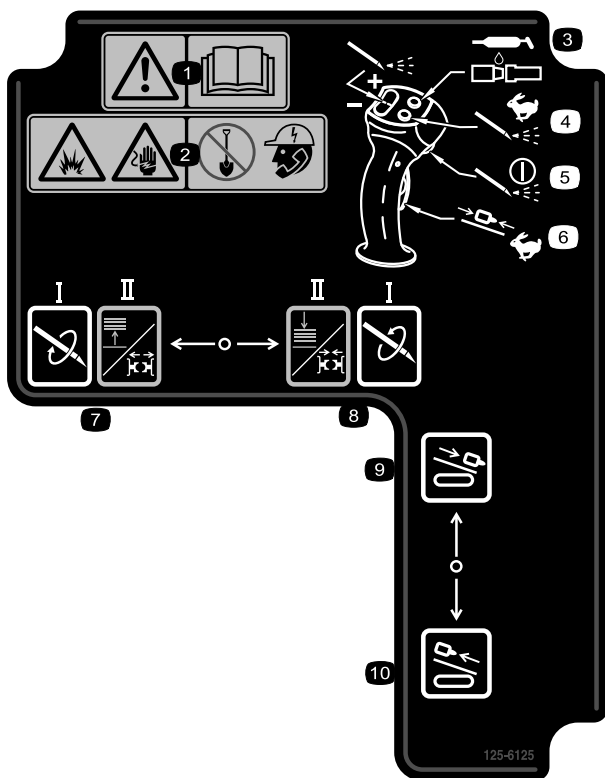
125-6123

1. Load pipes from back row first.



125-6124

1. Center the pipe joint between the upper and lower wrenches.



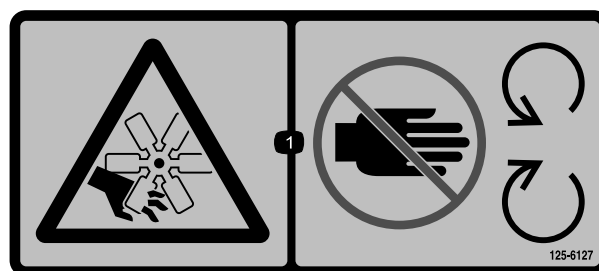
125-6125

1. Warning—read the *Operator's Manual*.
2. Explosion hazard; electrical shock hazard—do not dig before calling local services.
3. Press to apply tread-joint compound.
4. Press and hold for maximum drilling fluid pressure; release to stop the flow.
5. Press to turn the drilling-fluid pump on or off.
6. Press and hold to move the drill carriage at high speed up or down the drill frame.
7. Mode I—spin drill spindle clockwise. Mode II—left trigger pressed, open the lower wrench; left trigger released, raise the pipe elevator.
8. Mode I—spin drill spindle counterclockwise. Mode II—left trigger pressed, close the lower wrench; left trigger released, lower the pipe elevator.
9. Thrust the drill carriage forward.
10. Pull the drill carriage rearward.



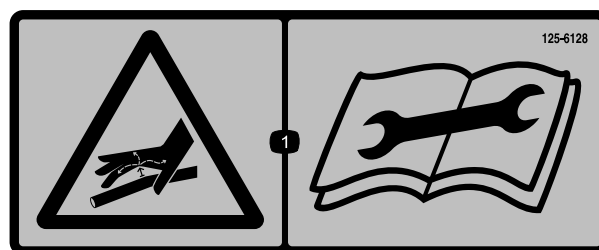
125-6126

1. Entanglement hazard—keep away from moving parts.



125-6127

1. Cutting/dismemberment hazard, fan—keep away from moving parts.



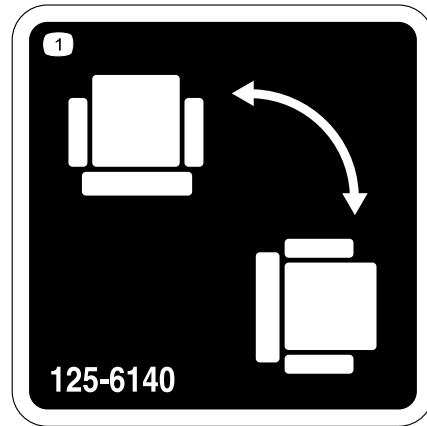
125-6128

1. High pressure fluid hazard, injection into the body—read the *Operator's Manual* before performing maintenance.



125-6129

1. Hot surface—keep away from hot surfaces.



125-6140

1. Rotate the chair.

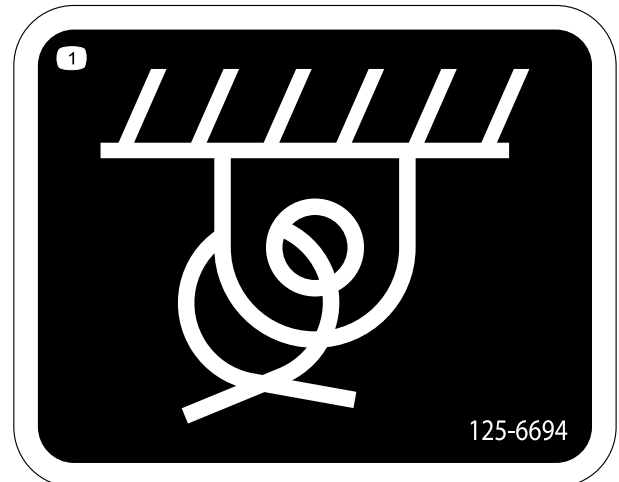


125-6131

1. Warning—stay at least 3 m (10 ft) away from the machine.

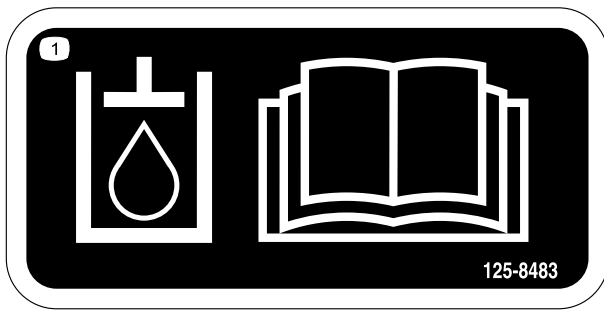


125-6137



125-6694

1. Tie-down point



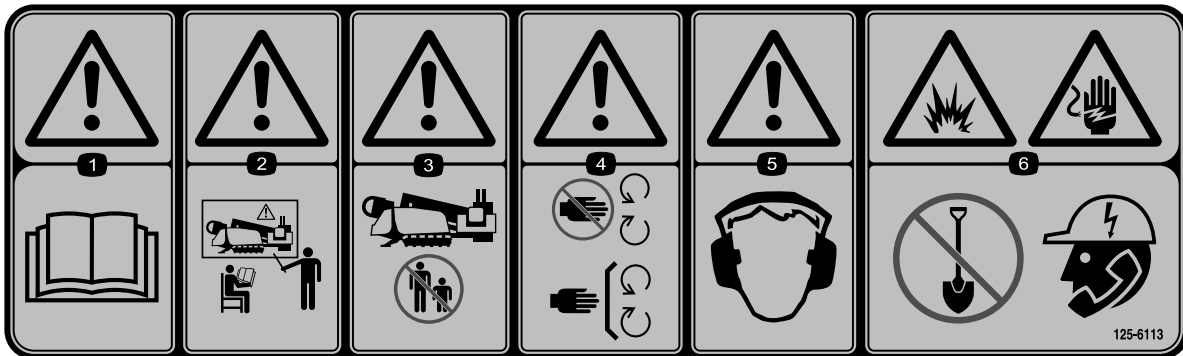
125-8483

1. Hydraulic fluid; read the *Operator's Manual*.



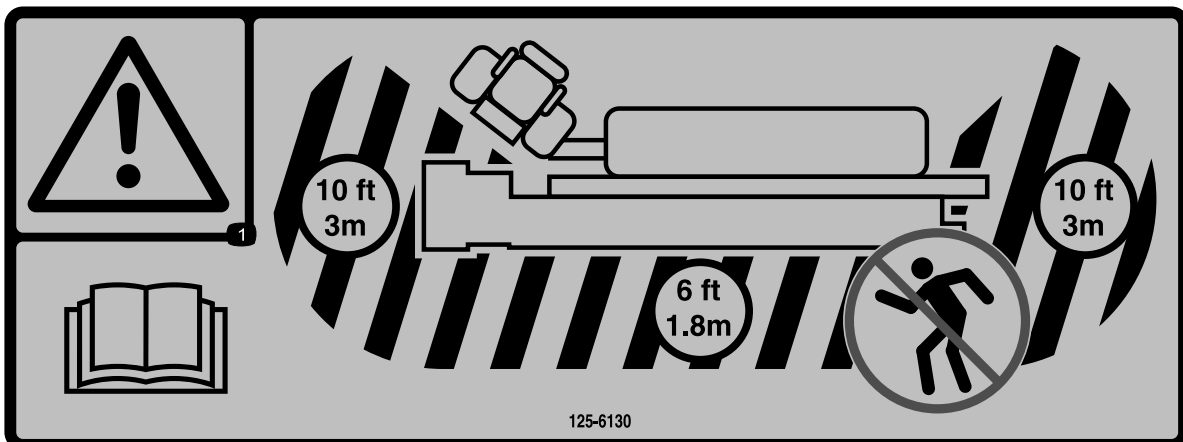
125-8473

1. Explosion hazard—wear eye protection.
2. Caustic liquid/chemical burn hazard—rinse affected area and seek medical assistance.
3. Fire hazard—keep open flames away.
4. Poison hazard—do not tamper with the battery.



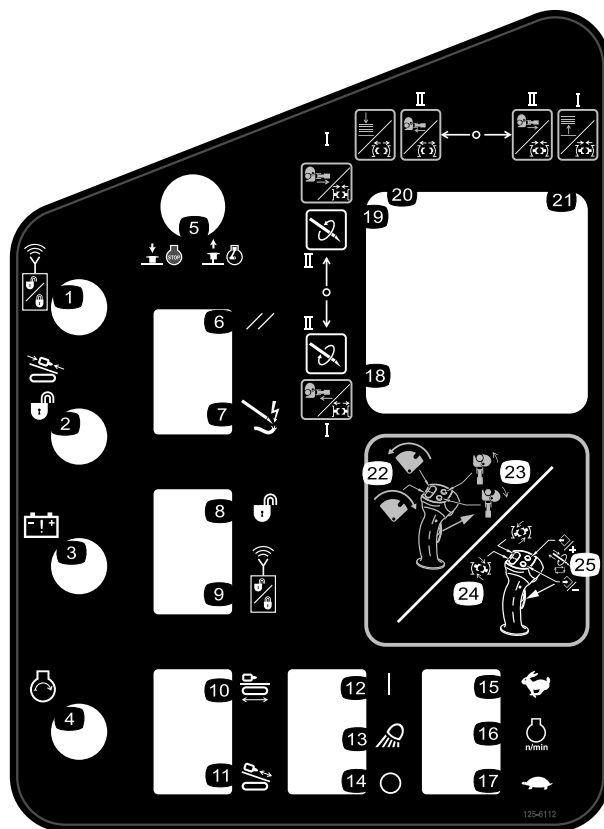
125-6113

1. Warning—read the *Operator's Manual*.
2. Warning—do not operate the machine unless you are trained.
3. Warning—keep bystanders away from the machine.
4. Warning—keep away from moving parts; keep all guards and shields in place.
5. Warning—wear hearing protection.
6. Explosion hazard, electrical shock hazard; do not dig before calling local utilities.



125-6130

1. Warning—read the *Operator's Manual*; stay at least 3 m (10 ft) away from the front and rear of the machine and 1.8 m (6 ft) away from the sides of the machine.



125-6112

1. Exit-side lockout—reset light
2. Exit-side lockout—drill-enabled light
3. Receiver-battery-status light
4. Engine—start
5. Press down to stop the engine; pull up to start the engine.
6. Reset Zap-Alert system
7. Zap-Alert system triggered
8. Unlock exit-side lockout
9. Reset exit-side lockout
10. Engage drive movement and setup functions
11. Engage drill carriage movement and other drill functions
12. Work lights—On
13. Work lights
14. Work lights—Off
15. Press and hold to increase engine speed.
16. Engine speed
17. Press and hold to decrease engine speed.
18. Mode I—left trigger released, extends pipe gripper toward drill frame; left trigger pressed, opens lower wrench. Mode II—spin drill spindle clockwise.
19. Mode I—left trigger released, extends pipe gripper toward pipe holder; left trigger pressed, closes lower wrench. Mode II—spin drill spindle counterclockwise.
20. Mode I—left trigger released, lowers pipe elevator; left trigger pressed, opens upper wrench. Mode II—left trigger released, extends pipe gripper toward drill frame; left trigger pressed, opens upper wrench.
21. Mode I—left trigger released, raises pipe elevator; left trigger pressed, closes upper wrench. Mode II—left trigger released, extends pipe gripper toward pipe holder; left trigger pressed, closes upper wrench.
22. With trigger released, rock forward to rotate pipe loader toward pipe cam, rock backward to rotate pipe loader toward drill frame.
23. With trigger released, upper button closes pipe gripper, lower button opens pipe gripper.
24. With trigger pressed, rock forward to rotate the upper wrench counterclockwise to loosen a joint; rock rearward to rotate the upper wrench clockwise to tighten a joint.
25. With trigger pressed, press front or rear button to resume the previously set auto-drill speed; press and hold the front button to increase the auto-drill speed; press and hold the rear button to decrease the auto-drill speed.

Product Overview

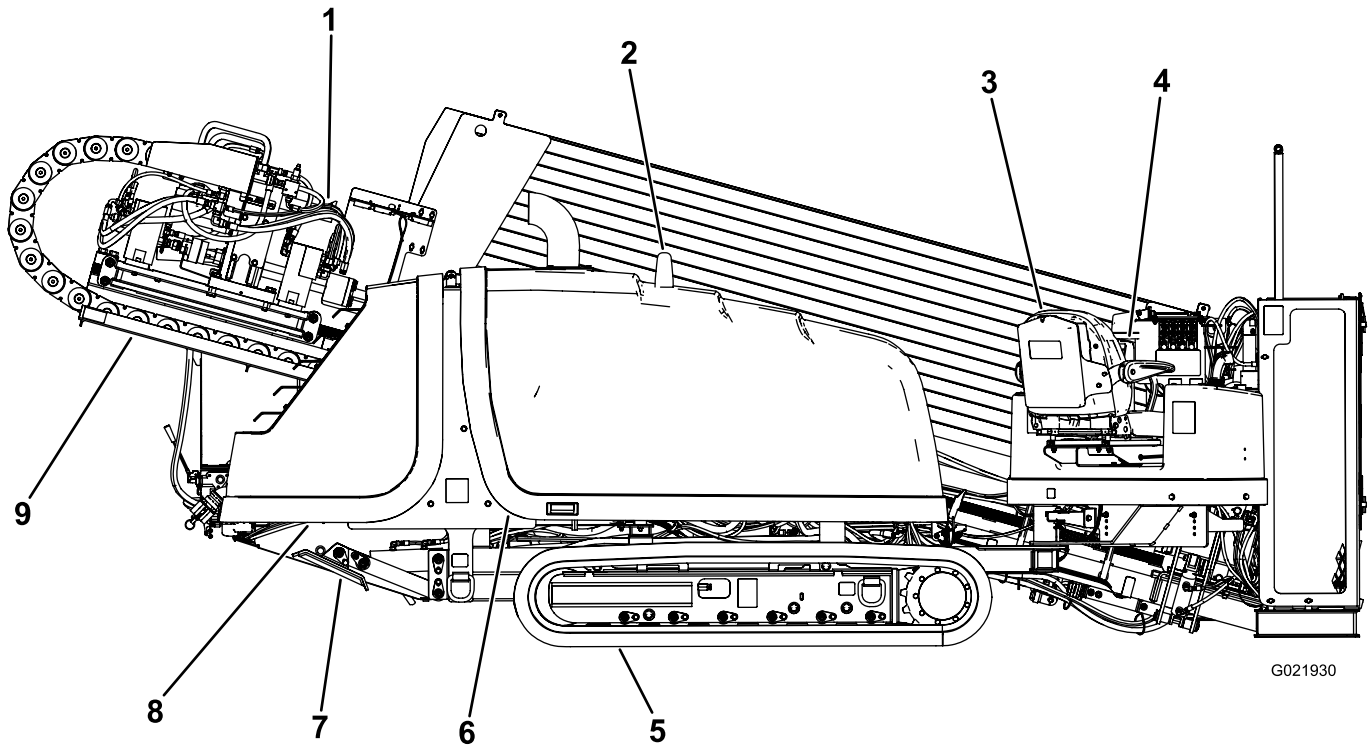


Figure 5

- | | |
|---------------------|---------------------|
| 1. Drill carriage | 6. Front hood |
| 2. Zap-alert strobe | 7. Right stabilizer |
| 3. Operator seat | 8. Rear hood |
| 4. Control panel | 9. Thrust frame |
| 5. Track | |

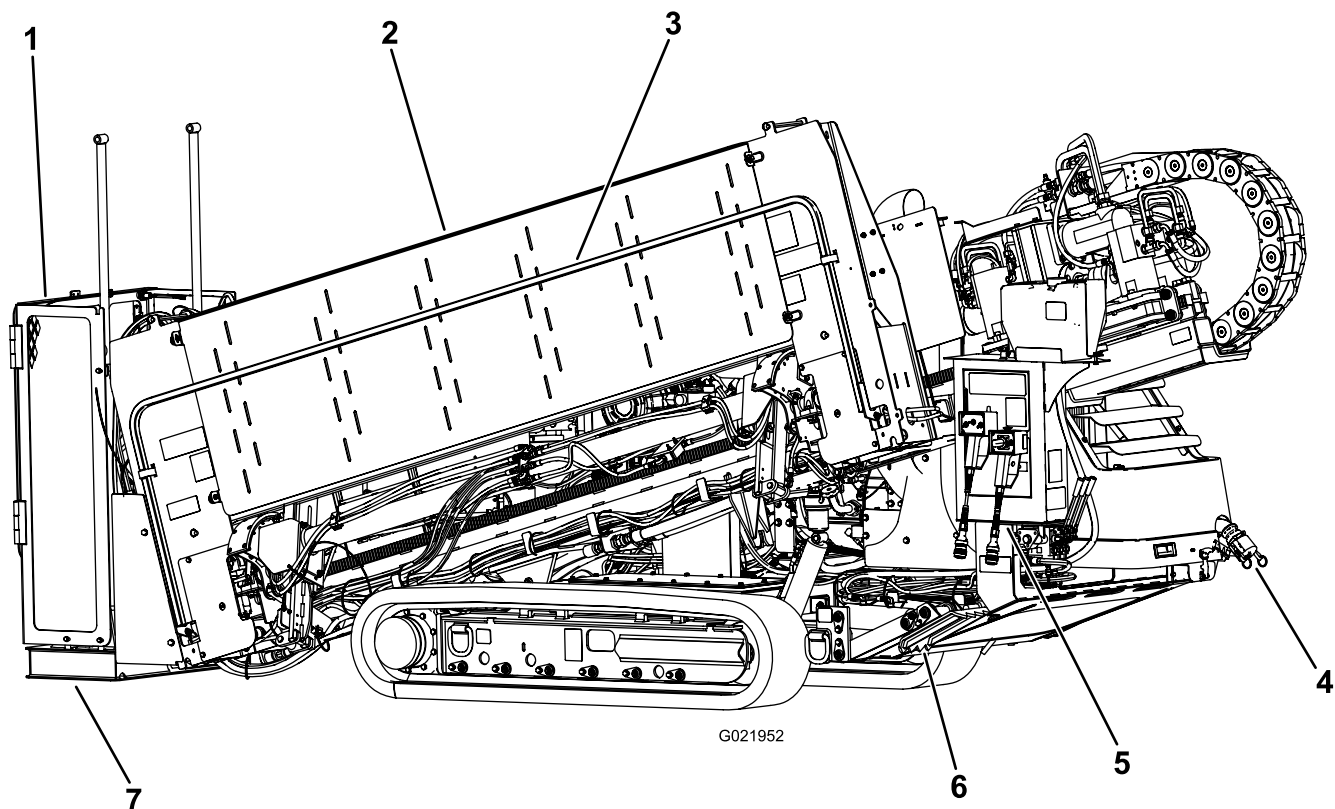
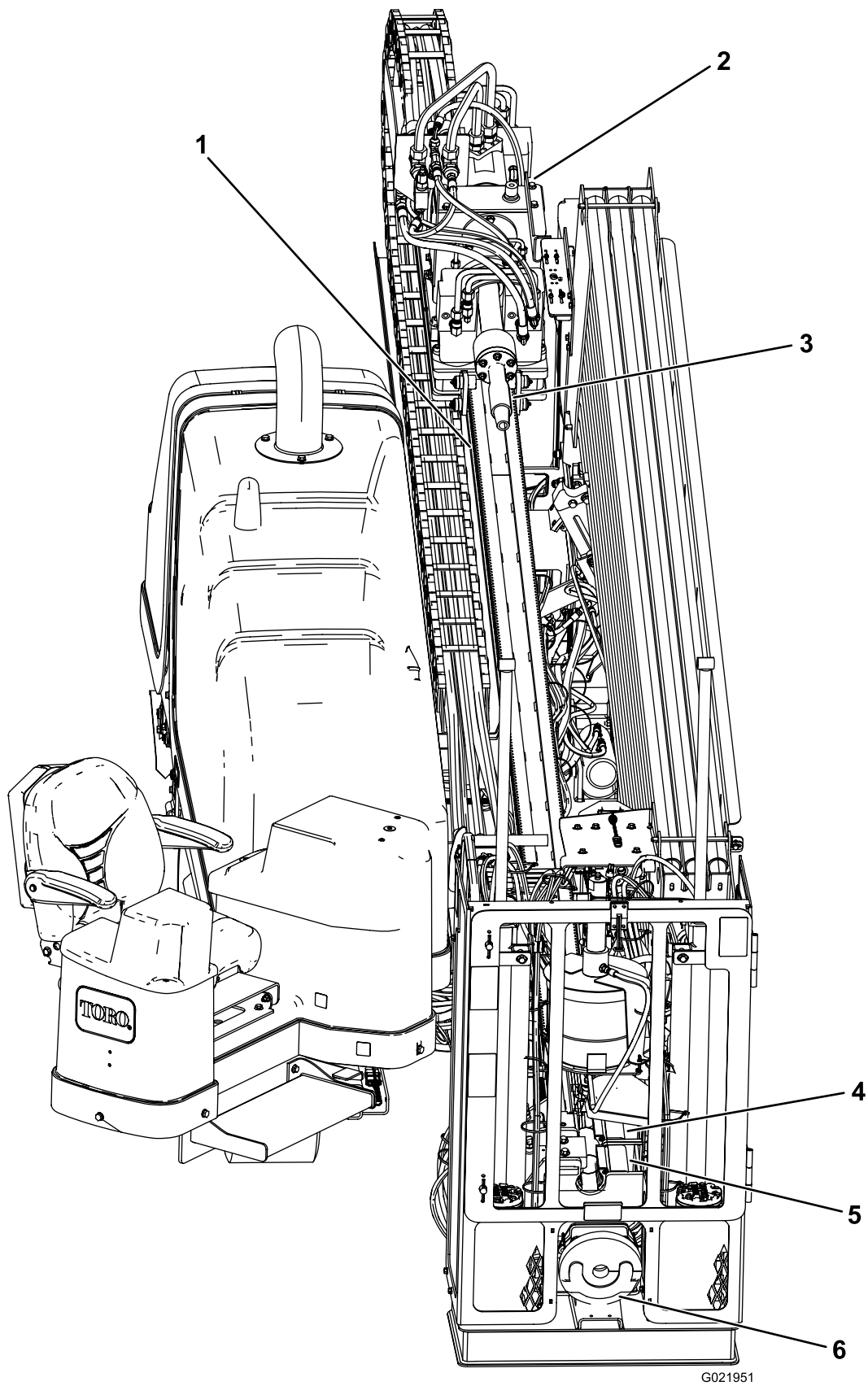


Figure 6

- | | |
|------------------------------|-----------------------|
| 1. Stake-down cage | 5. Rear-control panel |
| 2. Pipe holder | 6. Left stabilizer |
| 3. Safety bar | 7. Stake-down plate |
| 4. Drilling-fluid-pump inlet | |



G021951

Figure 7

- | | |
|-------------------|-----------------|
| 1. Thrust frame | 4. Upper wrench |
| 2. Drill carriage | 5. Lower wrench |
| 3. Drill spindle | 6. Pipe wiper |

Controls

Refer to the following sections for the appropriate machine controls:

- Operator Platform
- Monitor
- Control Panel
- Left Joystick—Mode I
- Left Joystick—Mode II
- Right Joystick—Mode I
- Right Joystick—Mode II
- Exit-Side-Lockout System (Standard Range)
- Exit-Side-Lockout System (Long Range)
- Rear Control Panel
- Drill Frame and Stabilizer Controls
- Drive Pendant
- Drill Pendant
- Stake-Down Levers
- Battery-Disconnect Switch

Operator Platform

The operator platform, located on the right, front corner of the machine, contains most of the controls you use to operate the drilling functions of the machine.

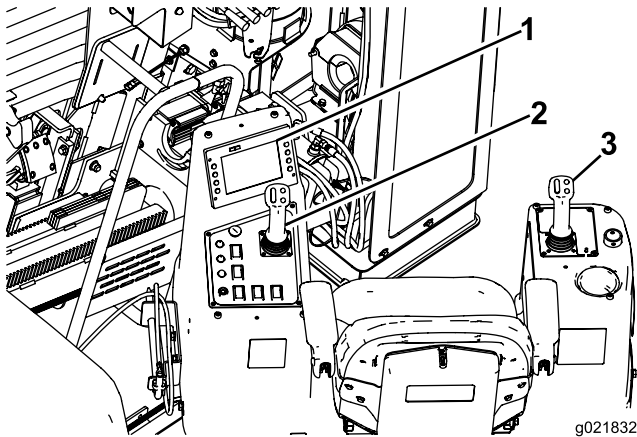


Figure 8

1. Operator display
2. Left control panel and joystick
3. Right joystick

Operator-Controls Covers

The covers protect the operator controls from adverse weather conditions, such as rain, wind, sunlight, etc. Remove them before using the machine and replace them before leaving the machine for the day. Each cover is secured with 2 screws as shown in [Figure 9](#).

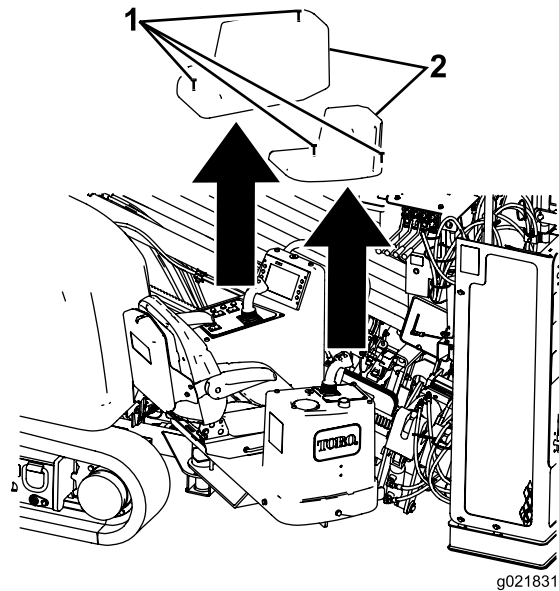


Figure 9

1. Screws
2. Covers

Operator-Platform Latch

The operator platform swings out away from the machine, making room for you to sit. It has 4 positions: travel (swung all the way into the machine), full-out, and 2 intermediate positions. Return the platform to the TRAVEL position before moving the machine.

To release the platform and swing it out or in, press down on the rear platform latch ([Figure 10](#)).

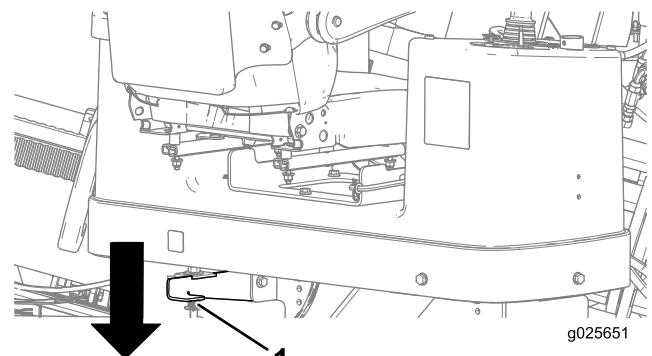


Figure 10

1. Rear platform latch

To release the platform and swing it out or in, press up on the front platform latch (Figure 11).

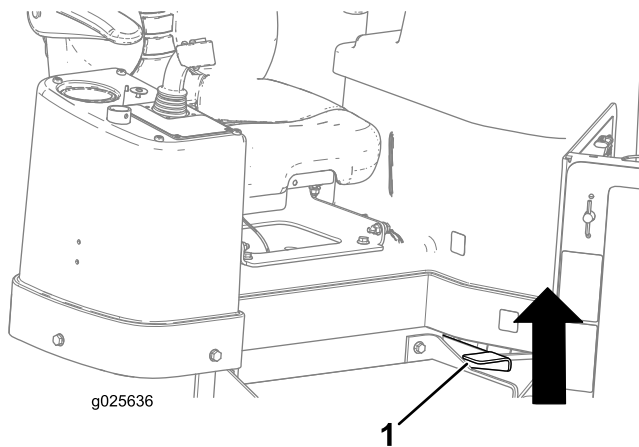


Figure 11

1. Front platform latch

Control Panel

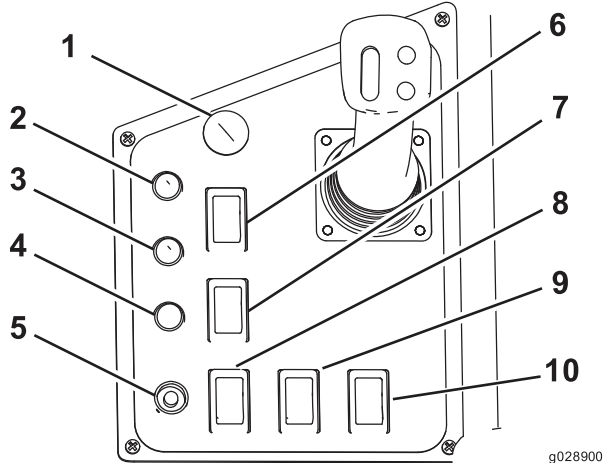


Figure 12

- | | |
|--|-----------------------------------|
| 1. Engine-stop button | 6. Ground-strike-reset switch |
| 2. Exit-side lockout—reset light | 7. Exit-side-lockout—reset switch |
| 3. Exit-side lockout—drill-enabled light | 8. Drive/drill switch |
| 4. Receiver-battery-status light | 9. Lights switch |
| 5. Engine-start button | 10. Engine-speed switch |

Exit-Side Lockout—Reset Light

This light (Figure 12) illuminates yellow when the exit-side lockout function is turned off on exit-side-lockout transmitter, indicating that you may reset the system.

Exit-Side Lockout—Drill-enabled Light

This light (Figure 12) illuminates green when the exit-side-lockout feature has been turned off and reset and the machine is ready to drill.

Exit-Side Lockout—Reset Switch

Press this switch (Figure 12) to enable drilling operation when the reset light illuminates.

Transmitter-Battery—Status Light

This light (Figure 12) illuminates red when the battery on the exit-side-lockout transmitter is too low to transmit. Stop drilling operations and fix the problem with the transmitter before continuing.

Engine-Start Button

Press this button (Figure 12) to start the engine. The key switch on the rear, control panel must be in the ON position.

Engine-Stop Button

Press this button (Figure 12) to immediately stop the engine and all drilling operations. You must pull this button out before you can start the engine again.

Ground-Strike-Reset Switch

Press this switch (Figure 12) to reset the Zap-Alert system after a ground strike has occurred and been fixed; refer to [Deploying the Zap-Alert System \(page 46\)](#).

Drive/Drill Switch

Press the top of this switch (Figure 12) to enable the drive and setup controls or the bottom to enable drill and pipe-loader functions.

Lights Switch

Press the top of this switch (Figure 12) to turn the machine lights on or the bottom to turn them off.

Engine-Speed Switch

- Press and hold the top of this switch to increase the engine speed.
- Press and hold the bottom of this switch to decrease the engine speed.
- Release the switch to maintain the current engine speed.

Left Joystick—Mode I

Note: The joystick controls vary depending on the control mode you select when powering up the machine. There are 2 control modes: Mode I and Mode II; refer to the Control-Select Screen in the *Software Guide* for information on setting the control mode.

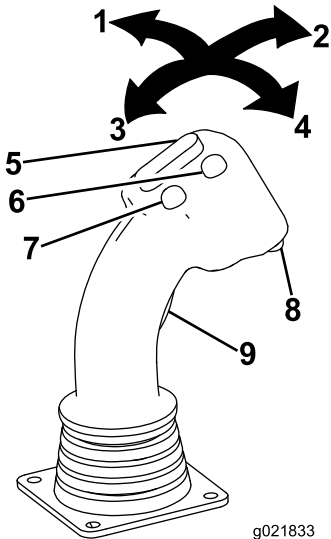


Figure 13

- | | |
|---------------------------|-----------------|
| 1. Joystick—move left | 6. Front button |
| 2. Joystick—move forward | 7. Rear button |
| 3. Joystick—move rearward | 8. Lower button |
| 4. Joystick—move right | 9. Trigger |
| 5. Toggle switch | |

Trigger

The trigger changes the other joystick controls from pipe loader controls to wrench operation controls.

- Press the trigger to enable the wrench controls.
- Release the trigger to enable the pipe loader controls.

Toggle Switch

- Left trigger pressed—rock the switch forward to rotate the upper wrench clockwise to loosen a joint; rock the switch rearward to rotate the upper wrench counterclockwise to tighten a joint.
- Left trigger released—rock the switch forward to rotate the pipe cam out towards the pipe loader; rock the switch rearward to rotate the pipe cam towards the drill frame.

Front Button

- Left trigger pressed—press this button to resume the previously set auto-drill speed. Press and hold this button to increase the auto-drill speed.
- Left trigger released—press this button to close the pipe gripper.

Rear Button

- Left trigger pressed—press this button to set the auto drill speed. Press and hold this button to decrease the auto-drill speed.
- Left trigger released—press this button to open the pipe gripper.

Lower Button

In the event of a sensor failure, use this button to override the pipe cam presets and manually move the cam. Only operate in this mode if absolutely necessary; you could damage the pipe cam or pipes if you do not align them correctly. If the sensor fails, contact your Authorized Toro Dealer for repair.

Joystick—Forward

- Left trigger pressed—closes the lower wrench.
- Left trigger released—retracts the pipe gripper toward the pipe holder.

Joystick—Rearward

- Left trigger pressed—opens the lower wrench.
- Left trigger released—extends the pipe gripper toward the drill frame.

Joystick—Left

- Left trigger pressed—opens the upper wrench.
- Left trigger released—lowers the pipe elevator.

Joystick—Right

- Left trigger pressed—closes the upper wrench.
- Left trigger released—raises the pipe elevator.

Left Joystick—Mode II

Note: The joystick controls vary depending on the control mode you select when powering up the machine. There are 2 control modes: Mode I and Mode II; refer to the Control-Select Screen in the *Software Guide* for information on setting the control mode.

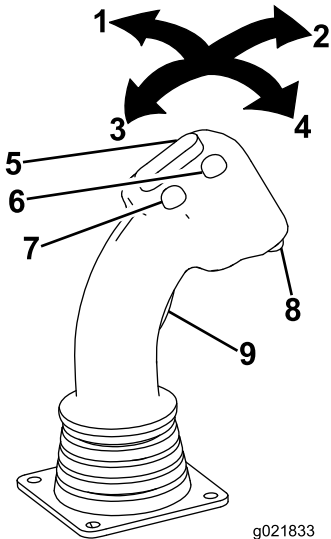


Figure 14

- | | |
|---------------------------|-----------------|
| 1. Joystick—move left | 6. Front button |
| 2. Joystick—move forward | 7. Rear button |
| 3. Joystick—move rearward | 8. Lower button |
| 4. Joystick—move right | 9. Trigger |
| 5. Toggle switch | |

Trigger

The trigger changes the other joystick controls from pipe loader controls to wrench operation controls.

- Press the trigger to enable the wrench controls.
- Release the trigger to enable the pipe loader controls.

Toggle Switch

- Left trigger pressed—rock the switch forward to rotate the upper wrench clockwise to loosen a joint; rock the switch rearward to rotate the upper wrench counterclockwise to tighten a joint.
- Left trigger released—rock the switch forward to rotate the pipe cam out towards the pipe loader; rock the switch rearward to rotate the pipe cam towards the drill frame.

Front Button

- Left trigger pressed—press this button to resume the previously set auto-drill speed. Press and hold this button to increase the auto-drill speed.
- Left trigger released—press this button to close the pipe gripper.

Rear Button

- Left trigger pressed—press this button to set the auto drill speed. Press and hold this button to decrease the auto-drill speed.
- Left trigger released—press this button to open the pipe gripper.

Lower Button

In the event of a sensor failure, use this button to override the pipe cam presets and manually move the cam. Only operate in this mode if absolutely necessary; you could damage the pipe cam or pipes if you do not align them correctly. If the sensor fails, contact your Authorized Toro Dealer for repair.

Joystick—Forward

Push the joystick forward to spin the drill spindle counterclockwise.

Joystick—Rearward

Pull the joystick rearward to spin the drill spindle clockwise.

Joystick—Left

- Left trigger pressed—opens the upper wrench.
- Left trigger released—extends the pipe gripper toward the drill frame.

Joystick—Right

- Left trigger pressed—closes the upper wrench.
- Left trigger released—retracts the pipe gripper toward the pipe holder.

Right Joystick—Mode I

Note: The joystick controls vary depending on the control mode you select when powering up the machine. There are 2 control modes: Mode I and Mode II; refer to the Control-Select Screen in the *Software Guide* for information on setting the control mode.

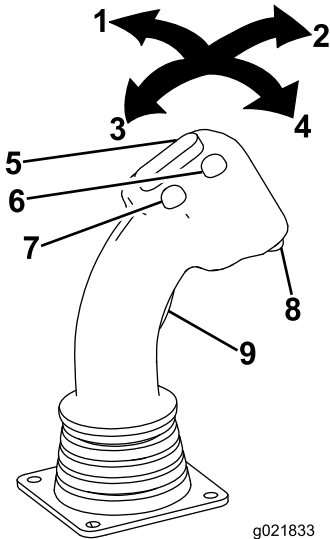


Figure 15

- | | |
|---------------------------|-----------------|
| 1. Joystick—move left | 6. Front button |
| 2. Joystick—move forward | 7. Rear button |
| 3. Joystick—move rearward | 8. Lower button |
| 4. Joystick—move right | 9. Trigger |
| 5. Toggle switch | |

Lower Button

Press this button to turn the drilling-fluid pump on or off.

Trigger

Press and hold the trigger to move the drill carriage at high speed up or down the drill frame.

Joystick—Forward

Push the joystick forward to thrust the drill carriage forward.

Joystick—Rearward

Pull the joystick rearward to pull the drill carriage rearward.

Joystick—Left

Push the joystick left to spin the drill spindle clockwise.

Joystick—Right

Push the joystick right to spin the drill spindle counterclockwise.

Toggle Switch

Rock the switch forward to increase the rate of flow of the drilling fluid; rock the switch rearward to decrease the rate of flow of the drilling fluid.

Note: Before using this feature you must first turn on the drilling-fluid pump using the lower button on the right joystick.

Front Button

Press this button to apply tread-joint compound.

Rear Button

Press and hold this button for maximum drilling fluid pressure; use this to quickly fill the pipe with drilling fluid after adding or removing a pipe. Release the button to stop the flow or return to the previously set flow rate.

Right Joystick—Mode II

Note: The joystick controls vary depending on the control mode you select when powering up the machine. There are 2 control modes: Mode I and Mode II; refer to Control-Select Screen in the *Software Guide* for information on setting the control mode.

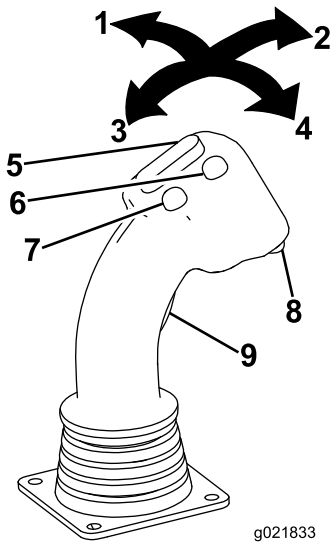


Figure 16

- | | |
|---------------------------|-----------------|
| 1. Joystick—move left | 6. Front button |
| 2. Joystick—move forward | 7. Rear button |
| 3. Joystick—move rearward | 8. Lower button |
| 4. Joystick—move right | 9. Trigger |
| 5. Toggle switch | |

Toggle Switch

Rock the switch forward to increase the rate of flow of the drilling fluid; rock the switch rearward to decrease the rate of flow of the drilling fluid.

Note: Before using this feature you must first turn on the drilling-fluid pump using the lower button on the right joystick.

Front Button

Press this button to apply tread-joint compound.

Rear Button

Press and hold this button for maximum drilling fluid pressure; use this to quickly fill the pipe with drilling fluid after adding or removing a pipe. Release the button to stop the flow or return to the previously set flow rate.

Lower Button

Press this button to turn the drilling-fluid pump on or off.

Trigger

Press and hold the trigger to move the drill carriage at high speed up or down the drill frame.

Joystick—Forward

Push the joystick forward to thrust the drill carriage forward.

Joystick—Rearward

Pull the joystick rearward to pull the drill carriage rearward.

Joystick—Left

- Left trigger pressed—opens the lower wrench.
- Left trigger released—raises the pipe elevator.

Joystick—Right

- Left trigger pressed—closes the lower wrench.
- Left trigger released—lowers the pipe elevator.

Exit-Side-Lockout System (Standard Range)

The exit-side-lockout system provides the individuals working around the machine with a means to disable the drill pipe from rotating and thrusting.

For more information and instructions, refer to the *Operator's Manual* for the Exit-side-lockout system.

Exit-Side-Lockout System (Long Range)

The exit-side-lockout system provides the individuals working around the machine with a means to disable the drill pipe from rotating and thrusting.

For more information and instructions, refer to the *Operator's Manual* for the Exit-side-lockout system.

Rear Control Panel

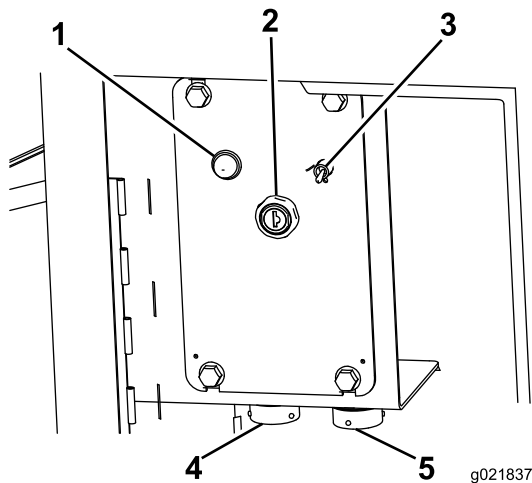


Figure 17

- | | |
|-------------------------|-----------------------------|
| 1. Engine-heating light | 4. Drill-pendant receptacle |
| 2. Engine, key switch | 5. Drive-pendant receptacle |
| 3. Fluid-pump switch | |

Engine-Heating Light

When the engine is cold, the heater warms the intake air to enable easier starting. This light illuminates while the heater is on. Wait until this light turns off before starting the engine.

Engine, Key Switch

The key switch has 3 positions as follows (Figure 18):

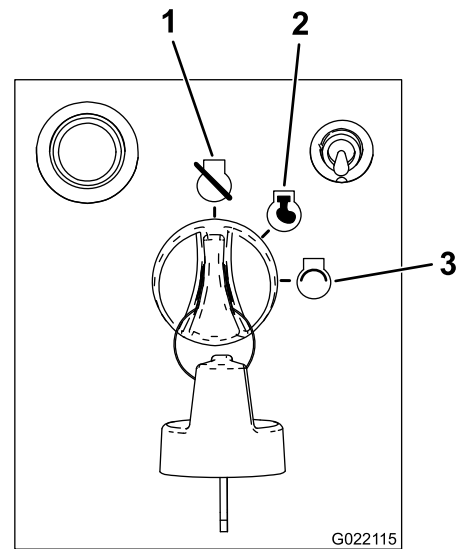


Figure 18

- | | |
|------------------------|--------------------------|
| 1. Engine-off position | 3. Engine-start position |
| 2. Engine-run position | |

- Engine-off position—turn the key to this position to stop the engine. The engine cannot be started from the operator platform when the key is in this position.
- Engine-run position—turn the key to this position after starting the engine. Turning the key to this position also enables the engine start button from the operator platform.
- Engine-start position—turn the key to this position to start the engine. Release the key to the RUN position once the engine has started.

Fluid-Pump Switch

Use this switch to turn on the fluid pump to use the spray gun when cleaning the machine.

Drill-Pendant Receptacle

Plug the drill pendant into this receptacle to attach it to the machine (Figure 17).

Drive-Pendant Receptacle

Plug the drive pendant into this receptacle to attach it to the machine (Figure 17).

Drill Frame and Stabilizer Controls

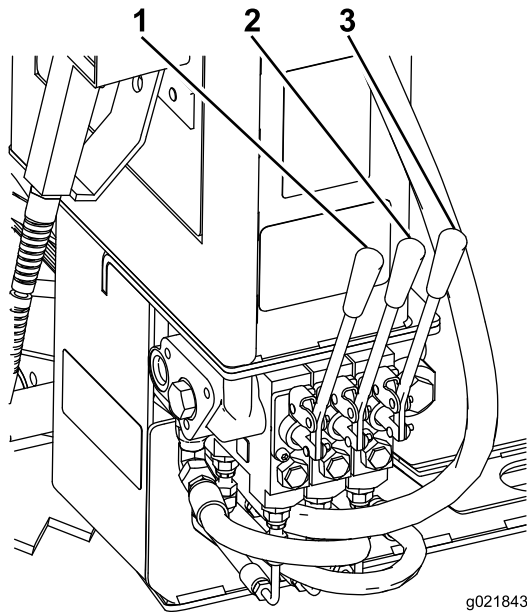


Figure 19

- | | |
|---------------------------|---------------------------|
| 1. Drill-frame tilt lever | 3. Right-stabilizer lever |
| 2. Left-stabilizer lever | |

Stabilizer Levers

Use the stabilizer levers to raise and lower the stabilizers.

Note: The DRIVE/DRILL switch on the operator panel must be switched to the DRIVE position for this function to work.

Drill-Frame Tilt Lever

Use the drill-frame tilt lever to tilt the drill frame to place the stake-down plate on the ground or to return the frame to the travel position.

Note: The DRIVE/DRILL switch on the operator panel must be switched to the DRIVE position for this function to work.

Drive Pendant

Refer to [Figure 17](#) for location.

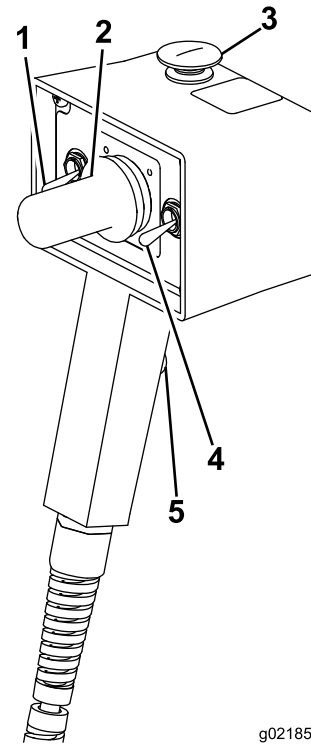


Figure 20

- | | |
|-----------------------------|-----------------------------|
| 1. Engine-speed switch | 4. Drive-speed switch |
| 2. Drive-direction joystick | 5. Operator-presence switch |
| 3. Engine-stop button | |

Engine-Stop Button

Press this button to immediately stop the engine and all movement/drilling operations. You must pull this button out before you can start the engine again.

Engine-Speed Switch

- Press and hold the top of this switch to increase the engine speed.
- Press and hold the bottom of this switch to decrease the engine speed.
- Release the switch to maintain the current engine speed.

Drive-Direction Joystick

Use the joystick to control the direction of the machine. The machine will travel in the direction you move the joystick.

Drive-Speed Switch

The switch sets the speed at which the machine will travel. Move the switch up for high speed or down for low speed.

Operator-Presence Switch

Press and hold this button to enable the other controls on the drive pendant. The machine will stop moving if you release this button.

Drill Pendant

The drill pendant (also referred to as the life-jacket pendant) is designed to allow you rudimentary control over only the drilling features when connected to the front receptacle, should the operator platform controls become non-responsive. You can also plug this pendant into the rear drill-pendant receptacle in the event that the drive pendant malfunctions to obtain basic movement functions at slow speed.

Only the drive functions can be operated from the rear drill-pendant receptacle.

Refer to [Figure 17](#) for location.

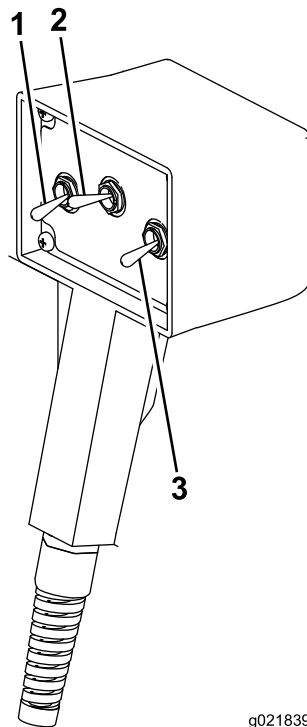


Figure 21

- | | |
|------------------|-----------------|
| 1. Left switch | 3. Right switch |
| 2. Center switch | |

Left Switch

- When connected to the drill-pendant receptacle, move this switch up to move the drill carriage forward or down to move the drill carriage rearward.
- When connected to the drive-pendant receptacle, move this switch up to move the left track forward or down to move the left track rearward.

Center Switch

Move this switch to the left to enable the pipe loader and wrench operation; move the switch to the center to turn off the drilling fluid.

Right Switch

- When connected to the front drill-pendant receptacle, move this switch up to rotate the drill spindle clockwise or down to rotate the drill spindle counterclockwise.
- When connected to the rear drill-pendant receptacle, move this switch up to move the right track forward or down to move the right track rearward.

Stake-Down Levers

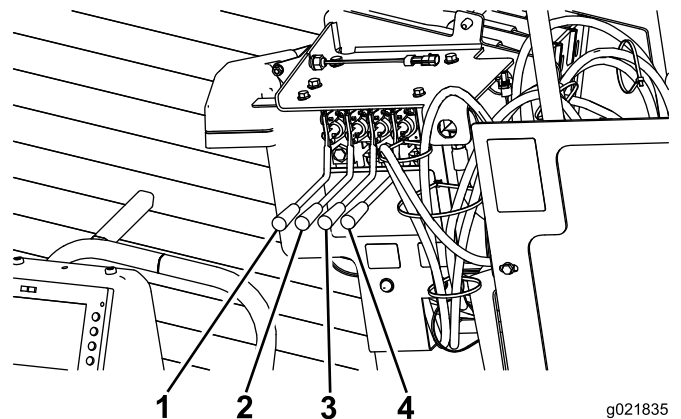


Figure 22

- | | |
|---------------------------------|----------------------------------|
| 1. Left-stake-raise/lower lever | 3. Right-stake-raise/lower lever |
| 2. Left-stake-spin lever | 4. Right-stake-spin lever |

Stake-Raise/Lower Levers

Push down on these levers to lower the stakes into the ground. Pull up on these levers to raise the stakes out of the ground.

Note: The DRIVE/DRILL switch on the operator panel must be switched to the DRIVE position for this function to work.

Stake-Spin Levers

Push down on these levers to spin the stakes clockwise. Pull up on these levers to spin the stakes counterclockwise.

Note: The DRIVE/DRILL switch on the operator panel must be switched to the DRIVE position for this function to work.

Battery-Disconnect Switch

Open the front hood to access the BATTERY-DISCONNECT switch; refer to [Opening the Front Hood \(page 58\)](#).

The BATTERY-DISCONNECT switch is located to the right of the engine; it is used to electrically disconnect the battery from the machine.

Turn the BATTERY-DISCONNECT switch to the ON or OFF position to perform the following:

- To energize the machine electrically, rotate the BATTERY-DISCONNECT switch clockwise to the ON position ([Figure 23](#)).
- To de-energize the machine electrically, rotate the BATTERY-DISCONNECT switch counterclockwise to the OFF position ([Figure 23](#)).

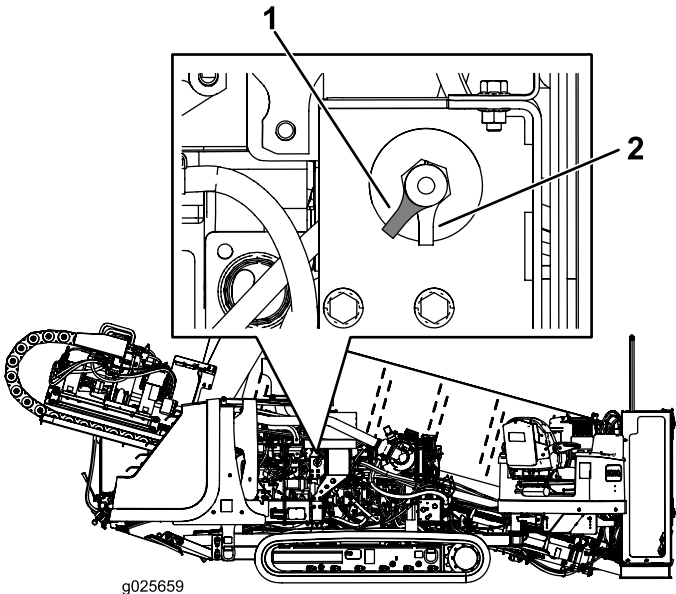


Figure 23

1. Battery-disconnect switch (On position) 2. Battery-disconnect switch (Off position)

Specifications

Note: Specifications and design are subject to change without notice.

Machine

Width	131 cm (51.5 inches)
Length	525 cm (207 inches)
Height	188 cm (74 inches)
Weight	4,765 kg (10,500 lbs)

Attachments/Accessories

A selection of Toro approved attachments and accessories is available for use with the machine to enhance and expand its capabilities. Contact your Authorized Service Dealer or Distributor or go to www.Toro.com for a list of all approved attachments and accessories.

Important: Use only Toro approved attachments. Other attachments may create an unsafe operating environment or damage the traction unit.

Operation

Note: Determine the left and right sides of the machine from the normal operating position.

Understanding Horizontal Directional Drilling

Horizontal directional drilling is a process used for drilling a horizontal bore through the soil and under obstructions such as roads, buildings, bodies of water, etc. Once you drill the bore, you pull back the utility lines or pipes through the bore and connect them as needed. Because it does not require very much disturbance of the surface, installation of utilities using directional drilling preserves the environment and saves both time and money over traditional installation methods such as trenching.

When installing cabling or pipe using a directional drill, you complete the following steps:

1. Gather site information.

Before operating in an area with high-voltage lines or cables, contact a “One-Call System Directory” service. In the USA, call 811 or your local utility company. If you do not know your local utility company’s phone number, call the national number (USA and Canada only) at 1-888-258-0808. Also, contact any utility companies that are not participants of the “One-Call System Directory” service. Please refer to [Drilling Near Utility Lines \(page 6\)](#) for more information.

Before fully planning the bore, you must gather information about the job site such as the location of other utilities, obstacles at the site, and what regulations and permits you will need to complete the job; refer to [Gathering Site Information \(page 32\)](#).

2. Plan the bore.

Before you can drill, you must first plan the bore path based on the information you gathered. Refer to [Planning the Bore Path \(page 34\)](#).

3. Prepare the job site and the machine.

Before drilling, you prepare the job site with an entry point, depth-gauge hole (optional), and an exit hole. You also need to drive the unit to the site, set it up for drilling, and connect it to a drilling-fluid mixer.

Note: When drilling, you connect the machine to a drilling-fluid mixer that mixes water with bentonite clay and other ingredients. The machine pumps this mixture, referred to as drilling fluid or “Mud”, through the drill pipe and out the drill bit. The drilling fluid lubricates the bit, helps to hold the bore open while drilling, and mixes with the spoils, flushing them out of the bore through the entry point.

Refer to [Preparing the Job Site and the Machine \(page 39\)](#) for instructions on preparing the job site and the machine.

4. Drill the bore.

You drill the bore in three stages:

A. Entry

In the entry phase of the bore, you push the drill bit and head into the ground at an angle of up to 16 degrees. After pushing in one or more pipes, you begin drilling down and forward until you reach the desired depth or depth-gauge hole (if used).

B. Horizontal Reach

After reaching the desired depth, you push the bit forward, steering the bit to a horizontal depth. The drill bit emits a radio signal from the sonde housing, which allows a crew member on the surface to track the location and depth of the head using the sonde receiver as you drill and steer it along a planned route.

C. Exit

Once you have attained the planned horizontal reach, you steer the head up at an angle similar to your entry angle bringing the bit into the exit hole or trench.

Refer to [Drilling the Bore \(page 49\)](#).

5. Backream the bore and pull back the cabling or pipe.

After entering the exit hole, the end crew detaches the drill bit and sonde housing from the drill pipe. In its place, they attach a reaming bit and the end of the cable or pipe to be pulled through the bore. The reaming bit is designed to enlarge the bore as you pull it back. As before, you pump drilling fluid through the pipe to the reaming bit as you pull the cable or pipe back through the bore to lubricate the reamer and allow the cable or pipe to slide easily through the bore. You continue pulling the pipe back until the reamer reaches the depth-gauge hole or exits at the entry point. There you remove the reamer and product from the drill pipe, pulling the pipe the rest of the way back to the machine.

Refer to [Backreaming and Pullback \(page 52\)](#) for instructions on backreaming and pulling cable or pipe.

6. Finish the bore and leave the job site.

After completing the operation, you need to disconnect and clean the machine and load it on the trailer; refer to [Finishing the Job \(page 54\)](#).

Gathering Site Information

Planning the Initial Route

Before you can begin boring, you need to plan the route you will bore and prepare as follows:

- Create a basic plan for the bore, mapping out the proposed route.
 - Note any obstacles which may affect the bore such as large trees, bodies of water, buildings, etc.
 - Plan the route of the bore to avoid as many obstacles as possible.
 - Determine the depth of any bodies of water to be crossed to ensure that you can get deep enough under them.
- Determine the depth you need to install the material at and the minimum bend radius both of the drill pipe and of the material being installed. This will seriously affect how long the bore needs to be and at what angle you can begin and end; refer to [Planning the Bore Path \(page 34\)](#).
- Have the area of the bore marked for utility lines (in the US call 811). Ensure that all lines are marked on your blueprints/bore plan as well.
- Contact the local authorities to arrange for any permits and traffic control that you will need to conduct the job.

Inspecting the Proposed Job Site

Physically inspect the site as follows:

- Note the terrain, slopes, valleys, hills, and any features not planned for previously.

Determine the degree of slope at both the proposed entry point and exit point.
- Determine what the soil types are in the area and, if possible, what they are at the depth you will be boring. You may need to dig test holes at intervals along the bore path to fully determine this.
- Walk the area of the bore looking for any possible unmarked obstructions. Look for manholes, pedestals, old foundations, etc.
- Identify all hazards of which you will be passing within 3 m (10 ft).

⚠ DANGER

Contacting underground hazards with the machine while drilling or reaming can cause explosion, electrocution, breathing problems, severe trauma, and death to you or bystanders.

- Ensure that all personnel at the job site wear personal protective equipment including a hard hat, eye protection, electrically insulated safety boots and gloves, and hearing protection.
- Keep bystanders and spectators away from the job site, including the complete bore path.
- Locate and expose all electric and gas lines that you will be crossing by careful hand digging.
- Ensure that you use the Zap-Alert system whenever operating the machine.

Common hazards include the following:

- Gas lines

⚠ DANGER

Drilling into a gas line can cause an explosion or fire, burning, injuring, or killing you or others in the vicinity of the break.

- ◇ Do not smoke or have any source of flame near gas lines or at either end of a bore that will be crossing a gas line.
- ◇ Keep bystanders and spectators away from the job site, including the complete bore path.
- ◇ Locate and expose all gas lines that you will be crossing by careful hand digging.
- ◇ Have the gas company turn off the gas to any lines you will be crossing before drilling.
- ◇ Use the receiver to track the exact position of the drill head when approaching gas lines.

- Electrical power lines

⚠ DANGER

Drilling into an electric power line will cause the machine to become electrified and may electrocute you or any bystanders.

- ◇ Keep bystanders and spectators away from the job site, including the complete bore path.
- ◇ Locate and expose all electric lines that you will be crossing by careful hand digging.
- ◇ Have the electric company turn off the power to any lines you will be crossing before drilling.
- ◇ Use the receiver to track the exact position of the drill head when approaching electric lines.
- ◇ Before drilling, setup and use the Zap-Alert system which is designed to notify in the case of an electric strike and electrically isolate the machine operator from the machine. If the Zap-Alert alarm triggers, stop what you are doing and do not leave the operator's position. Refer to [Deploying the Zap-Alert System \(page 46\)](#) for detailed instructions on using the Zap-Alert system.

- Crystalline silica and other dust

If you will be drilling through or cutting concrete, sand, or other substances that create dusts or fumes, you need to ensure that you and all workers wear breathing protection to protect your lungs from the dust.

⚠ WARNING

Machining or handling stone, masonry, concrete, metal, and other materials can generate dust, mists, and fumes containing chemicals, such as silica, known to cause serious or fatal injury or illness, such as respiratory disease, silicosis, cancer, birth defects, or other reproductive harm.

- ◇ Control dust, mist, and fumes at the source where possible. Water should be used for dust suppression when feasible.
- ◇ Use good work practices and follow the recommendations of the manufacturer or suppliers, OSHA, and other occupational and trade associations.
- ◇ When the hazards from inhalation cannot be eliminated, the operator and any bystanders should wear a respirator approved by OSHA for the material being handled.

⚠ WARNING

Silicosis Warning: Grinding, cutting, or drilling stone, masonry, concrete, metal, and other materials with silica in their composition may give off dust or mist containing crystalline silica. Silica is a basic component of sand, quartz, brick, clay, granite, and numerous other minerals and rocks. Repeated and/or substantial inhalation of airborne crystalline silica can cause fatal respiratory diseases, including silicosis. In addition, some other authorities have listed respirable crystalline silica as a substance known to cause cancer. When cutting such materials, follow respiratory precautions.

Planning the Bore Path

Before setting up the job site, you need to plan the bore path, including the following:

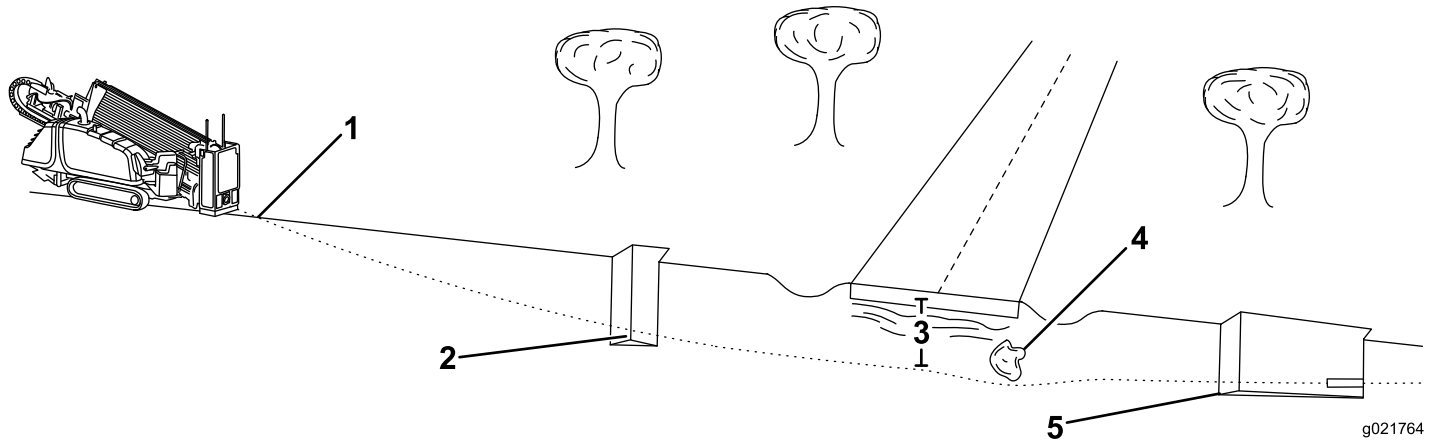


Figure 24

1. Bore entry
2. Beginning-of-bore-at-depth point
3. Bore depth
4. Obstacle
5. End-of-bore-at-depth point and bore exit

- **Bore entry**

This is the location where you setup the machine and the drill bit enters the ground. Depending on conditions, this will typically be set back 9 to 15 m (30 to 50 ft) from the beginning-of-the-bore-at-depth point.

- **Beginning-of-bore-at-depth point**

This is the point where you want the utility line or pipe to end after installation is complete. It is typically the point at which the bore levels out and begins to bore horizontally. This may be the same as the entry point, or you may dig a separate depth-gauge hole at this point (Figure 24).

- **Bore depth**

This is the depth at which you want to install the utility line or pipe. This machine is designed primarily for installations between 1 and 3 m (3.5 to 10 ft).

- **Obstacles in the path**

It is important to know where the known obstacles are that you will need to steer around or under before starting so that you can plan where to begin steering prior to reaching the obstacle.

- **End-of-bore-at-depth point**

This is the point where you want the utility line or pipe to begin after installation is complete. Often this will also be the bore exit.

- **Bore exit**

This is the location where the drill head will exit the ground and the point at which you will pull the utility lines or pipe into the bore. If this point will be at the surface instead of at installation depth, you will need to determine the distance from the end-of-bore-at-depth location

needed for steering the drill to the surface, typically 9 to 15 m (30 to 50 ft) from the end-of-the-bore-at-depth point.

Determining the Bore Entry Point

One of the more challenging aspects of planning the bore path is to determine the entry point of the bore. You need to take the following traits into account when determining the location of the entry point:

- **Bore depth**

This is the depth at which you want to install the utility line or pipe. This machine is designed primarily for installations between 1 and 3 m (3.5 to 10 ft).

- **Pipe and material flexibility**

The 3 m (10 ft) pipes used on this machine can flex to an 8% pitch over the length of the pipe; this equates to a bend of no more than 20 cm (8 inches) off of a straight path (Figure 25).

Important: If you steer the pipe to bend sharper than 20 cm (8 inches) per pipe, you may damage the pipes and their connections. You must also make steering changes gradually over the entire length of each pipe. If you steer the whole 20 cm (8 inches) in only 25 to 50 cm (1 to 2 ft) of travel, you will permanently damage the pipes.

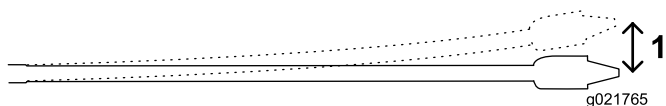


Figure 25

1. 20 cm (8 inches)

This flexibility is often rated in materials as a minimum bend radius, which is the radius of the circle formed if the material or pipes, connected together, were bent to form a giant circle. The minimum radius of a circle made with the pipe used with this machine is 31 m (101 ft).

- **Entry pitch**

The entry pitch is the angle at which the machine enters the ground. With the tracks on level ground, the stabilizers down, and the stake-down plate on the ground, the drill frame angle is about 15 degrees or a 27% pitch. This pitch will change depending on the slope of the ground and other factors of the job site. You can also reduce this pitch a bit by building up the ground under the stake-down plate before positioning the machine. You can determine the actual pitch of the drill frame by placing the drill bit and sonde housing on the frame and then use the receiver to display the pitch.

The steeper your entry pitch is, the deeper your bore will have to be due to the limitations of the pipe flexibility. Typically you need to insert the drill and at least 1/3 of a pipe into the ground before you can start steering toward the beginning of the bore point. [Figure 26](#), [Figure 27](#), and the following table illustrate the relationship between entry pitch and depth.

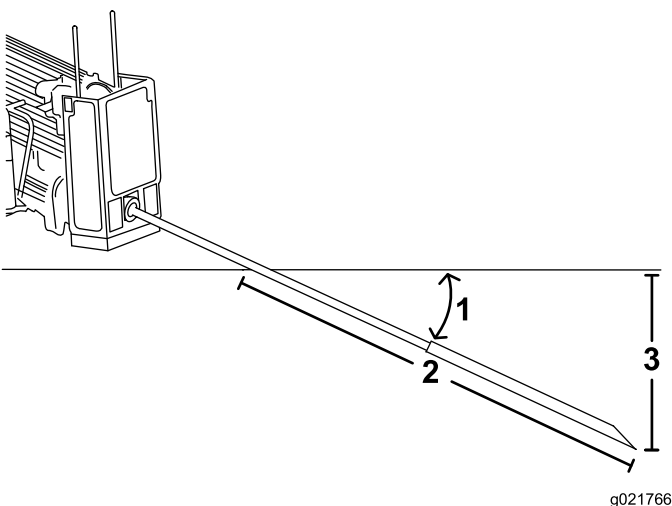


Figure 26

1. 26% pitch
2. 3 m (10 ft)
3. 76 cm (30 inches)

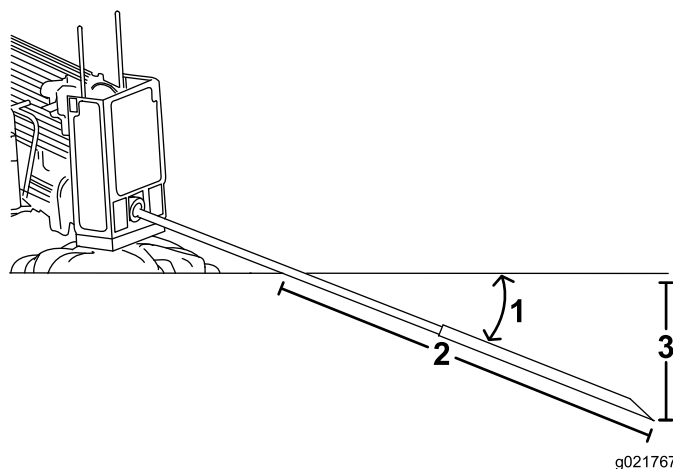


Figure 27

1. 18% pitch
2. 3 m (10 ft)
3. 53 cm (21 inches)

Note: The depths given in the following table are for 3 m (10 ft) of combined drill head and pipe. As you steer up, the pitch of the steered section will change and can be monitored with the receiver. Use the following table to identify how many lengths of pipe will be necessary to insert and steer to the beginning point and help you choose an entry point.

Pitch	Depth Change per 10 feet	Pitch	Depth Change per 10 feet
1%	2 cm (1 inch)	26%	76 cm (30 inches)
2%	5 cm (2 inches)	27%	79 cm (31 inches)
3%	10 cm (4 inches)	28%	81 cm (32 inches)
4%	13 cm (5 inches)	29%	84 cm (33 inches)
5%	15 cm (6 inches)	30%	86 cm (34 inches)
6%	18 cm (7 inches)	31%	91 cm (36 inches)
7%	20 cm (8 inches)	32%	94 cm (37 inches)
8%	25 cm (10 inches)	33%	97 cm (38 inches)
9%	28 cm (11 inches)	34%	99 cm (39 inches)
10%	30 cm (12 inches)	35%	102 cm (40 inches)
11%	33 cm (13 inches)	36%	104 cm (41 inches)
12%	36 cm (14 inches)	37%	107 cm (42 inches)
13%	39 cm (15 inches)	38%	109 cm (43 inches)
14%	43 cm (17 inches)	39%	112 cm (44 inches)
15%	46 cm (18 inches)	40%	114 cm (45 inches)
16%	48 cm (19 inches)	41%	117 cm (46 inches)
17%	51 cm (20 inches)	42%	117 cm (46 inches)
18%	53 cm (21 inches)	43%	119 cm (47 inches)
19%	56 cm (22 inches)	44%	122 cm (48 inches)
20%	61 cm (24 inches)	45%	124 cm (49 inches)
21%	64 cm (25 inches)	46%	127 cm (50 inches)
22%	66 cm (26 inches)	47%	130 cm (51 inches)
23%	69 cm (27 inches)	48%	133 cm (52 inches)
24%	71 cm (28 inches)	49%	135 cm (53 inches)
25%	74 cm (29 inches)	50%	137 cm (54 inches)
All measurements are approximate and will vary depending on soil conditions.			
Note: These values and more can be found in the <i>Driller's Handbook & Daily Log</i> by Digital Control Incorporated.			

Given the above information, you can calculate the number of rods required to reach your beginning point at the appropriate depth. Toro recommends that you start the entry point a distance back from your beginning-at-depth point by the same distance as the length of pipes you will need to reach that point. This will ensure that you have enough extra space so you will not need to over-steer and damage the pipes.

The following example illustrates the process given an installation using the maximum entry pitch of the machine (26%) on level ground:

- You insert the first 3 m (10 ft) of drill bit/pipe into the ground with no steering. The end of the drill bit will be 76 cm (30 inches) deep (Figure 25).

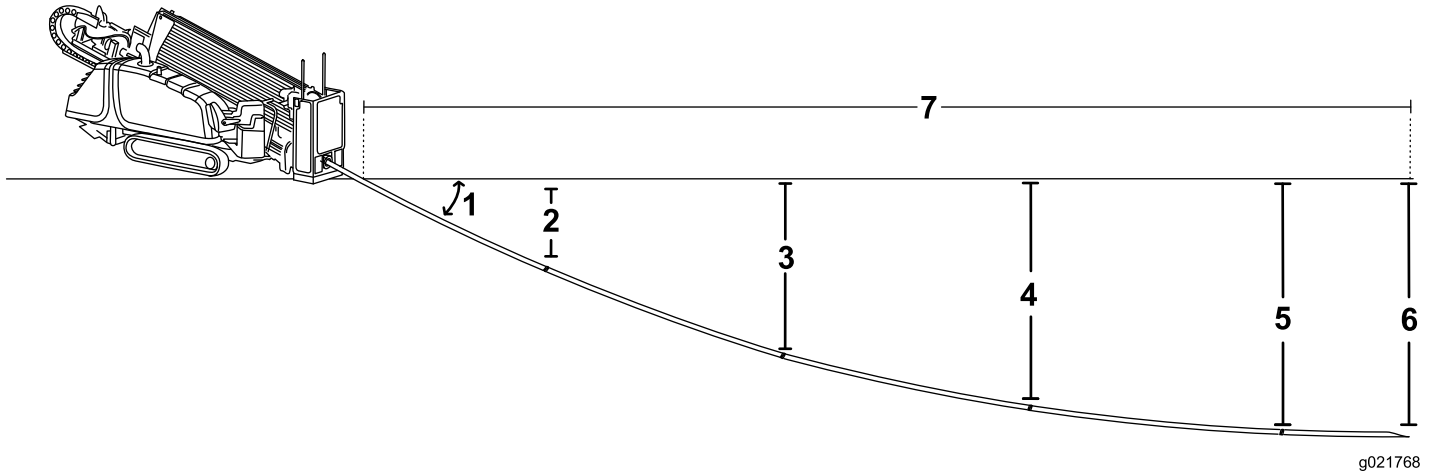


Figure 28

- | | | |
|-----------------------|-----------------------|-------------------|
| 1. 26% pitch | 4. 185 cm (73 inches) | 7. 14.7 m (45 ft) |
| 2. 76 cm (30 inches) | 5. 203 cm (80 inches) | |
| 3. 142 cm (56 inches) | 6. 208 cm (82 inches) | |

- You begin steering up for the next 3 m (10 ft), pushing the pipes in at the maximum pitch change of 8%. This results in a change of pitch from 26% at the beginning of the 3 m (10 ft) to 18% at the end of the 3 m (10 ft) for an average pitch of 22%. Given that, the drill head lowers another 66 cm (26 inches) and is now 142 cm (56 inches) deep.
- Continuing steering up for the next 3 m (10 ft) at an 8% pitch change, your pitch will change from 18% to 10% for an average pitch of 14%. Given that, the drill head lowers another 43 cm (17 inches) and is now 185 cm (73 inches) deep.
- Continuing steering up for the next 3 m (10 ft) at an 8% pitch change, your pitch will change from 10% to 2% for an average pitch of 6%. Given that, the drill head lowers another 18 cm (7 inches) and is now 203 cm (80 inches) deep.
- Leveling the drill head from 2% to 0% takes less than 1.5 m (5 ft) more for a final depth of 208 cm (82 inches). Reaching this final point took four and a half, 3 m (10 ft) pipes. So for this example your entry point should be 14.7 m (45 ft) back from the beginning-at-depth point of your installation.

The following example illustrates the process given an installation using the machine at an 18% pitch on level ground:

- You insert the first 3 m (10 ft) of drill bit/pipe into the ground with no steering. The end of the drill bit will be 53 cm (21 inches) deep (Figure 29).

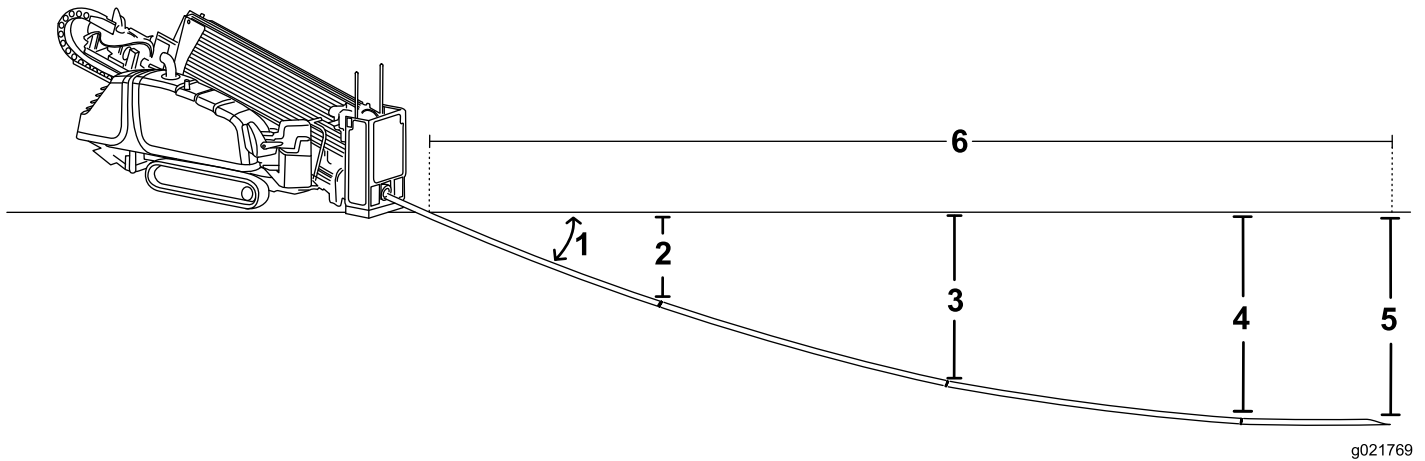


Figure 29

- | | | |
|----------------------|-----------------------|-----------------------|
| 1. 18% pitch | 3. 96 cm (38 inches) | 5. 119 cm (47 inches) |
| 2. 53 cm (21 inches) | 4. 114 cm (45 inches) | 6. 10.6 m (35 ft) |

- You begin steering up for the next 3 m (10 ft), pushing the pipes in at the maximum pitch change of 8%. This results in a change of pitch from 18% at the beginning of the 3 m (10 ft) to 10% at the end of the 3 m (10 ft) for an average pitch of 14%. Given that, the drill head lowers another 43 cm (17 inches) and is now 96 cm (38 inches) deep.
- Continuing steering up for the next 3 m (10 ft) at an 8% pitch change, your pitch will change from 10% to 2% for an average pitch of 6%. Given that, the drill head lowers another 18 cm (7 inches) and is now 114 cm (45 inches) deep.
- Leveling the drill head from 2% to 0% takes less than 1.5 m (5 ft) more for a final depth of 119 cm (47 inches). Reaching this final point took three and a half, 3 m (10 ft) pipes. So for this example your entry point should be 10.6 m (35 ft) back from the beginning-at-depth point of your installation.

Important: You can use the information contained in this section to determine both the space needed to steer up to the exit point if needed and also to steer around obstacles.

Mapping the Bore

With the information you gathered previously, map out the route of the bore, identifying the following so that you can mark the site later:

- Entry point
- Location of the machine and supporting equipment
- Beginning of bore at depth
- Any obstacles that you need to steer around and the locations where you need to start steering to get around or under them
- Any utility lines you will need to cross
- Slope and soil changes along the path that will affect the bore
- End of the bore at depth
- Exit location if different than the end of the bore

Preparing the Job Site and the Machine

Before drilling, prepare the job site and machine as follows:

- Mark and prepare the bore path [Marking and Preparing the Bore Path \(page 39\)](#).
- Test the Zap-Alert system; refer to [Testing the Zap-Alert System \(page 39\)](#).
- Load the drill pipes into the pipe holder if needed; refer to [Loading Drill Pipes into the Pipe Holder \(page 41\)](#).
- Add fuel to the machine; refer to [Adding Fuel \(page 41\)](#).
- Check the oil level in the engine; refer to [Checking the Engine-Oil Level \(page 43\)](#).
- Check the engine coolant level; refer to [Checking the Cooling System \(page 43\)](#).
- Check the hydraulic fluid level; refer to [Checking the Hydraulic-Fluid Level \(page 43\)](#).
- Check the oil level in the drilling-fluid pump; refer to [Checking the Drilling-Fluid-Pump Oil Level \(page 86\)](#).
- Load/unload the machine; refer to [Loading and Unloading the Machine \(page 43\)](#).
- Drive the machine to the entry point; refer to [Understanding Horizontal Directional Drilling \(page 31\)](#).
- Connect the machine to a drilling-fluid source; refer to [Connecting to a Drilling-Fluid Source \(page 48\)](#).
- Set up the drill bit(s) and tracking electronics; refer to [Setting Up the Drill Head and Tracking System \(page 45\)](#).
- Set up the machine for drilling; refer to [Setting up the Machine for Drilling \(page 45\)](#).
- Deploy the Zap-Alert system; refer to [Deploying the Zap-Alert System \(page 46\)](#).

Marking and Preparing the Bore Path

1. Walk the bore path, marking it on the ground with marking paint so that the receiver operator will be able to follow the plan.
2. Hand dig to expose any buried utility lines marked previously that the bore path will be crossing. This will allow the receiver operator to know exactly where they are.
3. If you are exiting the bore at ground level and not in an existing trench, dig an angled hole into which the bit will enter at the end of the bore.
4. If desired, dig a hole to the beginning-of-the-bore point where you can disconnect the pipe or lines after pulling them back.

Testing the Zap-Alert System

The Zap-Alert system is an electric strike sensing device on the machine that triggers a strobe light and audible alarm in the event that the drill bit, reamer, or stake breaks into an energized power line. In the event of an electric strike, the machine will become energized, setting off the alarm.

⚠ DANGER

If the Zap-Alert system activates while drilling, the machine, except for the operator's platform, will become energized. If you step off the operator platform or if someone touches the machine or wet ground near the machine or in the bore, you or they could be electrocuted causing serious injury or death.

- Test the Zap-Alert system before drilling.
- Deploy the grounding stake before drilling. Ensure that the stake is fully inserted into moist soil.
- If the Zap-Alert is triggered:
 - Stay in the seat and do not touch the ground or any other part of the machine until the power has been turned off. Do not pour liquids or urinate from the operator platform onto the ground.
 - Stop drilling, stop the drilling-fluid flow, and retract the drill out of the ground.
 - Keep everyone away from the machine.
 - Keep standing or running water and drilling fluid contained close to the machine. Keep water and drilling fluid sources away from the broken line.
 - Contact the utility company to have power shut off to the broken line. Do not reset the Zap-Alert system until the power has been turned off.

Test the Zap-Alert system before using the drill each day, as follows:

1. Open the front hood; refer to [Opening the Front Hood \(page 58\)](#).
2. Lay the grounding stake flat on the ground away from the machine. Do not drive the stake into the ground.
Important: Do not allow the stake to touch any part of the machine.
3. Connect an alligator clip from the Zap-Alert tester to the grounding stud on the Zap-Alert system ([Figure 30](#)).

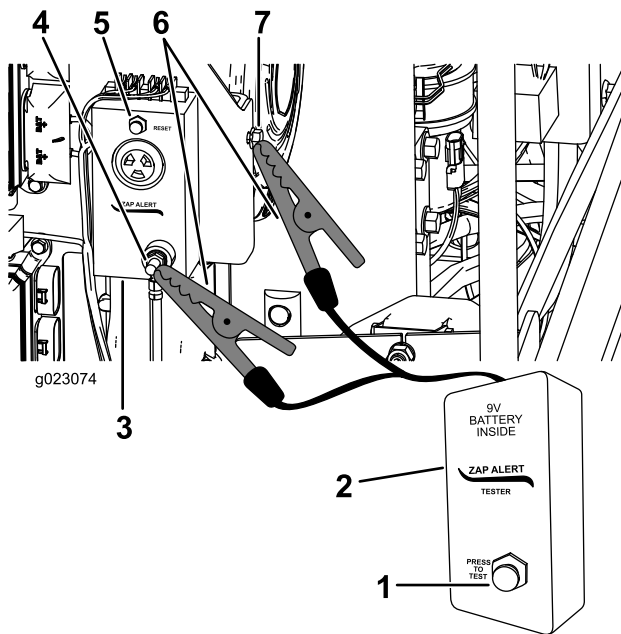


Figure 30

- | | |
|------------------------------------|----------------------------|
| 1. Test button | 5. Reset button |
| 2. Zap-alert tester | 6. Alligator clips |
| 3. Zap-alert system | 7. Machine grounding point |
| 4. Zap-alert system grounding stud | |

4. Connect the other alligator clip to a metal component of the machine frame.
5. Press the TEST button on the Zap-Alert tester ([Figure 30](#)).
The Zap-Alert alarm should sound, and the strobe on top of the front hood should flash.
6. Press the ZAP-ALERT RESET button to stop the alarm ([Figure 30](#)).
7. Disconnect the alligator clips from the grounding stud and the machine.
8. Store the grounding stake in the holder on the operator platform as shown in [Figure 31](#).

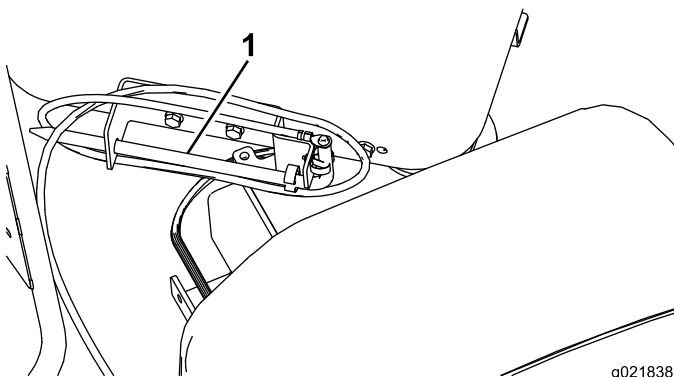


Figure 31

1. Grounding stake

If either the audible alarm or the strobe light failed to trigger when you pressed the TEST button, have them repaired before drilling with the machine.

Mounting a Fire Extinguisher

Mount your fire extinguisher below the operator seat ([Figure 32](#)).

Note: A fire extinguisher is not provided with the machine.

The recommended fire extinguisher is a dry chemical fire extinguisher approved for class B and C fires.

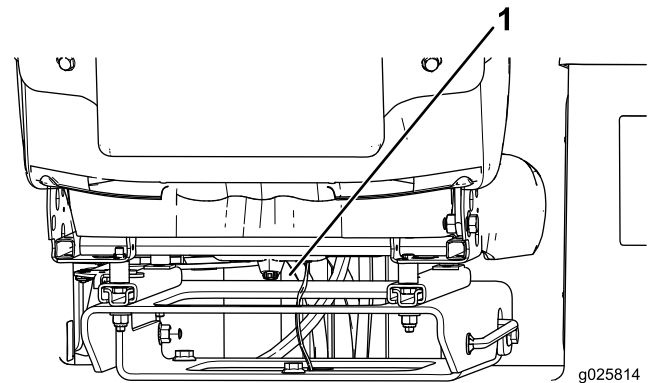


Figure 32

1. Mounting location

Before using the machine, fill the pipe holder with up to 40 drill pipes.



1. Pipe
2. Male end
3. Clevis pins

- Note:** Before drilling, check the condition of the pipes and replace any that are bent or damaged.

Service Interval: Before each use or daily—Check the fuel level.

Fuel tank capacity: 114 L (30 US gallons)

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Use of summer grade fuel above -7° C (20° F) will contribute toward longer fuel pump life and increased power compared to winter grade fuel.

Important: Do not use kerosene or gasoline instead of diesel fuel. Failure to observe this caution will damage the engine.

⚠ WARNING

Fuel is harmful or fatal if swallowed. Long-term exposure to vapors can cause serious injury and illness.

- Avoid prolonged breathing of vapors.
- Keep face away from nozzle and gas tank or conditioner opening.
- Keep fuel away from eyes and skin.

Biodiesel Ready

This machine can also use a biodiesel blended fuel of up to B20 (20% biodiesel, 80% petrodiesel). The petrodiesel portion should be low or ultra low sulfur. Observe the following precautions:

- The biodiesel portion of the fuel must meet specification ASTM D6751 or EN14214.
- The blended fuel composition should meet ASTM D975 or EN590.
- Painted surfaces may be damaged by biodiesel blends.
- Use B5 (biodiesel content of 5%) or lesser blends in cold weather.
- Monitor seals, hoses, gaskets in contact with fuel as they may be degraded over time.
- Fuel filter plugging may be expected for a time after converting to biodiesel blended.
- Contact your dealer if you wish for more information on biodiesel.

In certain conditions during fueling, static electricity can be released causing a spark which can ignite the fuel vapors. A fire or explosion from fuel can burn you and others and can damage property.

- Place fuel containers on the ground away from your vehicle before filling.
- Do not fill fuel containers inside a vehicle or on a truck or trailer bed because interior carpets or plastic truck bed liners may insulate the container and slow the loss of any static charge.
- When practical, remove equipment from the truck or trailer and refuel the equipment with its tracks on the ground.

- If this is not possible, then refuel such equipment on a truck or trailer from a portable container, rather than from a fuel dispenser nozzle.
- If a fuel dispenser nozzle must be used, keep the nozzle in contact with the rim of the fuel tank or container opening at all times until fueling is complete.

⚠ DANGER

In certain conditions, fuel is extremely flammable and highly explosive. A fire or explosion from fuel can burn you and others and can damage property.

- Fill the fuel tank outdoors, in an open area, when the engine is cold. Wipe up any fuel that spills.
- Do not fill the fuel tank inside an enclosed trailer.
- Do not smoke when handling fuel, and stay away from an open flame or where fuel fumes may be ignited by a spark.
- Store fuel in an approved container and keep it out of the reach of children. Do not buy more than a 30-day supply of fuel.
- Do not operate without entire exhaust system in place and in proper working condition.

1. Park the machine on a level surface.
2. Open the rear hood; refer to [Opening the Rear Hood \(page 58\)](#).
3. Using a clean rag, clean the area around fuel tank cap.
4. Remove the cap from the fuel tank ([Figure 34](#)).

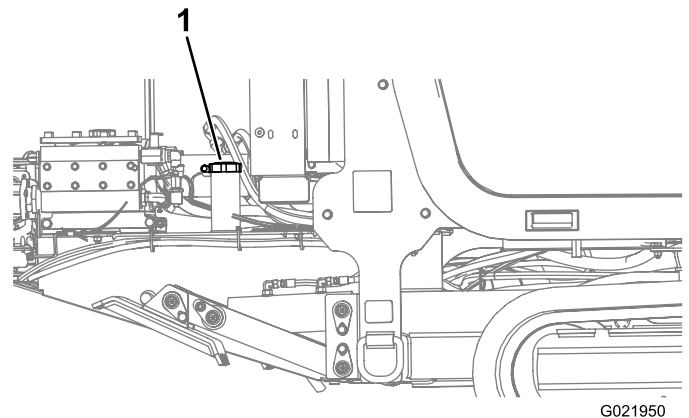


Figure 34

1. Fuel-tank cap

5. Fill the tank until the level is to the bottom of the filler neck with diesel fuel.
6. Install fuel tank cap tightly.

Note: If possible, fill the fuel tank after each use. This will minimize possible buildup of condensation inside the fuel tank.

Adjusting the Carriage Pressure

To hydraulically adjust the carriage pressure, do the following:

1. Press button 7 on the screen to turn the carriage pressure to the ON position (green); refer to the Carriage-Pressure Screen in the *Software Guide* for this machine.
2. Increase or decrease the carriage pressure as follows:
 - Press button 5 on the screen to decrease the carriage pressure.
 - Press button 6 on the screen to increase the carriage pressure.

Note: The carriage-pressure gauge will fluctuate up or down based on how much you increase or decrease the carriage pressure.

Checking the Engine-Oil Level

Before you start the engine and use the machine, check the oil level in the engine crankcase; refer to [Checking the Engine-Oil Level \(page 66\)](#) in Engine Maintenance.

Checking the Cooling System

Before you start the engine and use the machine, check the cooling system; refer to [Cooling System Maintenance \(page 77\)](#).

Checking the Hydraulic-Fluid Level

Before you start the engine and use the machine, check the hydraulic fluid level; refer to [Checking the Hydraulic Fluid \(page 83\)](#) in Hydraulic System Maintenance.

Starting/Stopping the Engine

To start the engine, complete the following:

1. Open the front hood; refer to [Opening the Front Hood \(page 58\)](#).
2. Turn the battery disconnect switch to the ON position; refer to [Battery-Disconnect Switch \(page 30\)](#).
3. Close and latch the hood.
4. Open the door on the rear control panel.
5. Turn the ignition key to the RUN position.
If the Wait-to-Start light illuminates, wait until it turns off before proceeding.
6. Turn the ignition key to the START position until the engine starts, then release it.

To stop the engine, turn the ignition key to the OFF position. In an emergency, you can also stop the engine and all processes by pressing the ENGINE-STOP button on either the drive pendant or the control panel.

Driving the Machine

1. Walk around the machine to ensure that no one is near it. Ensure that all bystanders are clear of the area where you will be moving the machine.
2. Connect the drive pendant to the right receptacle on the bottom of the rear control panel.
3. With the pendant in hand, walk at least 6 feet to the side of the machine. Be sure to keep this safe distance whenever moving the machine.
4. Press and hold the OPERATOR-PRESENCE button on the drive pendant.
5. Use the speed switch on the pendant to increase or decrease the engine speed as desired.
6. Set the desired travel speed, using the speed switch.
7. Use the joystick to move the machine as desired.

Note: For more information on the drive pendant, refer to [Drive Pendant \(page 28\)](#).

Loading and Unloading the Machine

⚠ WARNING

Moving a machine of this size on a trailer over public roads carries risks to those around the machine if it should come loose, be involved in an accident, hit a low hanging structure, etc.

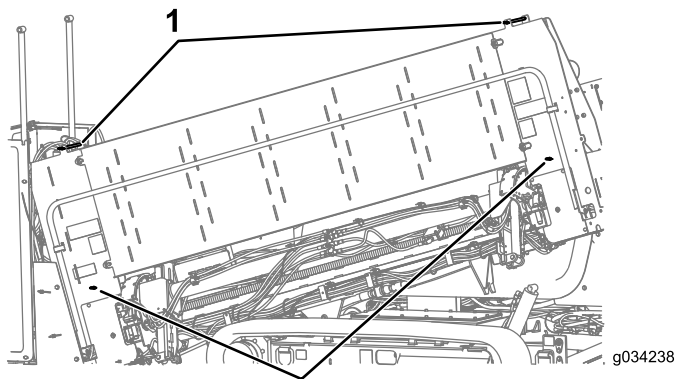
- Follow the tie-down procedures described in this section when moving the machine.
- Follow all local traffic regulations governing the hauling of large equipment. This manual cannot adequately cover all laws and safety regulations; it is your responsibility to know and follow the laws and regulations that pertain to you.

⚠ WARNING

The machine can slip and fall from a trailer or ramp, crushing anyone caught beneath it and causing serious injury or death.

- Keep all bystanders away from the machine and trailer.
- Ensure that the trailer and ramp are not slippery and are free of ice, grease, oil, etc.
- Move the machine onto the ramp at slow speed with the engine at slow speed.
- Ensure that you have the machine centered on the ramp and trailer.

1. Ensure that the ramp and the trailer or truck bed can support the weight of the machine.
2. Ensure that the upper and rear pipe-holder pins are installed [Figure 35](#).



2
Figure 35

1. Upper pins 2. Lower pins

3. Place a block at the front and rear of the trailer and/or truck tires.
4. Using the drive pendant, set the engine speed to slow, and the drive speed to slow.
5. Using the drive pendant, carefully drive the machine forward or rearward up the ramp and into position on the trailer.
6. Lower the stake-down plate to the deck of the trailer.
7. Turn off the engine.
8. Use appropriately rated chains and binders to secure the rings on the left and right track frames and the stake-down plate to the trailer ([Figure 36](#)).

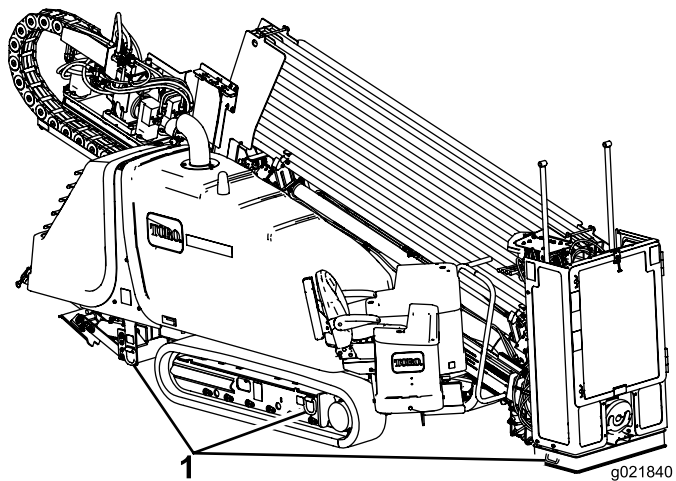


Figure 36

1. Tie-down points (only right side shown)

9. Measure the distance from the ground to the highest point on the machine for reference to ensure that you do not collide with low hanging obstacles.
10. Remove the block from the trailer tires, and stow them with the machine for use when unloading it.

11. After driving a few miles, pull over and check to ensure that all chains are still tight and that the machine has not moved.

To unload the machine, reverse the above procedure.

Setting Up the Drill Head and Tracking System

The drill head consists of two parts, the drill bit and the sonde housing (Figure 37).

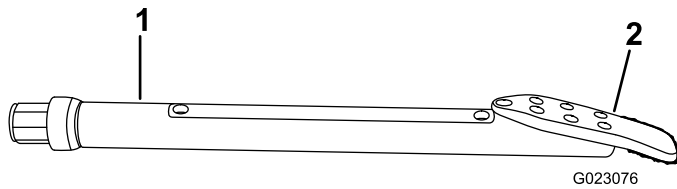


Figure 37

1. Sonde housing 2. Drill bit

Drill bits vary in size and type to meet the various soil conditions you may need to drill through. Some of the possibilities are as follows:

- **Straight blade**—Used in a wide range of medium density soils.
- **Bent blade**—Used in medium to soft soils. This bit has an added 20° bend to increase steering performance in soft soils.
- **Triangle point blade**—Use in hard and rocky soils. This bit has carbide edges to reduce wear.

All of the above bits come in varying widths. A wider blade increases your ability to steer in soft soils. A narrower blade moves through hard soils better. Contact your Authorized Toro Dealer for a complete list of available blades.

The sondes and receivers are essential to track the position of the drill head throughout the drilling operation. The sonde housing on the drill head opens up to accept the sonde beacon which works with the receiver to track the location, pitch, direction, head orientation, and more of the drill head. Refer to the *Tracking System Operator's Manual* for instructions on using the system.

To install the sonde beacon into the sonde housing on the drill head, complete the following:

1. Replace the batteries in the sonde beacon as described in the *Tracking System Operator's Manual*.
2. Loosen the screws securing the housing cover to the housing and remove the cover (Figure 38).

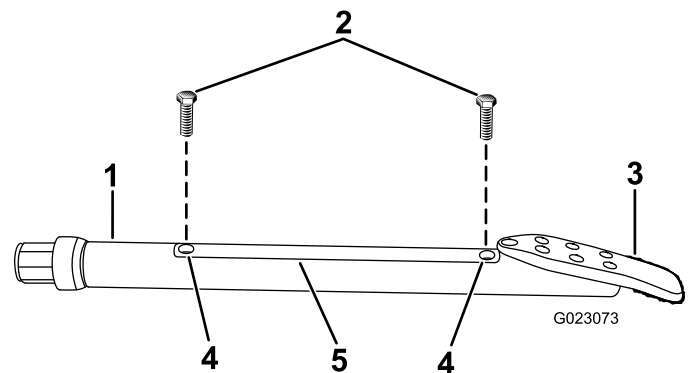


Figure 38

1. Sonde housing 4. Housing cover
2. Screws 5. Housing
3. Drill bit

3. Insert the sonde beacon with the forward end toward the drill bit into the sonde housing (Figure 39).

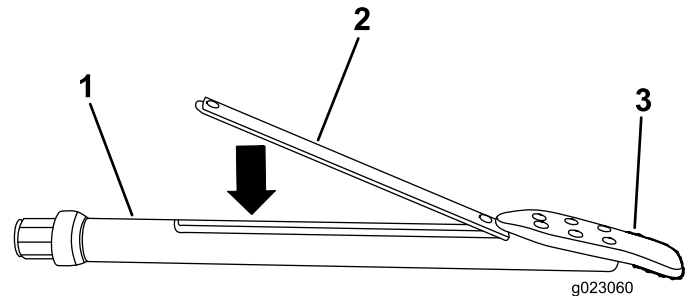


Figure 39

1. Sonde housing 3. Drill bit
2. Sonde beacon

4. Install the housing cover and secure it with the screws (Figure 38).

Setting up the Machine for Drilling

1. Using the drive pendant, drive the machine to the location that you have prepared for it, ensuring that the front of the machine is the proper distance back from entry point and the drill frame is in line with the bore path.
2. Drive up to the location and make sure that all utilities are located and marked prior to drilling.
3. Loosen the 4 screws that secure the covers over the operator consoles and remove the covers (Figure 40).

Note: Store them someplace safe for the day.

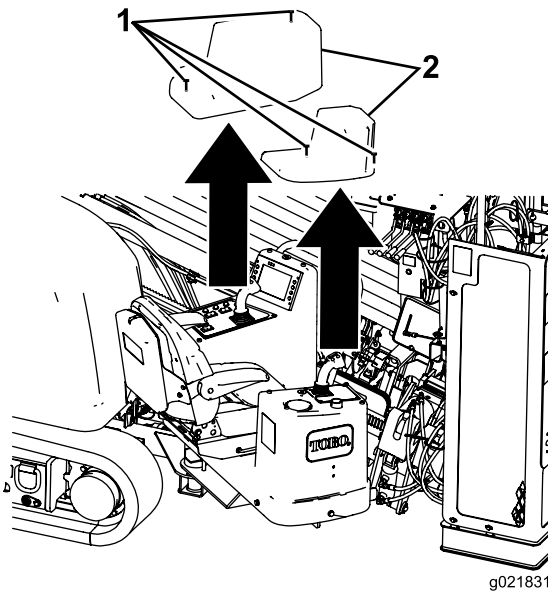


Figure 40

1. Screw
2. Cover

4. Lower the pedestrian safety bar and secure it in place (Figure 41).

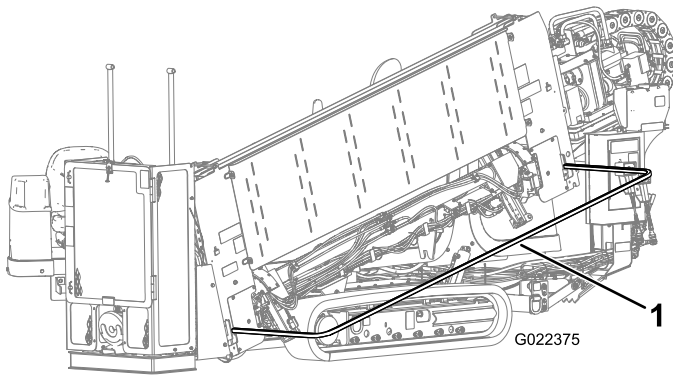


Figure 41

1. Pedestrian safety bar (lowered position shown)

5. Push down on the rear platform latch securing the operator platform, and swing it out to the desired position, ensuring that it locks in place (Figure 42).

Note: The operator platform has 4 positions: travel (swung all the way into the machine), full-out, and 2 intermediate positions.

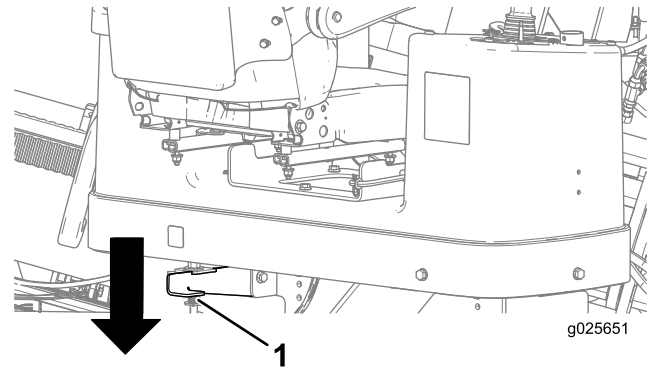


Figure 42

1. Rear platform latch

Deploying the Zap-Alert System

The Zap-Alert system is an electric strike sensing device on the machine that triggers a strobe light and audible alarm in the event that the drill bit, reamer, or stake breaks into an energized power line. In the event of an electric strike, the machine will become energized, setting off the alarm. The operator's platform is electrically isolated from the rest of the machine to protect you.

⚠ DANGER

If the Zap-Alert system activates while drilling, the machine, except for the operator's platform, will become energized. If you step off the operator platform or if someone touches the machine or wet ground near the machine or in the bore, you or they could be electrocuted causing serious injury or death.

- Test the Zap-Alert system before drilling.
- Deploy the grounding stake before drilling. Ensure that the stake is fully inserted into moist soil.
- If the Zap-Alert is triggered:
 - Stay in the seat and do not touch the ground or any other part of the machine until the power has been turned off. Do not pour liquids or urinate from the operator platform onto the ground.
 - Stop drilling, stop the drilling-fluid flow, and retract the drill out of the ground.
 - Keep everyone away from the machine, wet ground near the machine or running from the machine, and any open sources of water/mud that is in the bore and contacting the broken line.
 - Contact the utility company to have power shut off to the broken line. Do not reset the Zap-Alert system until the power has been turned off.

1. Remove the grounding stake from the holder on the side of the operator platform (Figure 43).

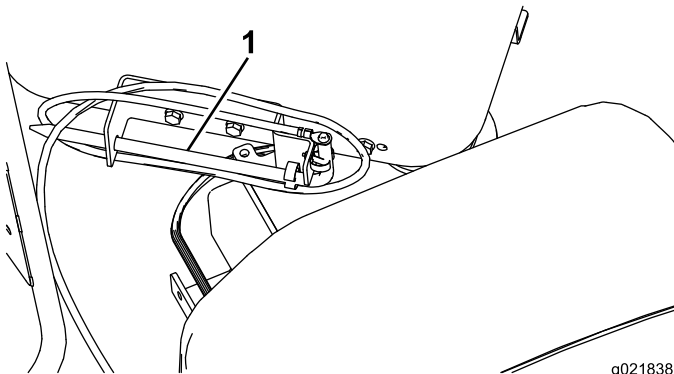


Figure 43

1. Grounding stake

2. Move the stake directly away from the machine, perpendicular to the drill frame and drive it into the ground until the handle touches the ground.

3. If the ground is dry where you put the stake, soak it with water before using the machine to ensure good electrical contact.

Lowering the Stakes

1. Move the operator station to the desired angle, switch the DRILL/DRIVE switch to the DRILL position, and raise the pipe elevators, so that the pipe is resting on the elevators; refer to [Starting the First Pipe](#) (page 49).
2. Load the first pipe and install the sonde and the drill head; refer to [Starting the First Pipe](#) (page 49).
3. Place the drill head on the drill frame, and take a pitch reading using the receiver; refer to the *Tracking System Operator's Manual*.
4. Lower the thrust frame, tilting the drill frame until the plate contacts the ground (Figure 44).

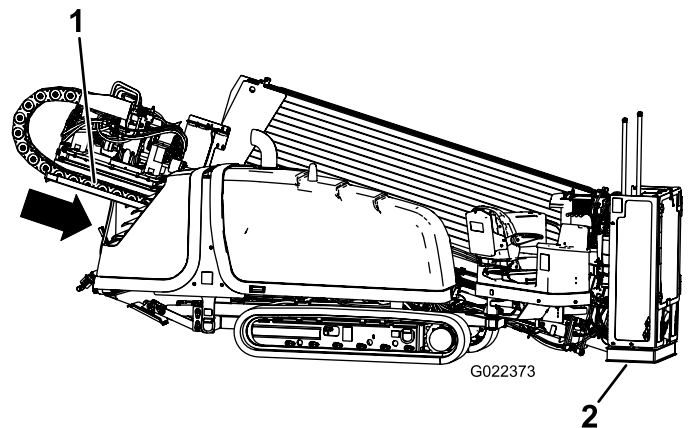


Figure 44

1. Thrust frame
2. Stake-down plate

5. Lower the rear stabilizers until they contact the ground firmly, or until the desired entry angle is achieved (Figure 45).

Note: The rear of the tracks should just start to lift off the ground.

Note: If the ground is soft, place timber below the stabilizers, and lower the stabilizers.

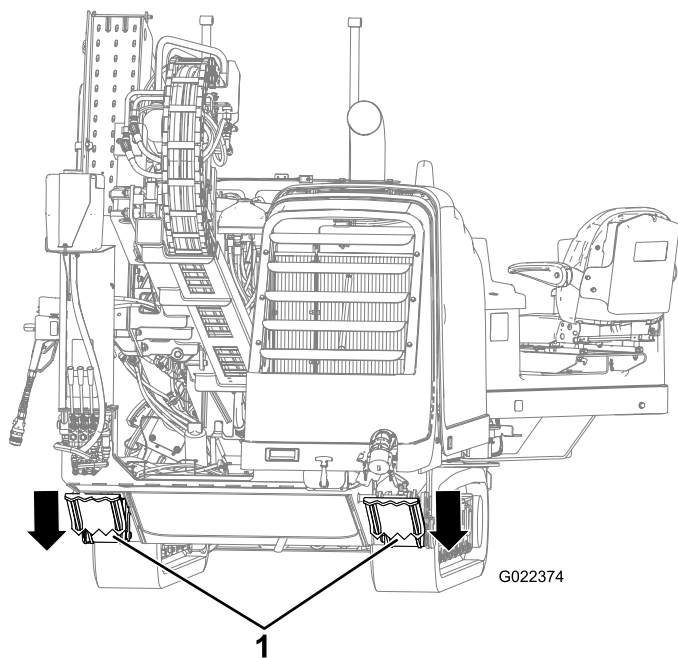


Figure 45

1. Rear stabilizers

6. Press the 2 right stake levers in to lower and spin the right stake auger until it seats fully (Figure 46).

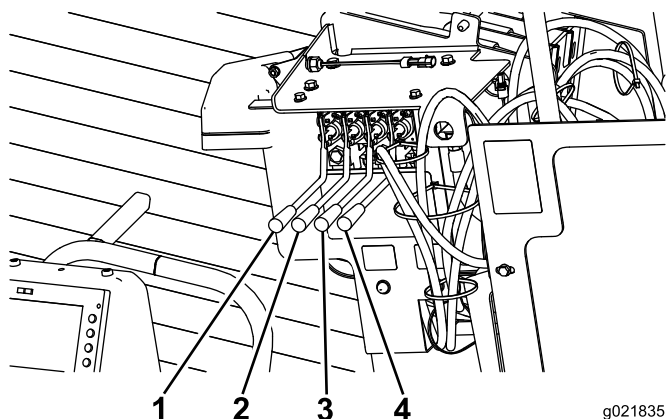


Figure 46

- | | |
|---------------------------------|----------------------------------|
| 1. Left-stake-raise/lower lever | 3. Right-stake-raise/lower lever |
| 2. Left-stake-spin lever | 4. Right-stake-spin lever |

7. Repeat step 6 for the left-side stake.

Connecting to a Drilling-Fluid Source

When drilling and reaming, you pump a mixture of bentonite clay, water, and sometimes other ingredients, collectively called drilling fluid or “Mud”, through the pipe and into the bore. This drilling fluid, or “Mud”, does the following for your bore:

- Lubricates the drill head
- Loosens the soil into which the drill is cutting
- Penetrates and binds loose soil to keep them from collapsing on the bore pipe.

The specific mixture you need will vary depending on your soil type and the operation you are performing; refer to your mixing system *Operator's Manual* for details.

Conversely, for some jobs (depending on the soil type and distance), you can pump screened water from a natural water source, such as a lake or river, through the drill in lieu of mixed drilling fluid.

- To connect the machine to a mixing system, refer to [Setting Up the Mixing System \(page 48\)](#).
- To connect the machine to a natural water source, refer to [Setting Up the Pump to Use a Natural Water Source \(page 49\)](#).

Setting Up the Mixing System

Set up your mixing system near the directional drill location, preferably down wind so fumes from the mixing system engine will not bother you while drilling. Follow the instructions provided in the mixing system *Operator's Manual* for setting it up and using it.

Complete the following to connect the exit hose from the mixing system to the drilling-fluid pump on the machine:

1. Raise the cam-lock levers on the pump-inlet cap and remove the cap (Figure 47).

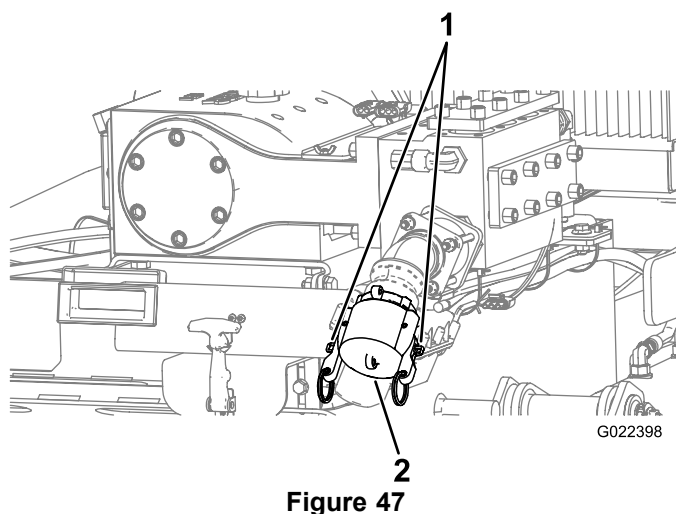


Figure 47

- | | |
|--------------------|-------------------|
| 1. Cam-lock levers | 2. Pump-inlet cap |
|--------------------|-------------------|

2. Insert the hose from the mixing system over the pump inlet and secure it with the cam-lock levers.

Setting Up the Pump to Use a Natural Water Source

To set up a pump to use a natural water source, you must ensure that you use the Y-screen to filter all materials other than water.

To install the Y-screen perform the following tasks:

1. Remove the pump-inlet cap (Figure 48).

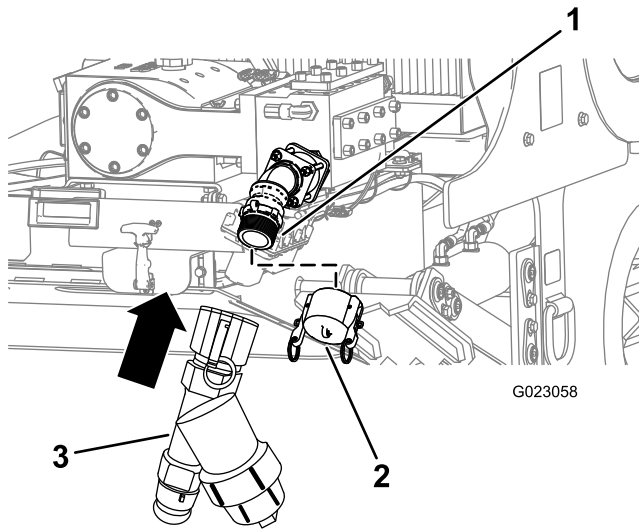


Figure 48

1. Pump threads
 2. Pump-inlet cap
 3. Y-screen
-
2. Align the Y-screen with the threads on the pump (Figure 48).
 3. Rotate and tighten the Y-screen onto the pump.
 4. Attach the hose to the Y-screen, and begin pumping from the natural water source.

Drilling the Bore

Starting the First Pipe

1. Ensure that all bystanders are away from the machine and that the exit-side lockout is On.
2. Move the drill carriage fully down the drill frame and spray the spindle threads with thread joint compound, then return the drill carriage to the upper end of the frame (Figure 43).

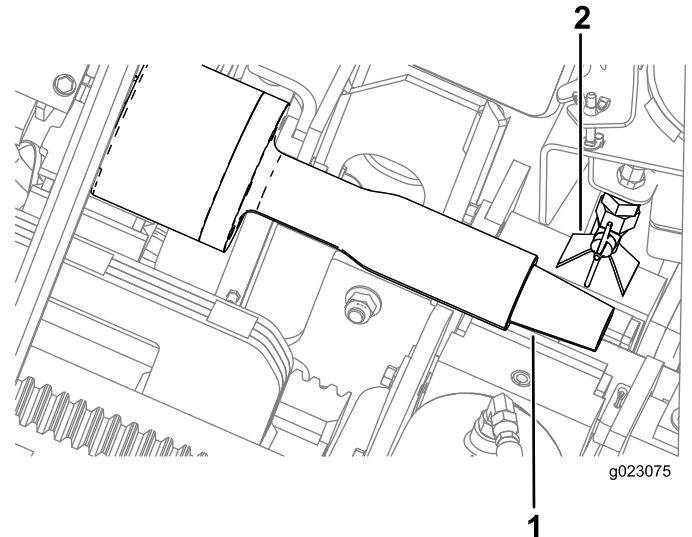


Figure 49

1. Drill spindle
 2. TJC-applicator nozzle
-
3. Rotate the pipe gripper to the first row of pipes in the pipe holder by aligning the row indicator to row number 1.
 4. Lower the pipe elevators to load a pipe into the pipe gripper.
 5. Rotate the pipe gripper with the pipe toward the drill frame, and extend the pipe until the pipe is centered over the frame and in front of the spindle on the drill carriage.
 6. Rotate the drill spindle clockwise and move the carriage slowly forward to insert the spindle into the female end of the pipe (Figure 50).

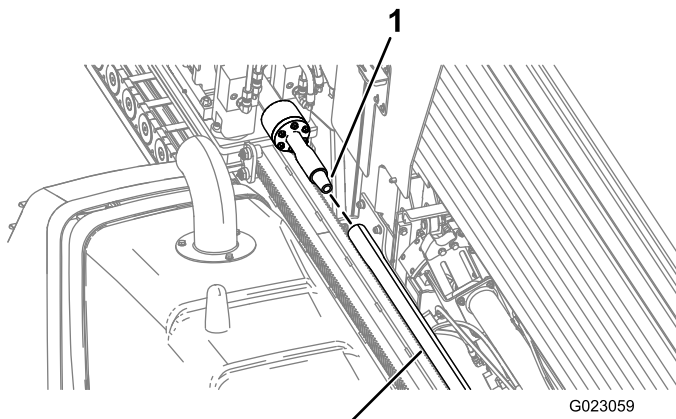


Figure 50

1. Drill spindle
2. Pipe

7. Continue to move the drill carriage slowly down the frame until the male threads on the pipe are under the thread-joint-compound applicator and apply thread-joint compound to the threads.
8. Release and retract the pipe gripper, rotating it all the way out to the third row of pipes.

Important: Ensure that you fully retract the pipe gripper and rotate it all the way out or the carriage may collide with the gripper, damaging the machine.

9. Continue to rotate the drive spindle clockwise, until the male pipe threads are fully seated into the sonde housing or the lead bar.

Note: Torque the threads to 2305 N-m (1700 ft-lb).

Installing the Drill Head

1. Using the exit-side-lockout transmitter, enable the exit side lockout.

⚠ WARNING

If the drill rotates or extends while you or others are manually working on the drill bit or pipe in front of the machine, the worker could get caught in the bit or pipe causing serious injury, amputation, or death.

- Enable the exit-side lockout on the exit-side-lockout transmitter before approaching the drill bit or pipe when attached to the machine. This will disable the drill carriage.
- Do not wear loose clothing or jewelry when working on a drill bit or pipe attached to the machine. Tie long hair up and out of the way.

2. Hand thread the lead bar onto the pipe threads then clear away from the front of the machine.
3. When the area is clear of people, disable the exit-side lockout using the exit-side-lockout transmitter (the OK-to-Drill light on the control panel should illuminate); press the exit-side-lockout, reset switch on the control panel.
4. Pull the drill pipe and lead bar back through the pipe guide and into the wrenches, aligning the thickened upper joint of the lead bar with the upper wrench (Figure 51).

Important: Do not clamp the wrench on the body of a pipe or it may damage the pipe. Grip the pipes on the thickened area near the joint.

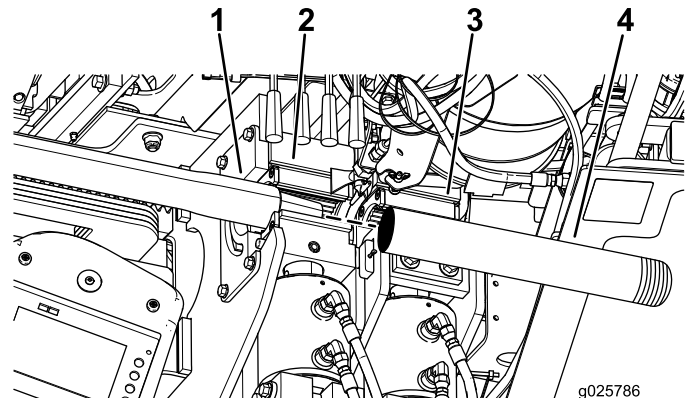


Figure 51

1. Drill pipe
2. Upper wrench (makeup/breakout wrench)
3. Lower wrench (stationary wrench)
4. Lead bar

- Using the upper wrench, clamp the lead bar and tighten it to full machine torque.
- Using the exit-side-lockout transmitter, enable the exit-side lockout.
- Double check the drill head and bit to ensure that the fluid ports are clean and free from obstructions.
- Install the drill head onto the end of the lead bar as directed by the drill head manufacturer, then clear away from the front of the machine.

Important: Do not pull the drill head into the pipe guide or you may damage the machine or the drill head.

Boring the Entry Shaft

The first boring step is to create the entry shaft. In this step, you push and bore the drill bit and first few pipes into the ground at an angle from 0 to 16 degrees (with the tracks flat on the ground) until you reach the desired depth of your installation.

Important: Drill and ream in a clockwise rotation. If you use a counterclockwise rotation the pipe will disconnect from each other and may be disconnected underground.

- When the area is clear of people, disable the exit-side lockout using the exit-side-lockout transmitter (the OK-to-Drill light on the control panel should illuminate); press the exit-side-lockout, reset switch on the control panel.
- Turn on the drilling fluid pump switch and allow the fluid pressure to build to 200 to 300 psi.
- Rotate the drill head until the bit is at the 6 o'clock position.
- Move the carriage forward driving the bit straight into the ground until the entire drill housing is underground.
- Continue pushing forward and begin rotating the drill spindle clockwise to initiate the drilling action.
- Drill forward until the carriage reaches the end of the frame, then retract it about 6 mm (1/4 inch).

Adding Drill Pipes

- Align the pipe joint in the wrench assembly.
- Close the lower wrench (stationary wrench) onto the first pipe.

Note: The drilling fluid will automatically shut off when you activate the upper wrench (makeup/breakout wrench).

- Pull back the carriage approximately 12.7 mm (0.5 inch).

Note: This will allow the carriage to float, and will not damage the pipe threads.

- Rotate the drill head counterclockwise until the spindle is completely removed from the pipe.
- Spray the spindle with thread joint compound, then return the drill carriage to the upper end of the frame.
- Rotate the pipe gripper to the closest row of pipes in the pipe holder.
- Lower a pipe into the pipe gripper and grip it in place.
- Rotate the pipe gripper toward the thrust frame, and extend it until the pipe is centered over the frame and in front of the spindle on the drill carriage.
- Rotate the drill spindle clockwise and move the carriage slowly forward to insert the spindle into the female end of the pipe (Figure 50).

Note: Tighten the joint until the pipe is rotating with the spindle.

- Move the drill carriage slowly down the frame until the male threads on the pipe are under the thread-joint-compound applicator and apply thread-joint compound to the threads.
- Rotate the drill spindle clockwise and move the carriage slowly forward to insert the male end of the pipe into the female end of the previous pipe. Tighten the joint until you reach no more than 2,304 N-m (1,700 ft-lb).
- Release and retract the pipe gripper, rotating it all the way out past the third row of pipes.

Important: Ensure that you fully retract the pipe gripper and rotate it all the way out or the carriage may collide with the gripper, damaging the machine.

- Release the wrench and continue the drilling operation.

Software version K or newer: After loading the first pipe the software will skip the certain proximity switches to improve operator productivity. The grippers will also function when the pipe loading cam is extended and retracted without operator input.

Steering the Drill Head

The drill bit is shaped like a wedge, angled from one side of the bit to the other. When you push the bit through the soil without rotating it, it will veer toward the direction the wedge is pointing. When you rotate the pipe and drill head it bores through the soil in a straight path.

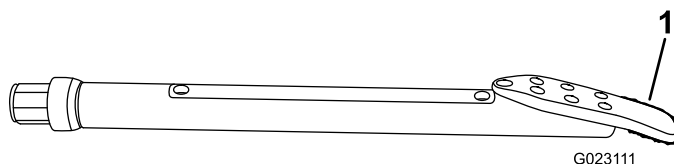


Figure 52

- Drill bit

When drilling, the receiver operator follows the drill head as it progresses. The receiver receives signals from the sonde in the drill head identifying its position, depth, pitch, direction, transmitter temperature, and orientation in the soil. The remote console is a screen that remains near you (the drill operator) to show you the information from the receiver while drilling so you can make steering decisions.

For detailed information on using the receiver and remote console to guide the drill head, refer to the *Operator's Manual* that came with your receiver.

Important: Do not steer the drill head more than 20 cm (8 inches) off center for every 10 feet of forward travel. If you steer more than this you will damage the drill pipes.

Boring the Horizontal Shaft

After creating the entry shaft, you gradually steer the drill head up while pushing forward, following the planned bore path. When you reach the desired depth, level out the drill head and bore the horizontal shaft, adding pipes as you go. While boring, pay close attention to the information relayed back to you by the receiver operator about the status and location of the drill head to ensure that you are following the planned path.

Important: While drilling, watch the sonde temperature. All sondes have a maximum temperature above which they will be damaged. Friction between the drill head and the soil will cause the temperature to raise. To reduce the temperature, slow down, decrease forward pressure, and increase the drilling fluid flow. If the drill head is entering a soil type other than what it is designed for, that can also raise temperature. Assess the situation and pull out the drill head and change it if necessary.

If you run into an obstruction, do the following:

1. Increase the flow of the drilling fluid for a few seconds without drilling, then attempt to continue drilling forward.

This may loosen the obstruction and allow you to push past it.

2. If the obstruction persists, try one or more of the following options:
 - If the obstruction is in an area where you can dig, stop the drill head with the Exit Side Lockout and dig down to the obstruction to identify it and remove it if possible.
 - Pull the drill head back 15 m (50 ft) or more and steer the drill head to the side, marking a new drill path around the obstacle.

Important: Do not steer the drill head more than 20 cm (8 inches) off center for every 10 feet of forward travel. If you steer more than this you will damage the drill pipes.

- If the obstruction is actually a change in soil types, such as a zone of rocky soil, pull the drill head all

the way back and change to a drill bit appropriate for drilling through the new soil type.

Exiting the Ground

As you approach the end of the bore, steer the drill head to the exit point, keeping the steering limits in mind as you do so. Before exiting the ground, ensure that everyone is away from the exit point. As soon as you break through, stop the drilling-fluid flow. Extend the drill forward until the entire drill head is out of the ground.

Backreaming and Pullback

After drilling the initial bore, you attach a reamer to the pipe which is then connected to a the product you are installing. The reamer is designed to widen the bore, pack the walls and lubricate the passage of the product into the bore.

The following reamers are available from your Authorized Toro Dealer in various sizes to meet your needs and soil conditions:

- **Carbide step-wing cutter**—Use this reamer in sandy and medium clay soil conditions to mix the drilling fluid with the soil, making a mixture that flows easily around the product being pulled.
- **Cast cone packer**—Use this reamer in soils that pack easily, such as soft clay, peat, and loam, to pack the sides of the bore, maintaining the bore opening.
- **Fluted reamer**—Use this reamer in hard clay and rocky soils; it combines the features of the other two reamers.

Connecting the Reamer and Product

⚠ WARNING

If the drill rotates or extends while you or others are manually working on the drill bit or pipe in front of the machine, the worker could get caught in the bit or pipe causing serious injury, amputation, or death.

- Enable the exit-side lockout on the exit-side-lockout transmitter before approaching the drill bit or pipe when attached to the machine. This will disable the drill carriage.
- Do not wear loose clothing or jewelry when working on a drill bit or pipe attached to the machine. Tie long hair up and out of the way.

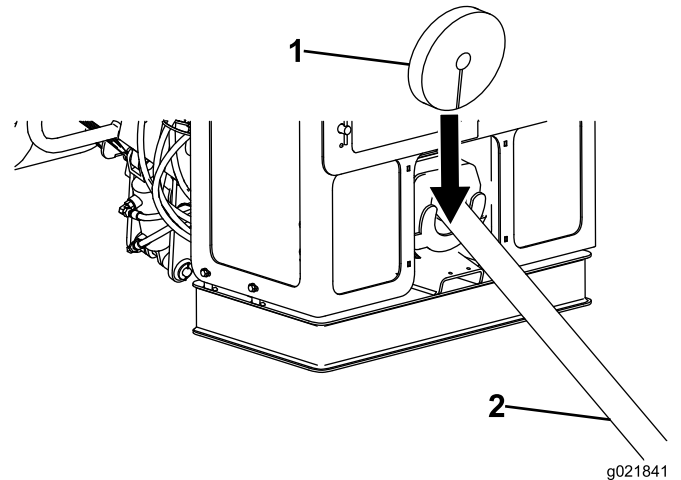


Figure 53

1. Using the exit-side-lockout transmitter, enable the exit side lockout.
2. Remove the drill head from the lead bar.
3. Double check the reamer to ensure that the fluid ports are clean and free from obstructions.
4. Install the reamer and swivel onto the end of the lead bar as directed by the reamer manufacturer
5. Connect the product to the reamer using an appropriate pulling connection; refer to your Authorized Toro Dealer to acquire the appropriate puller to meet your requirements.

Removing Drill Pipes

1. Using the exit-side-lockout transmitter, enable the exit side lockout.
2. Install a drill-pipe wiper around the pipe and into the retaining bracket on the front of the machine.

This will remove most of the dirt and mud from the pipe as you pull it back into the machine, keeping the machine clean. Contact your Authorized Toro Dealer to purchase drill-pipe wipers.

1. Drill-pipe wiper
2. Drill pipe
3. Disengage the exit-side lockout and reset the system.
4. Begin rotating the drill spindle clockwise and slowly retract the drill carriage to pull the pipe back into the machine
5. When the joint between the pipes is centered between the two wrenches, the drill carriage will stop, and a green light will illuminate below the spray valve.
6. Close the lower wrench onto the pipe joint.
Note: The drilling fluid will automatically shut off when you close the lower wrench.
7. Rotate the pipe gripper to the drill frame, extend the pipe-gripper arms to the pipe, and grip the pipe to support it.
8. Close the upper wrench onto the pipe joint.
9. Rotate the upper wrench counterclockwise until the joint is loosened.
10. Release the upper wrench.
11. Pull back the carriage approximately 12.7 mm (0.5 inch).
Note: This will allow the carriage to float, and will not damage the pipe threads.
12. Rotate the drill spindle counterclockwise moving rearward slowly until the pipes are separated.
13. Move the drill carriage back until the male-pipe threads just clear the female end of the lower pipe, then close the upper wrench onto the pipe end, but not on the threads.
14. Rotate the drill spindle counterclockwise until the upper-pipe joint is loose but not separated.
15. Release the upper wrench.
16. Move the drill carriage back until the pipe is lined up with the pipe holder.

17. Rotate the drill spindle counterclockwise moving rearward slowly until the spindle fully separates from the pipe.
18. Retract the pipe gripper arms.
19. Rotate the pipe cam to the desired row.

Note: Fill the outside rows first.

20. Release the pipe gripper and raise the pipe into the holder row.
21. Raise the pipe into the pipe basket with the pipe elevators.
22. Rotate the pipe gripper past the third row of pipes.

Important: Ensure that you fully retract the pipe gripper and rotate it all the way out or the carriage may collide with the gripper, damaging the machine.

23. Move the drill spindle down the frame under the thread-joint-compound applicator, and spray the spindle with thread joint compound.
24. Rotate the drill spindle clockwise and move the carriage slowly forward to insert the spindle into the female end of the pipe secured in the lower wrench.

Note: Tighten the joint until you reach no more than 2,304 N-m (1,700 ft-lb).

25. Release the wrench and continue reaming/retraction as needed.

Removing the Last Pipe and the Reamer

Important: Do not pull the drill head into the pipe guide or you may damage the machine or the drill head.

1. Using the exit-side-lockout transmitter, enable the exit side lockout.
2. After the reamer has cleared the ground, if you have not already done so, disconnect the product being installed from the reamer.
3. Connect the drilling fluid pump to a source of clean water.
4. Turn the pump on to flush clean water through the pump, spindle, and reamer until the water runs clear.
5. Remove and store the last pipe; refer to [Removing Drill Pipes](#) (page 53).
6. Leave the lead bar clamped in the lower wrench, but do not connect the drill spindle to the lead bar.
7. Remove the reamer from the end of the lead bar as directed by the reamer manufacturer.
8. Release the lower wrench and pull the lead bar out of the pipe guide.

Finishing the Job

Complete the following after each day of use:

- Connect the hand spray gun to the pump and clean the machine with clean water; refer to [Cleaning with the Spray-Hose Attachment](#) (page 88).
- Add grease to the grease fittings; refer to [Greasing the Machine](#) (page 60).
- If the air temperature is below freezing or will be before the next use, refer to [Preparing the Drilling-Fluid System for Cold Weather](#) (page 87).
- Install the controls covers; refer to [Operator-Controls Covers](#) (page 21).
- Flush the drilling fluid out of the drilling-fluid pump with water or antifreeze.

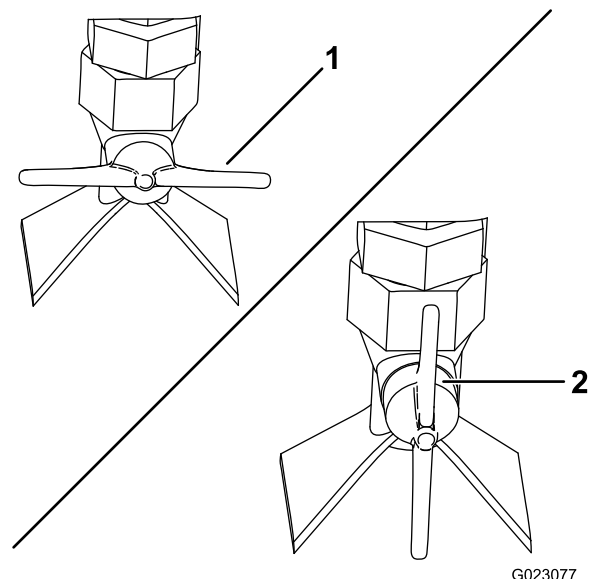
Note: The drilling-fluid pump may be damaged if the drilling-fluid dries up in the pump.

Using the TJC Applicator

Adjusting the Applicator Nozzle

You can adjust the applicator nozzle to spray thread-joint compound (TJC) either in a fan-shaped spray or as a stream.

- For fan-shaped spray—turn the spray valve on the side of the nozzle horizontal ([Figure 54](#)).
- For a stream—turn the spray valve on the side of the nozzle vertical ([Figure 54](#)).



G023077

Figure 54

1. Spray valve—fan-shaped spray (horizontal)
2. Spray valve—stream (vertical)

Adjusting the TJC-spray Volume

To adjust the volume of thread-joint compound that is delivered by the applicator, complete the following:

1. Loosen the jam nut on the adjustment bolt located on top of the TJC-applicator piston (Figure 55).

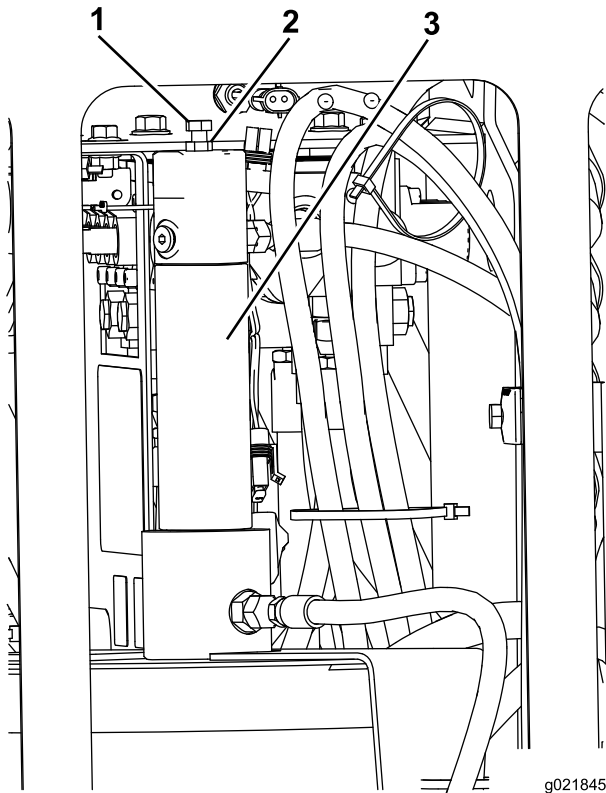


Figure 55

- | | |
|--------------------|--------------------------|
| 1. Adjustment bolt | 3. TJC-applicator piston |
| 2. Jam nut | |

2. Adjust the bolt as follows:
 - To increase the applied volume of compound, thread the bolt out (up).
 - To decrease the applied volume of compound, thread the bolt in (down).
3. When you have attained the desired application volume, tighten the jam nut to secure the adjustment.

Filling the TJC Applicator

1. Stop the machine and stop the engine.
2. Open the stake-down-guard door.
3. Loosen the wing nuts securing the cover straps to the machine (Figure 56).

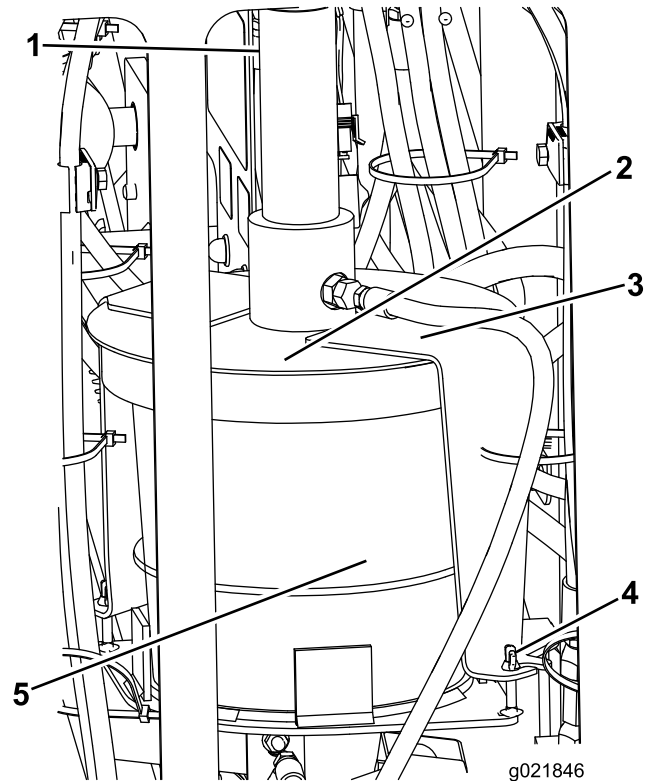


Figure 56

- | | |
|--------------------------|---------------|
| 1. TJC-applicator piston | 4. Wingnut |
| 2. Cover | 5. TJC bucket |
| 3. Strap | |

4. Rotate the cover and pull the cover straps off the retaining bolts (Figure 56).
5. Lift the cover assembly off and out of the empty thread-joint-compound bucket (Figure 56).
6. Replace the empty bucket with a new full bucket.
7. Place the plunger into the new bucket and lower the cover assembly onto the bucket (Figure 56).
8. Slide the cover straps over the retaining bolts and rotate the cover to seat the straps on the bolts (Figure 56).
9. Tighten the wing nuts.

Moving a Disabled Machine

Whenever the machine is stopped and the engine is not running, the hydrostatic brakes automatically engage. Do not attempt to tow the machine if it cannot move under its own power. If possible, repair the machine at the site. If this is not possible, use a crane and a spreader bar to lift the machine onto a trailer, using the lift points shown in [Figure 57](#).

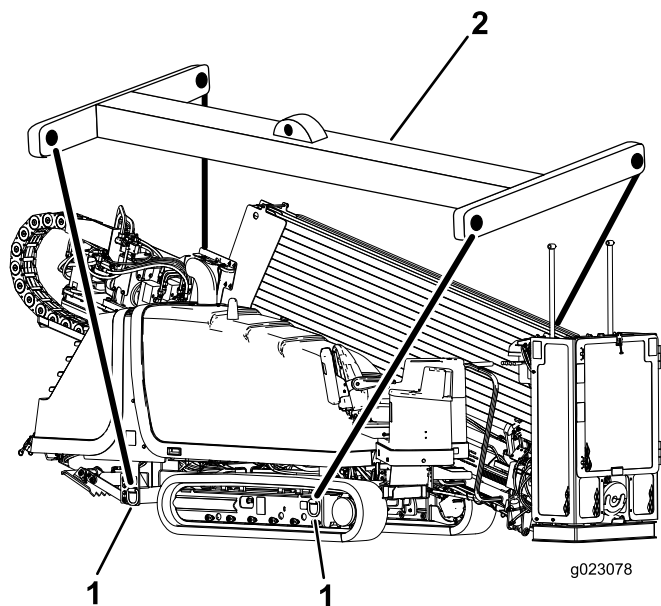


Figure 57

Repeat lift points on other side

1. Spreader bar

2. Lift point

Maintenance

Note: Determine the left and right sides of the machine from the normal operating position.

Recommended Maintenance Schedule(s)

Maintenance Service Interval	Maintenance Procedure
After the first 100 hours	• Check the gearbox drive oil. • Change the gearbox-drive oil.
After the first 250 hours	• Adjust the valve clearance. • Change the planetary oil.
Before each use or daily	• Check the fuel level. • Grease the machine. (Grease immediately after every washing). • Check the crankcase-vent tube and clean it if necessary. • Check the indicator on the display screen for a restricted air filter. • Check the engine-oil level. • Check the track tension. • Check the coolant level in the reservoir for the radiator. • Check the hydraulic fluid level. • Check the drilling-fluid-pump oil level. • Clean the machine with the spray-hose attachment.
Every 50 hours	• Check and clean the dust valve. • Remove air cleaner cover and clean out debris. Do not remove the filter. • Check the fuel-water separator for water and sediment. • Check the battery condition • Check the planetary-drive oil level (Also, check if external leakage is observed). • Check the coolant level in the radiator.
Every 250 hours	• Clean or replace the air-cleaner filter. • Change the engine-oil filter. • Change the engine oil. • Clear the spark arrestor in the muffler of carbon buildup. • Replace the primary and secondary, fuel filters. • Check the condition of the engine-drive belt.
Every 300 hours	• Check the condition of the coolant system components. Clean dirt and debris from them and repair or replace the components as necessary.
Every 500 hours	• Inspect the fuel lines and connections. • Check the gearbox drive oil (or yearly, whichever comes first). • Change the gearbox-drive oil (or yearly, whichever comes first). • Change the hydraulic-fluid return filter. • Change the hydraulic-pressure filter. • Change the drilling-fluid pump oil.
Every 800 hours	• Change the planetary oil (or yearly, whichever comes first).
Every 1,000 hours	• Drain and clean the fuel tank. • Check the concentration of the coolant before the winter season. • Clean the cooling system. (Clean the cooling system if the coolant becomes dirty or rust colored.) • Check the tension on the engine drive belt. • Change the hydraulic fluid.
Every 2,000 hours	• Adjust the valve clearance.
Yearly or before storage	• Touch up chipped paint.
Every 2 years	• Replace moving hoses.

Important: Refer to your *Engine Operator's Manual* for additional maintenance procedures.

⚠ CAUTION

If you leave the key in the ignition switch, someone could accidentally start the engine and seriously injure you or other bystanders.

Remove the key from the ignition before you do any maintenance.

⚠ WARNING

Improperly servicing or repairing the machine may cause injury or death.

If you do not understand the service procedures for this machine, contact your dealer or see the service manual for this machine.

⚠ WARNING

Raised equipment on the machine without an operator may cause injury or death.

Before you leave the operator's compartment, support or lower the equipment and stop the engine.

⚠ WARNING

Replace all covers and guards after you service or clean the machine. Do not operate the machine without the covers or guards in place.

Premaintenance Procedures

Opening the Front Hood

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Push down on the hood latch as shown in [Figure 58](#).

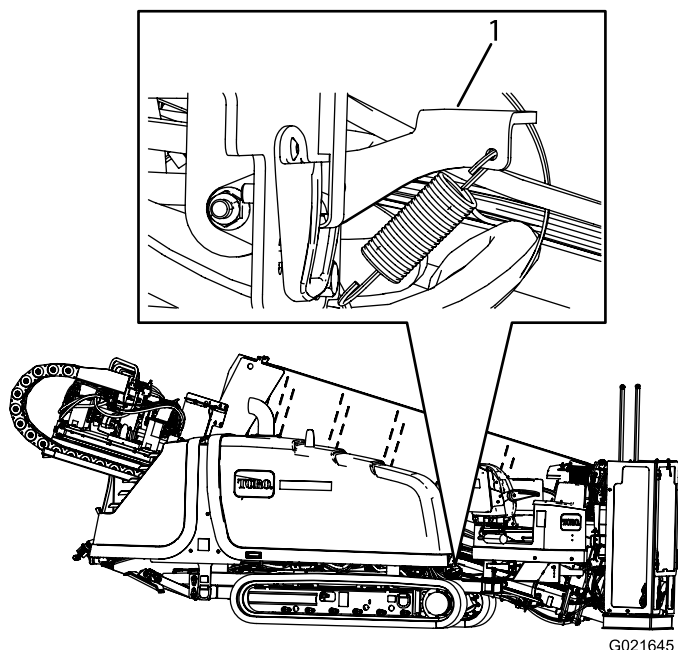


Figure 58

1. Hood latch

3. Lift up on the handle as shown in [Figure 59](#).

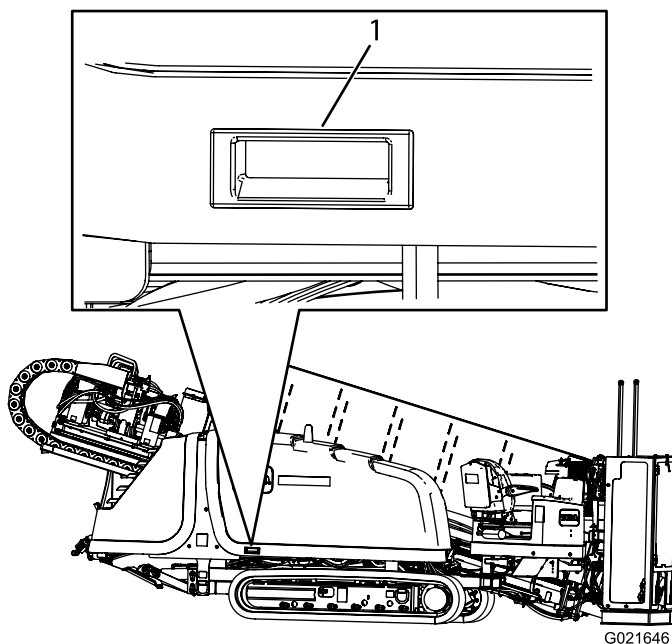


Figure 59

1. Hood handle

Opening the Rear Hood

1. Park the machine on a level surface, stop the engine, and remove the ignition key.

2. Pull the hood latch out (Figure 60).

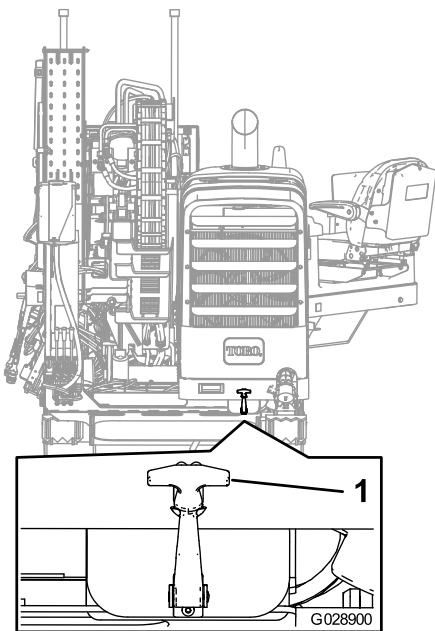


Figure 60

1. Hood latch

3. Lift up the handle as shown in Figure 61.

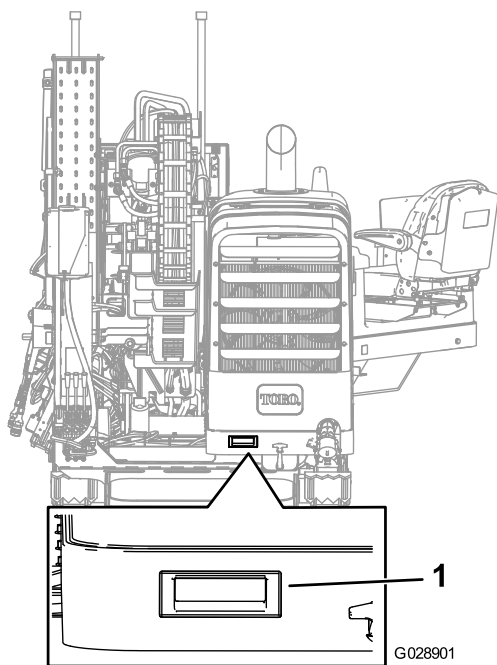


Figure 61

1. Hood handle

Using the Cylinder Lock

⚠ WARNING

The thrust frame may lower when it is in the raised position, causing serious injury or death.

Install the cylinder lock before performing maintenance that requires the thrust frame to be raised.

Installing the Cylinder Lock

1. Start the engine.
2. Lower the thrust frame to the fully-lowered position.
3. Stop the engine.
4. Position the cylinder lock over the cylinder rod (Figure 62).
5. Secure the cylinder lock with the cotter pin and clevis pin (Figure 62).
6. Turn the engine to the ON position, and raise the thrust frame until it rests on the cylinder lock.

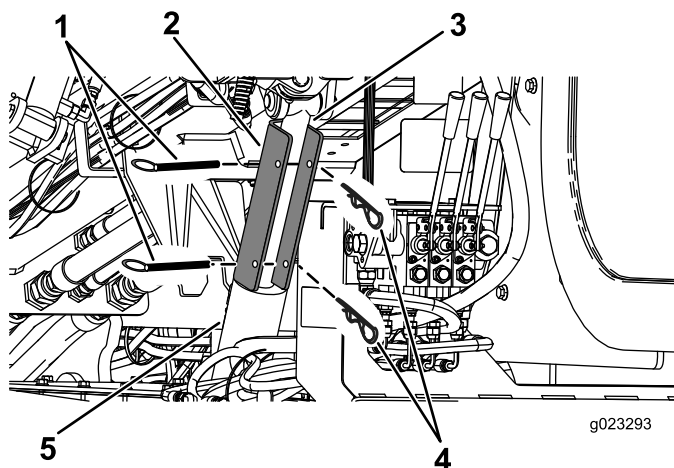


Figure 62

- | | |
|----------------------|------------------|
| 1. Cotter pin | 4. Clevis pin |
| 2. Cylinder lock | 5. Lift cylinder |
| 3. Lift cylinder rod | |

Removing and Storing the Cylinder Lock

1. Start the engine.
2. Lower the thrust frame to the fully lowered position.
3. Stop the engine.
4. Remove the cotter pin and the clevis pin that secure the cylinder lock (Figure 62).
5. Remove the cylinder lock.
6. Turn the engine to the ON position, and raise the thrust frame.

7. Store the cylinder lock next to the anti-freeze tank (Figure 63).

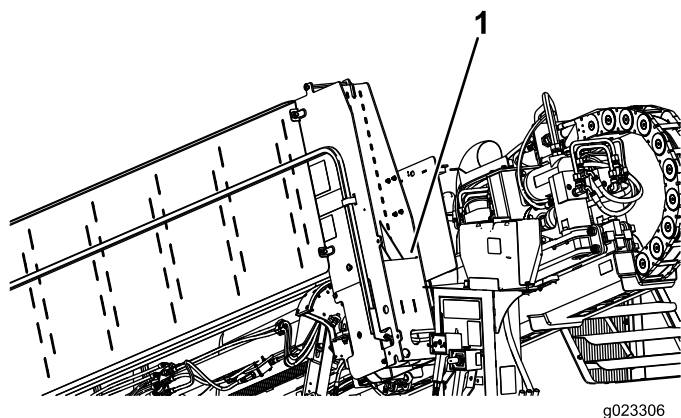


Figure 63

1. Location behind the rear of the pipe holder

Lubrication

Greasing the Machine

Service Interval: Before each use or daily (Grease immediately after every washing).

Grease type: General-purpose grease.

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Clean the grease fittings with a rag.
3. Connect a grease gun to each fitting.
4. Pump grease into the fittings until grease begins to ooze out of the bearings (approximately 3 pumps).
5. Wipe up any excess grease.

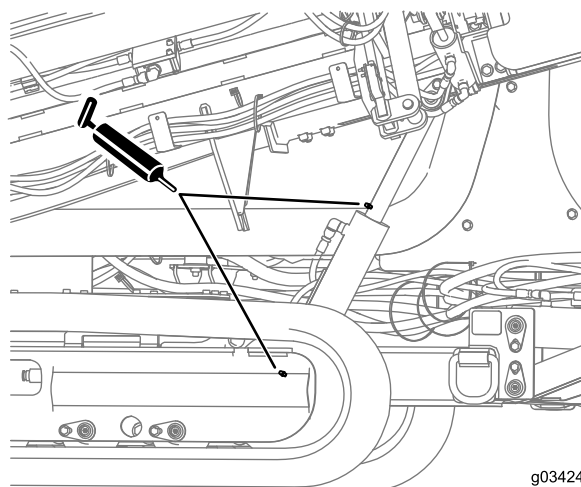


Figure 64

Lift cylinder (drill/carriage side; lower grease fitting is behind the track roller)

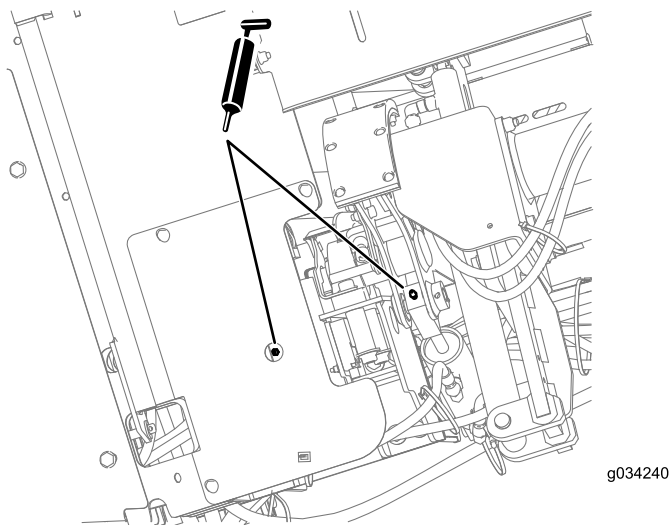


Figure 65

Front-pipe elevator and cam cylinder (drill/carriage side)

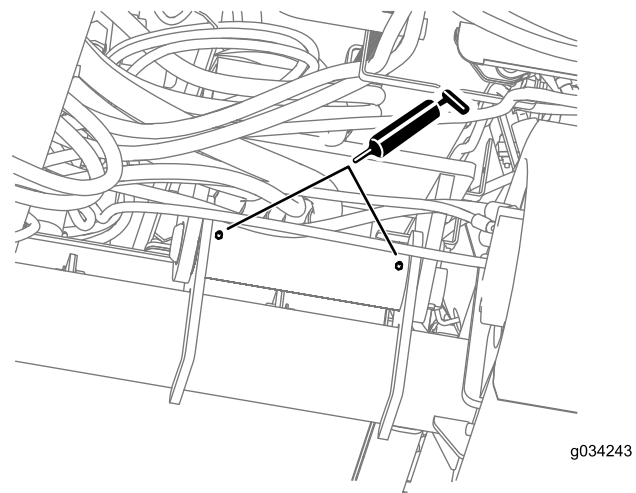


Figure 68

Thrust-frame pivot pin (Under side of machine)

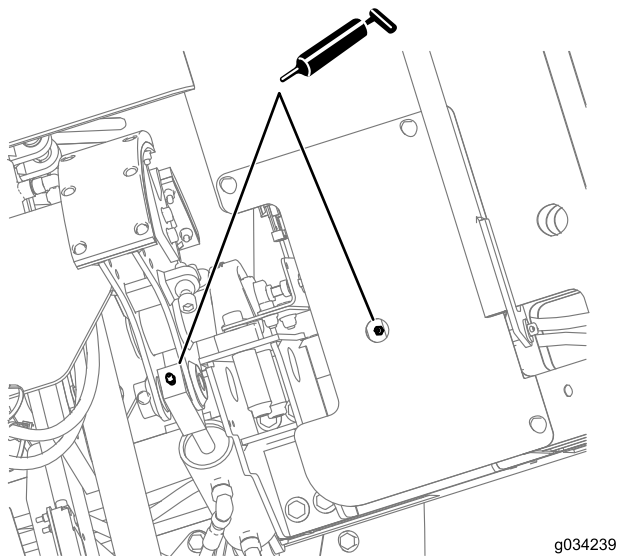


Figure 66

Rear-pipe elevator and cam cylinder (drill/carriage side)

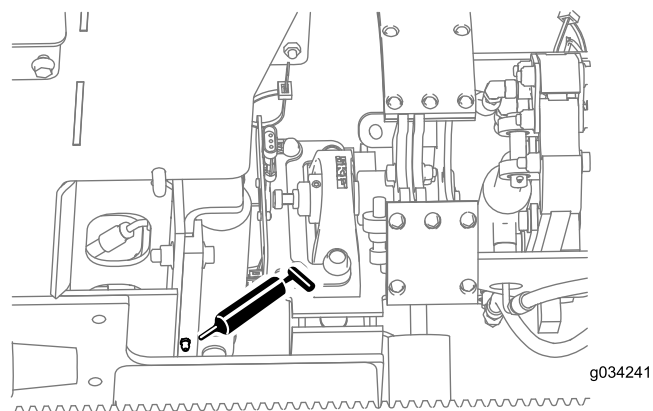


Figure 69

Rear-pipe elevator (operator's side)

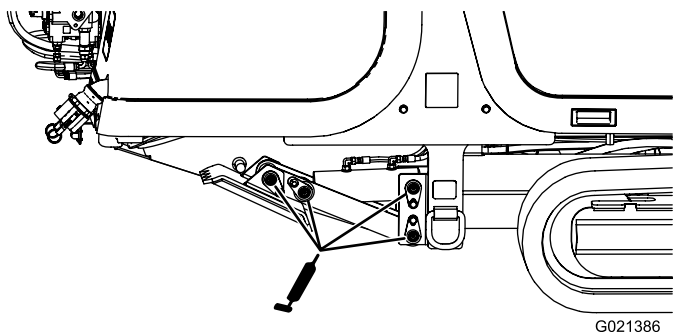


Figure 67

Stabilizer cylinder and foot (drill/carriage side; repeat on other side)

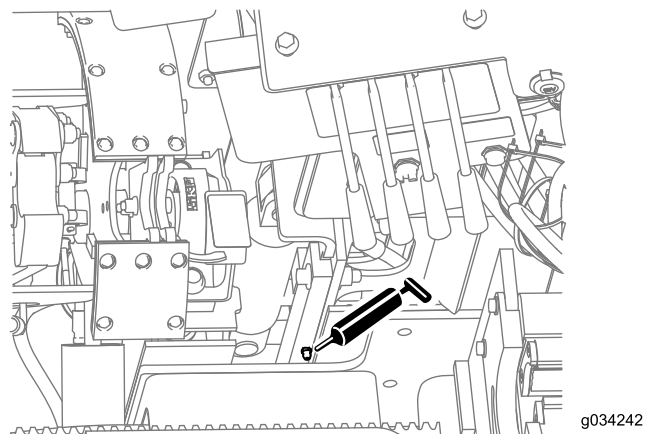


Figure 70

Front-pipe elevator (operator's side)

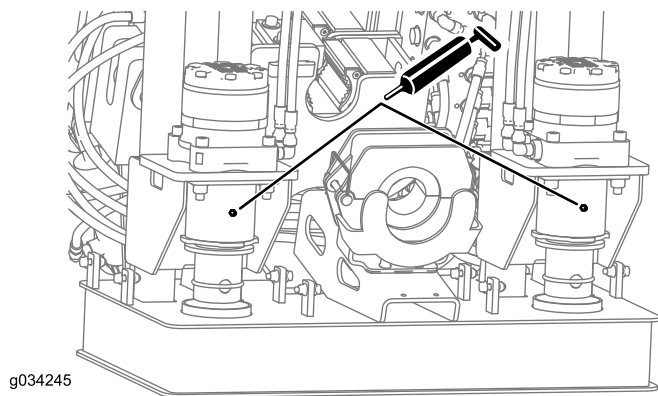


Figure 71
Stakedown motors

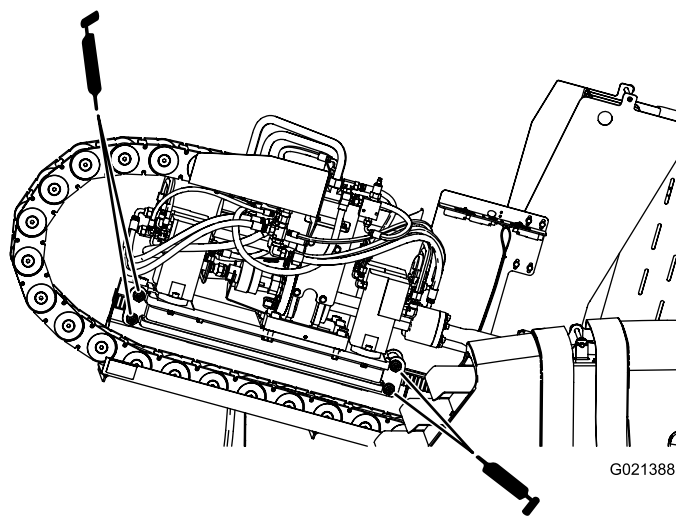


Figure 72
Carriage-roller bearings (operator's side shown; repeat on other side)

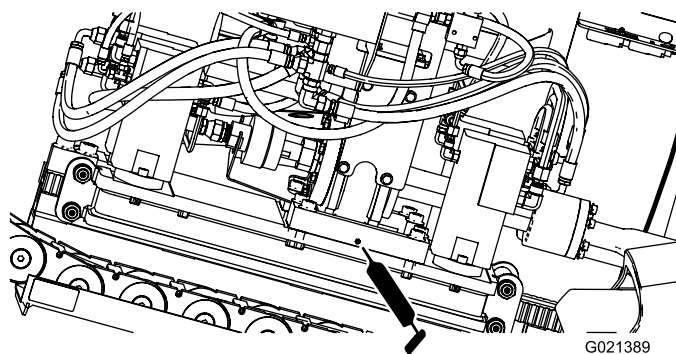


Figure 73
Gearbox float (operator's side shown; repeat on other side)

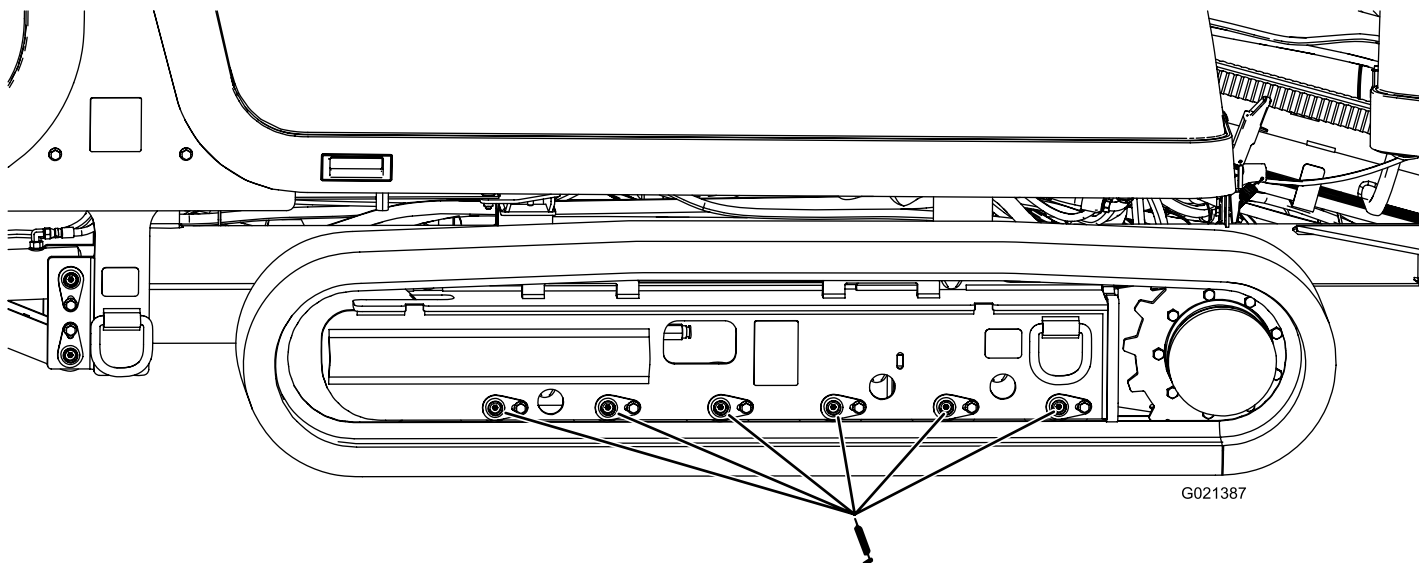


Figure 74
Track roller (operator's side shown; repeat on other side)

Engine Maintenance

Cleaning the Crankcase-Vent Tube

Service Interval: Before each use or daily—Check the crankcase-vent tube and clean it if necessary.

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Open the front hood; refer to [Opening the Front Hood \(page 58\)](#).
3. Gently pull the crankcase-vent tube out ([Figure 77](#)).
4. Clean the end of the crankcase-vent tube ([Figure 77](#)).

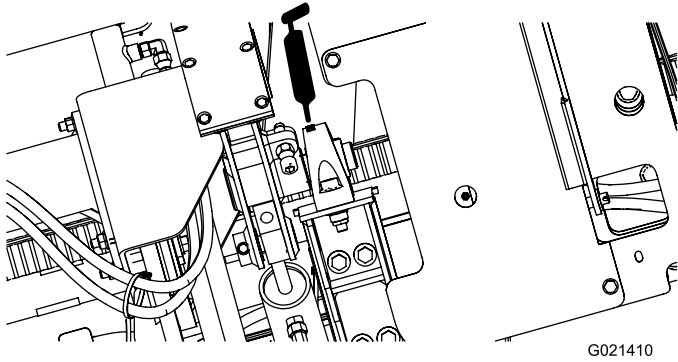


Figure 75

Rear-cam bearing (operator's side)

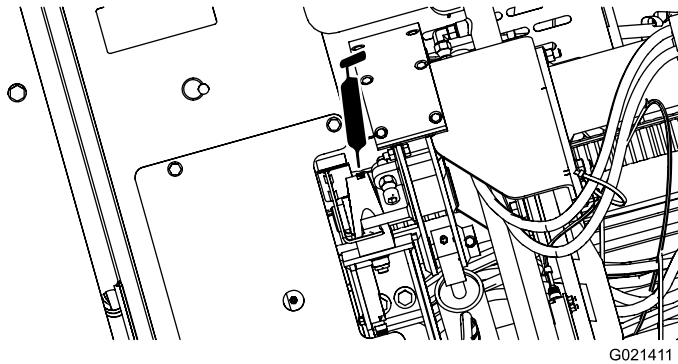


Figure 76

Front-cam bearing (drill/carriage side)

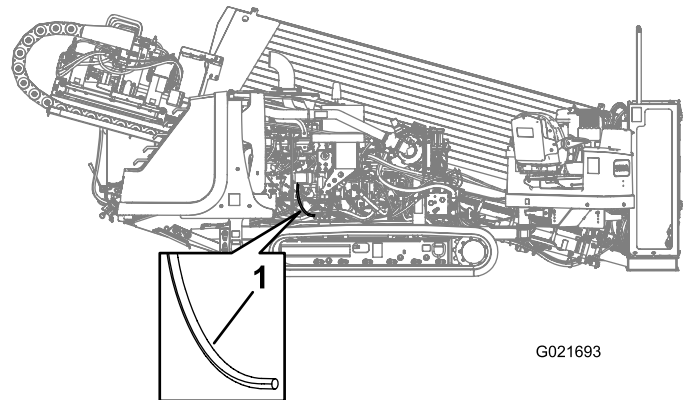


Figure 77

1. Crankcase vent tube

Servicing the Air-Cleaning System

Important: Do not remove the elements from the machine to check for dirty filters; use the following procedure instead.

Important: Do not replace the old air-cleaner filter with a filter that is more than 5 years old; check the date of manufacture on the end cap of the element.

Note: Every time you service the air-cleaner system, ensure that all hose connections and flanges are air tight. Replace all damaged parts.

- Check the air-cleaner body for damage which could cause an air leak. Replace it if it is damaged. Check the whole intake system for leaks, damage or loose hose clamps. Also, inspect the rubber intake hose connections at the air cleaner and turbo to make sure the connections are complete.
- Service the air-cleaner filter only when “Check Air Filter” is displayed on the screen. Changing the air filter before

it is necessary only increases the chance of dirt entering the engine when the filter is removed.

- Be sure the cover is seated correctly and seals with the air-cleaner body.

Checking the Air-Cleaner Indicator

Service Interval: Before each use or daily

1. Start the engine.
2. Check the restricted, air-cleaner indicator on the display screen; refer to the *Software Guide* for this machine.
3. Replace the air-filter element(s) as follows:
 - A. Replace the primary, air-cleaner filter; refer to [Servicing the Air-Cleaner Filter \(page 65\)](#).
 - B. Repeat steps 1 and 2; if the restricted air-cleaner indicator is still shown on the display screen, replace the secondary, air-cleaner filter; refer to [Servicing the Air-Cleaner Filter \(page 65\)](#).

Cleaning the Dust Valve

Service Interval: Every 50 hours

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Open the front hood.
3. Squeeze the sides of the dust valve on the air-cleaner cover to release any collected water, dust, or dirt from the valve. ([Figure 78](#)).

Note: Ensure that there are no obstructions inside the dust valve.

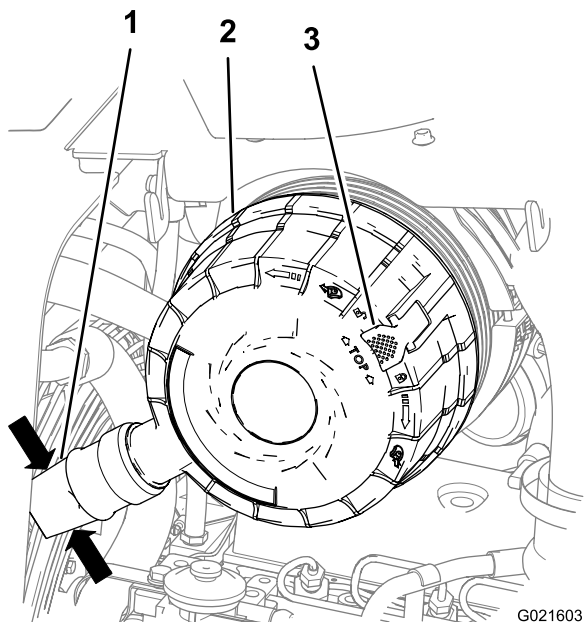


Figure 78

1. Dust valve
2. Latch
3. Air-cleaner cover

Servicing the Air-Cleaner Cover

Service Interval: Every 50 hours—Remove air cleaner cover and clean out debris. Do not remove the filter.

Removing the Air-Cleaner Cover

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Open the front hood.
3. Clean the outside of the air-cleaner canister with a clean, damp cloth.
4. Check the air-cleaner canister for damage which could cause an air leak. Replace a damaged air cleaner body.

Important: Service the air-cleaner filter only when “Check Air Filter” is displayed on the screen. Changing the air filter before it is necessary only increases the chance of dirt entering the engine when the filter is removed.

5. Pull the latch for the air-cleaner cover outward ([Figure 78](#)).
6. Rotate the filter cover counterclockwise so that the dust cap is at the 4 o'clock position ([Figure 79](#)).

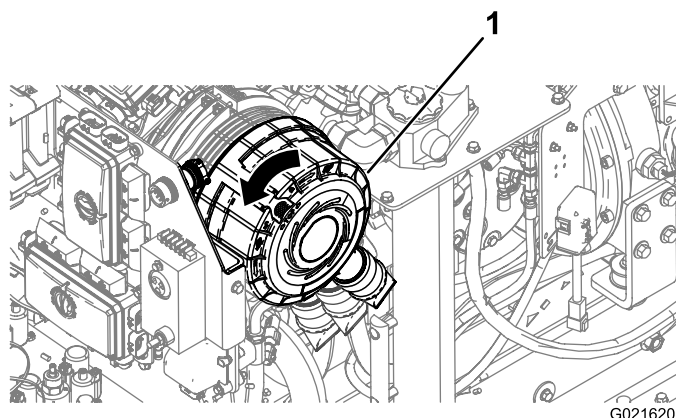


Figure 79

1. Air-cleaner cover

7. Pull the air-cleaner cover away from the filter housing and remove the cover ([Figure 80](#)).

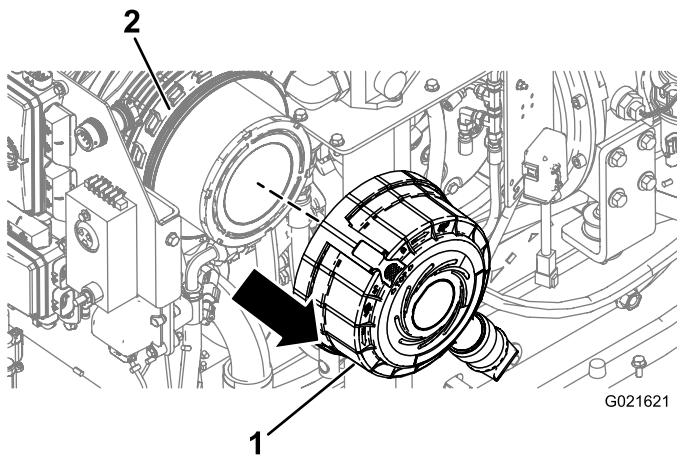


Figure 80

1. Air-cleaner cover
2. Filter housing

8. Clean any debris from inside the cover.

Important: If “Check Air Filter” is not displayed on the screen, do not remove the air filters.

Installing the Air-Cleaner Cover

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Align the dust cap on the air cleaner filter cover to the 5 o'clock position.
3. Align the air cleaner filter cover with the filter housing (Figure 80).
4. Rotate the air cleaner filter cover clockwise, so that the dust cap is at the 4 o'clock position (Figure 79).
5. Push the latch on the air cleaner filter cover inward until it is fully seated (Figure 79).

Servicing the Air-Cleaner Filter

Service Interval: Every 250 hours

Replace the filters only when the “Check Air Filter” indicator appears on the display screen; refer to [Checking the Air-Cleaner Indicator \(page 64\)](#).

Note: Contact your Authorized Toro Dealer to order replacement filters.

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Open the front hood.
3. Before removing the filter, clean out all debris from the inside of the filter body using low-pressure air (40 psi, clean and dry).

Important: Avoid using high pressure air which could force dirt through the filter into the intake tract. This cleaning process prevents debris from migrating into the intake when the primary filter is removed.

4. Remove the primary filter (Figure 81).

Important: Do not clean the used filter.

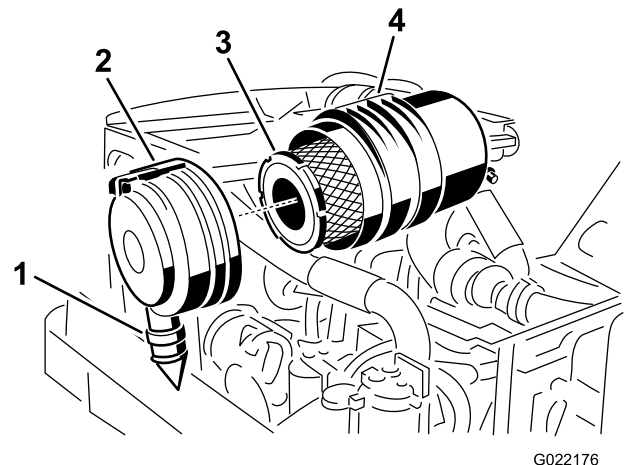


Figure 81

1. Rubber-outlet valve
2. Air-cleaner latch
3. Air-cleaner, primary filter
4. Air-cleaner body

5. Inspect the new filter for shipping damage, checking the sealing end of the filter and the body. Do not use a damaged element.

Important: Do not clean the used safety filter (Figure 82). Replace the safety filter with a new one after every 3 primary filter services, or when indicated by the “Check Air Filter” on the display screen. If you are not replacing it, do not remove the safety filter.

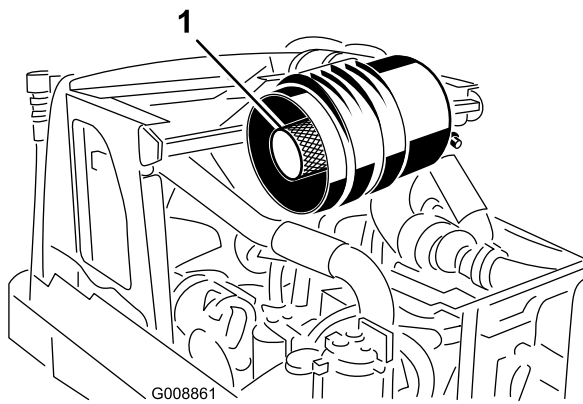


Figure 82

1. Safety filter

6. Insert the new primary filter by applying pressure to the outer rim of the filter to seat it in the canister. Do not apply pressure to the flexible center of the filter.
7. Remove the rubber outlet valve from the cover, clean the cavity, and replace the outlet valve.
8. Install the cover.

Servicing the Engine Oil and Filter

The engine is shipped with oil in the crankcase; however, check the oil level before and after you first start the engine.

Crankcase capacity: 7.5 L (8 US qt) with the filter.

Use only high-quality SAE 15W-40 heavy-duty engine oil with an API classification of CH-4 or higher.

While SAE 15W-40 oil with an API classification of CH-4 or higher is recommended for most climates, refer to [Figure 83](#) for oil viscosity recommendations for extreme climates.

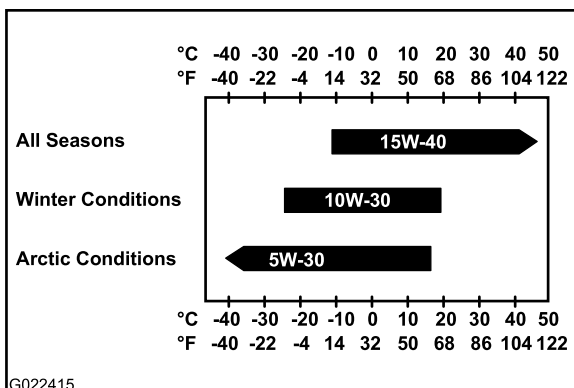


Figure 83

Note: Limited use of low-viscosity oils such as SAE 10W-30 with an API classification of CH-4 or higher can be used for easier starting and providing sufficient oil flow at ambient temperatures below -5°C (23°F). However, continuous use

of low viscosity oil can decrease engine life because of wear ([Figure 83](#)).

Toro Premium Engine Oil is available from an Authorized Toro Service Dealer in either 15W-40 or 10W-30 viscosity with API classification CH-4 or higher. See the parts catalog for part numbers.

Checking the Engine-Oil Level

Service Interval: Before each use or daily—Check the engine-oil level.

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Open the front hood.
3. Remove the dipstick ([Figure 84](#)), and wipe it clean.

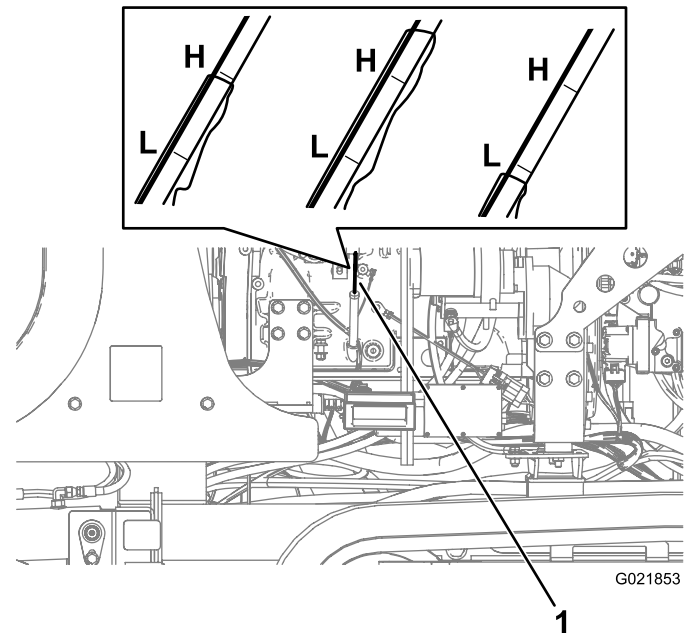


Figure 84
Operator's side

1. Dipstick

4. Insert the dipstick into the oil fill tube, pull the dipstick out again, and read the oil level on the dipstick.

Note: The oil level on the dipstick should be at the High mark or between the Low and High marks. If the oil is below the Low mark, complete the following procedure:

- A. Remove the fill cap ([Figure 85](#)) and add oil until the level reaches the High mark. **Do not overfill.**

Important: Use an oil canister with a bendable hose or a funnel to fill the machine with oil.

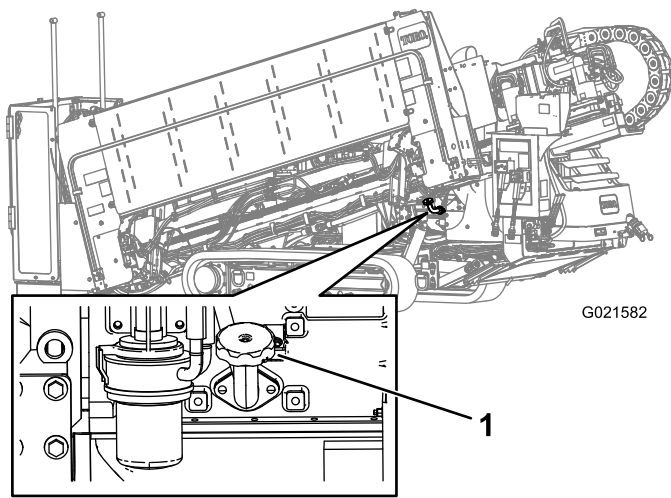


Figure 85

1. Oil-fill cap

B. Install the oil fill cap and the dipstick.

Changing the Engine-Oil Filter

Service Interval: Every 250 hours

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Open the front hood.
3. Align a drain pan or several rags under the oil filter and the oil-filter adapter ([Figure 86](#)).

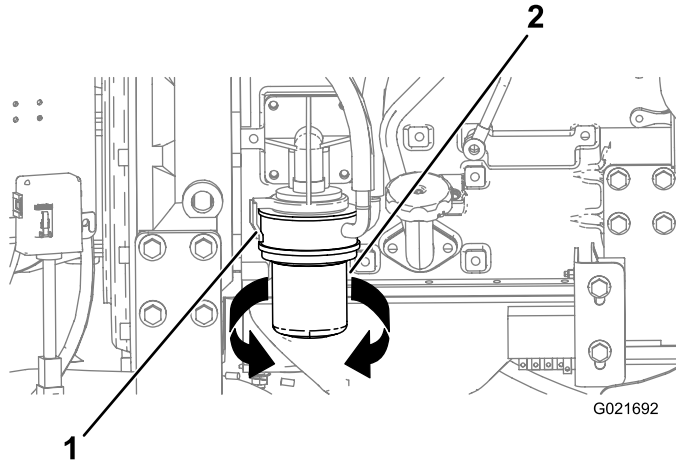


Figure 86

1. Oil-filter adapter
2. Oil filter

4. Rotate the oil filter counterclockwise and remove the oil filter ([Figure 86](#)).
- Note:** Discard the oil filter.
5. Using a clean rag, wipe clean the surface of the oil-filter adapter where the oil filter seats with a clean rag.
 6. Fill the new oil filter with the specified-engine oil.
 7. Apply a thin layer of the specified-engine oil to the seal of the oil filter.

8. Align the oil filter to the oil-filter adapter and rotate it clockwise until the seal of the oil filter contacts the oil-filter adapter ([Figure 86](#)).

Note: Do not use an oil filter strap wrench to install the new oil filter. The wrench can dent an oil filter and therefore cause a leak.

9. Hand tighten the oil filter an additional 1/2 turn ([Figure 86](#)).
10. Remove the oil pan or rags you placed in step 3 and dispose of the used oil according to local codes.

Changing the Engine Oil

Service Interval: Every 250 hours

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Remove the drain plug ([Figure 87](#)).

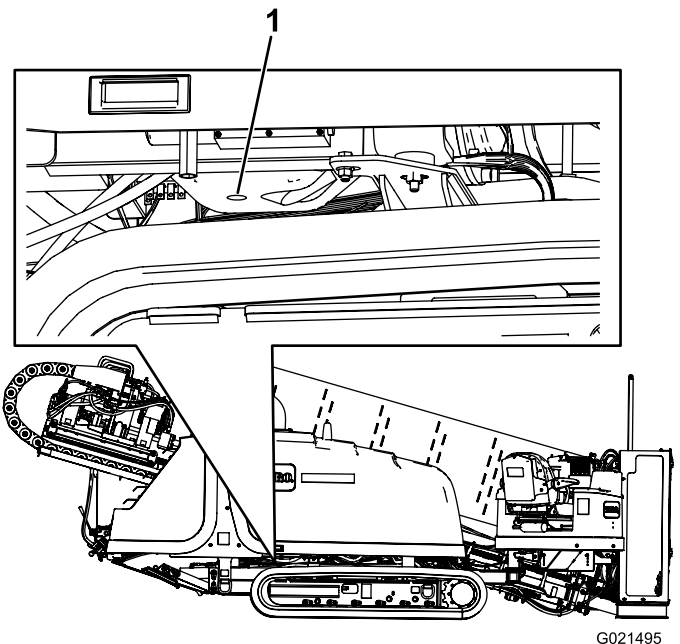


Figure 87

1. Engine-oil drain plug

3. Clean the threads on the drain plug and apply 3 layers of PTFE sealing tape.
4. Drain the oil into a drain pan.
5. When the oil stops, install the drain plug.
6. Change the engine-oil filter; refer to [Changing the Engine-Oil Filter](#) (page 67).
7. Install the drain plug onto the drain fitting ([Figure 87](#)).
8. Remove the oil-fill cap from the filler neck by pulling the cap upward.

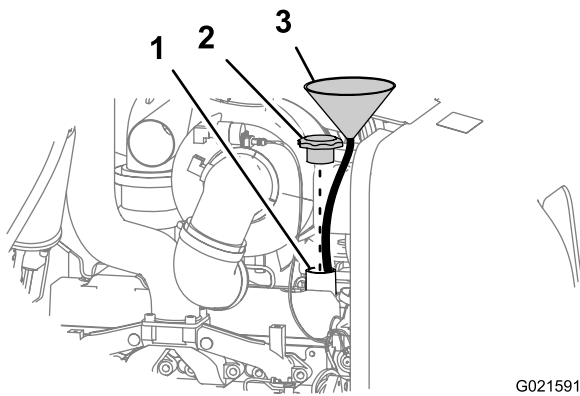


Figure 88

1. Filler neck
2. Oil-fill cap
3. Funnel

Note: Use a funnel with a flexible, attached hose to direct the engine oil into the engine.

9. Fill the crankcase with approximately 7.5 L (8 US qt) of the specified engine oil; refer to [Servicing the Engine Oil and Filter](#) (page 66).
10. Install the oil-fill cap.
11. Start the engine, run it at idle for about 2 minutes, and check for oil leaks.
12. Stop the engine and remove the key.
13. Wait for 2 or 3 minutes and check the oil level; refer to [Checking the Engine-Oil Level](#) (page 66).

Adjusting the Valve Clearance

Service Interval: After the first 250 hours

Every 2,000 hours

Refer to the engine owner's manual, included with the machine, for the adjustment procedure.

If you cannot adjust the valve clearance, contact your Authorized Toro Service Dealer for valve adjustment.

Servicing the Spark Arrestor (If Equipped)

Service Interval: Every 250 hours—Clear the spark arrestor in the muffler of carbon buildup.

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Remove the pipe plug from the clean-out port at the lower side of the muffler.

⚠ WARNING

The muffler may be hot and could cause injury.

Be careful not to touch the hot muffler.

3. Start the engine.
4. Plug the normal muffler exit with a block of wood or metal plate so that the exhaust flow will be forced out of the clean-out port. Continue to block the exit until carbon deposits cease coming out of the port.

⚠ WARNING

Do not stand in line with the clean-out port; hot elements could cause serious injury.

Wear safety glasses.

5. Stop the engine and replace the pipe plug.

Fuel System Maintenance

⚠ DANGER

Under certain conditions, diesel fuel and fuel vapors are highly flammable and explosive. A fire or explosion from fuel can burn you and others and can cause property damage.

- Use a funnel and fill the fuel tank outdoors, in an open area, when the engine is off and is cold. Wipe up any fuel that spills.
- Do not fill the fuel tank completely full. Add fuel to the fuel tank until the level is 25 mm (1 inch) below the bottom of the filler neck. This empty space in the tank allows the fuel to expand.
- Never smoke when handling fuel, and stay away from an open flame or where fuel fumes may be ignited by a spark.
- Store fuel in a clean, safety-approved container and keep the cap in place.

Draining Water from the Fuel Filter

Service Interval: Every 50 hours—Check the fuel-water separator for water and sediment.

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Open the front hood.
3. Align a drain pan under the secondary-fuel filter (Figure 89).

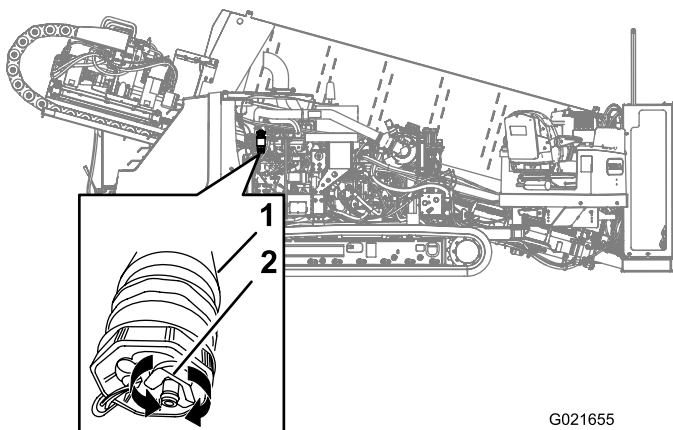


Figure 89

1. Secondary-fuel filter
2. Drain valve

4. Rotate the drain valve at the bottom of the secondary-fuel filter 2 or 3 turns counterclockwise,

and drain any water and sediment from the fuel filter (Figure 89).

Note: If the fuel-water separator has any water or sediment, also drain the water and sediment from the fuel tank; refer to [Draining Water from the Fuel Tank](#) (page 69).

5. When clean fuel appears, rotate the drain valve clockwise until it is closed.

Note: Do not overtighten the drain valve.

6. Prime the fuel system; refer to [Priming the Fuel System](#) (page 70).

Draining Water from the Fuel Tank

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Place a drain pan under the drain plug in the fuel tank.
3. Loosen the drain plug until the water and sediment drain out (Figure 90).

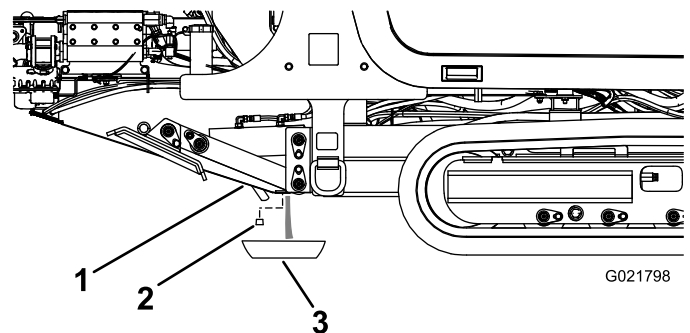


Figure 90

1. Fuel tank
2. Drain plug
3. Drain pan

4. Clean the threads on the drain plug and apply 3 layers of PTFE sealing tape.
5. When clean fuel appears, install the drain plug and tighten it securely.
6. Check the fuel tank drain plug for leaks.

Priming the Fuel System

Note: Prime the fuel system whenever any of the following occur:

- You drained water from the fuel filter.
 - You replaced the fuel filter.
 - You ran the engine until the fuel tank is empty or drained the fuel tank.
1. Park the machine on a level surface, stop the engine, and remove the ignition key.
 2. Open the front hood.
 3. Ensure that the engine and the exhaust system are cool.
 4. Ensure that the fuel tank is at least 1/4 full.
 5. Rotate the BATTERY-DISCONNECT switch clockwise to the ON position.
 6. Locate the PRIMING button on the top of the filter adapter for the secondary-fuel filter (Figure 91).

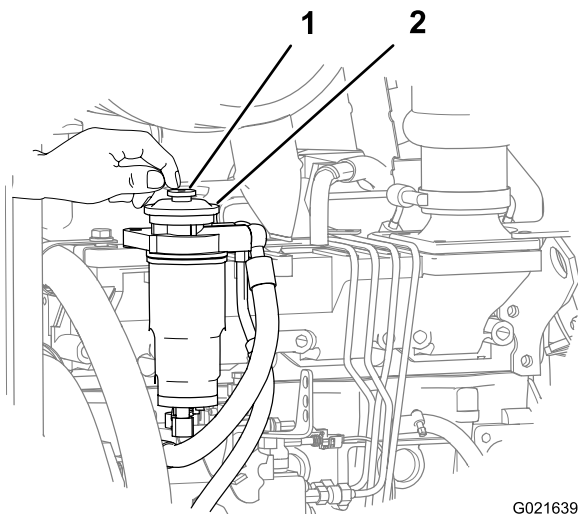


Figure 91

1. Priming button 2. Filter adapter

7. Press down and release the PRIMING button repeatedly until you feel resistance when pressing the PRIMING button (Figure 91).
8. If the engine does not start after priming the fuel system and making several attempts to start the engine, bleed the high-pressure fuel lines; refer to your engine owner's manual or contact your Authorized Toro Service Dealer for assistance.

⚠ WARNING

The fuel system is under high pressure. Bleeding the system without proper precautions and training could result in injury to you from injected fluid or fire or explosion. Read the engine owner's manual for the proper bleeding procedure or contact your Authorized Toro Dealer.

Replacing the Fuel Filters

Service Interval: Every 250 hours—Replace the primary and secondary, fuel filters.

Replacing the Primary Fuel Filter

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Open the front hood; refer to [Opening the Front Hood \(page 58\)](#).
3. Place clean rags under the primary fuel filter.
4. Loosen the hose clamps and separate the primary fuel filter from the fuel hoses (Figure 92).

Note: Do not remove the hose clamps from the hoses.

Note: Discard the fuel filter.

5. Align the new primary fuel filter to the hoses with the arrow printed on the filter pointing forward (Figure 92).
6. Slip the hoses over the hose fitting of the primary fuel filter and tighten the hose clamps (Figure 92).
7. Replace the secondary fuel filter; refer to [Replacing the Secondary Fuel Filter \(page 70\)](#).

Replacing the Secondary Fuel Filter

1. Remove the secondary fuel filter as follows:
 - A. Clean the secondary fuel-filter assembly and the surrounding area.
 - B. Completely drain water from the filter; refer to [Draining Water from the Fuel Filter \(page 69\)](#).
 - C. Firmly grasp the secondary-fuel-filter element, and rotate the water sensor counterclockwise, and remove the water sensor (Figure 92).

Note: Retain the water sensor and discard the O-ring.

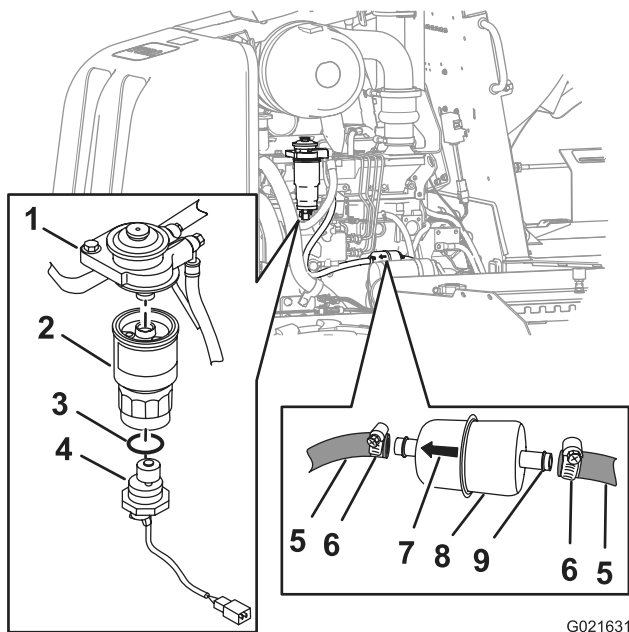


Figure 92

- | | |
|-----------------------------|------------------------|
| 1. Filter adapter | 6. Hose clamp |
| 2. Secondary-filter element | 7. Arrow |
| 3. O-ring | 8. Primary fuel filter |
| 4. Water sensor | 9. Fitting |
| 5. Fuel sensor | |

- D. Firmly grasp the secondary-fuel-filter element, and rotate it counterclockwise, and remove the filter from the filter adapter (Figure 92).

Note: Discard the filter element.

- E. Clean the filter adapter with a clean rag.

2. Install the secondary, fuel filter as follows:
- Apply a thin film of clean fuel to the seal on the fuel-filter element.
 - Align the new secondary-filter element to the filter adapter (Figure 92).
 - Rotate the secondary-filter element until the seal contacts the filter adapter, then rotate the filter element an additional $3/4$ turn.

Important: Do not use a filter wrench to tighten the filter. You could damage the filter and cause a leak.

- Align the new O-ring over the water sensor (Figure 92).
 - Align the water sensor to the bottom of the secondary, fuel filter (Figure 92).
 - Firmly grasp the secondary-filter element and rotate the water sensor clockwise until hand-tight (Figure 92).
3. Prime the fuel system; refer to [Priming the Fuel System](#) (page 70).

4. Start the engine and check for leaks at the fuel filters.

Checking Fuel Lines and Connections

Service Interval: Every 500 hours/Yearly (whichever comes first)—Inspect the fuel lines and connections.

Inspect the fuel lines and connections for deterioration, damage, or loose connections.

Draining and Cleaning the Fuel Tank

Service Interval: Every 1,000 hours/Yearly (whichever comes first)—Drain and clean the fuel tank.

Drain and clean the tank if the fuel system becomes contaminated or if the machine will be stored for an extended period of time. Use clean fuel to flush out the tank. Refer to [Draining Water from the Fuel Tank](#) (page 69) for draining instructions.

Note: Perform this procedure when the fuel level is low, to avoid the need to drain large volumes of fuel.

Electrical System Maintenance

Servicing the Battery

Service Interval: Every 50 hours—Check the battery condition

⚠ WARNING

CALIFORNIA Proposition 65 Warning

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

Important: Before welding on the machine, disconnect the negative cable from the battery to prevent damage to the electrical system. Also, disconnect the engine and machine controllers before welding on the machine.

Note: Check the battery condition weekly or after every 50 hours of operation. Keep the terminals and the entire battery case clean because a dirty battery will discharge slowly. To clean the battery, wash the entire case with a solution of baking soda and water. Rinse with clear water. Coat the battery posts and cable connectors with Grafo 112X (skin-over) grease (Toro Part No. 505-47) or petroleum jelly to prevent corrosion.

⚠ WARNING

Exposure to battery acid or a battery explosion can cause serious personal injury.

Before you service a battery, wear face protection, protective gloves, and protective clothing.

⚠ WARNING

A battery contains sulfuric acid, which can cause serious burns; and they can produce explosive gases.

- Avoid contact with skin, eyes, or clothing; flush affected areas with water.
- If taken internally, drink large quantities of water or milk. *Do not* induce vomiting. Seek medical attention immediately.
- Keep sparks, flames, and lit cigarettes and cigars away from the battery.
- Ventilate the battery when you are charging it or using it in an enclosed area.
- Wear eye protection when working near a battery.
- Wash your hands after handling a battery.
- Keep the battery out of the reach of children.

⚠ WARNING

If you try to charge or jump start a frozen battery, it could be explosive, causing personal injury to you or others in the area.

To prevent the battery electrolyte from freezing, keep the battery fully charged.

⚠ WARNING

- Sparks or a flame can cause hydrogen gas in a battery to explode.
- When you disconnect the battery cables, disconnect the negative (-) cable first.
- When you connect the battery cables, connect the negative (-) cable last.
- Do not short-circuit the battery posts with a metal object.
- Do not weld, grind, or smoke near a battery.

Note: The electrical system in this machine is 12 volts.

Charging the Battery

 WARNING

Charging the battery produces gasses that can explode.

Do not smoke near the battery and keep sparks and flames away from battery.

Important: Keep the battery fully charged. This is especially important to prevent battery damage when the temperature is below 32° F (0° C).

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Open the front hood.
3. Clean the exterior of the battery case and the battery posts.
4. Look at the battery and identify the positive and negative battery posts.
5. Connect the positive lead of the battery charger to the positive battery post (Figure 93).

Note: Connect the leads of the battery charger to battery posts before connecting the charger to the electrical source.

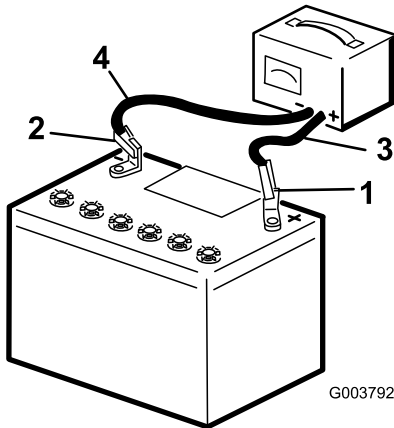


Figure 93

1. Positive battery post

2. Negative battery post
3. Red (+) charger lead

4. Black (-) charger lead
-
6. Connect the negative lead of the battery charger to the negative battery post (Figure 93).
7. Connect the battery charger to the electrical source.

Important: Do not overcharge the battery.

Note: Charge the battery as shown in battery charging table.

Battery-Charger Table

Charger setting	Charging time
4 to 6 amperes	30 minutes
25 to 30 amperes	10 to 15 minutes

8. When the battery is fully charged, unplug the charger from the electrical source, then disconnect the charger leads from the battery posts (Figure 93).

Jump-Starting the Machine

 WARNING

Jump-starting the battery can produce gasses that can explode.

Do not smoke near the battery and keep sparks and flames away from battery.

Note: This procedure requires 2 people to perform. Ensure that the person making the connections wears the proper face protection, protective gloves, and clothing.

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Open the front hood.
3. Ensure that all controls are in the NEUTRAL position.
4. Sit in the operator seat and have the other person make the connections.

Note: Ensure that the jumper battery is a 12-volt battery.

Important: If you are using another machine for power, ensure that the 2 machines are not touching each other.

5. Prepare to start the engine; refer to Starting/Stopping the Engine (page 43).
6. Remove the cover from the jump post (Figure 94).

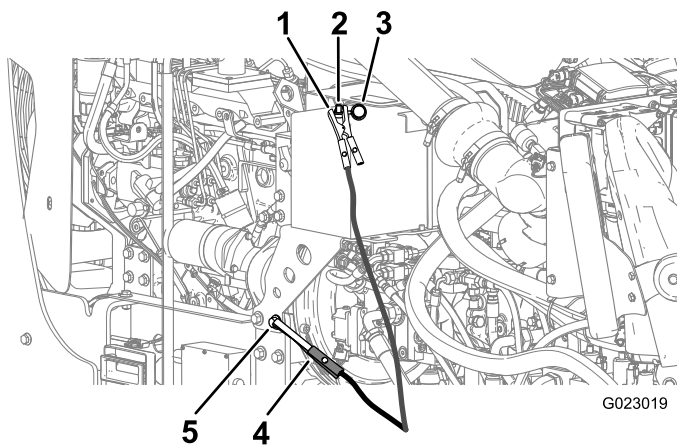


Figure 94

1. Jumper-cable clamp (positive)
 2. Jump post
 3. Cover
 4. Ground point (unpainted bolt)
 5. Jumper-cable clamp (negative)
-
7. Connect the positive (+) jumper cable to the jump post (Figure 94).
 8. Connect the negative (-) jumper cable to a ground point, such as an unpainted bolt or chassis member (Figure 94).
 9. Start the engine; refer to [Starting/Stopping the Engine](#) (page 43).
- Important:** If the engine starts and then stops, *do not* operate the starter motor until the starter motor stops turning. *Do not* operate the starter motor for more than 30 seconds at one time. Wait 30 seconds before operating the starter motor to cool the motor and to build up the charge in the battery.
10. When the engine starts, have the other person disconnect the negative (-) jumper cable from the frame and then disconnect the positive (+) jumper cable (Figure 94).

Drive System Maintenance

Checking the Oil Level for the Planetary Drive

Service Interval: Every 50 hours—Check the planetary-drive oil level (Also, check if external leakage is observed).

Oil specification: SAE 85W-140 API classification level GL4

Planetary drive oil capacity: approximately 1.4 L (1.5 US qt)

Toro Premium Gear Oil is available from an Authorized Toro Service Dealer. See the parts catalog for part numbers.

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Clean the area around the oil-level plug with a cleaning solvent (Figure 95).

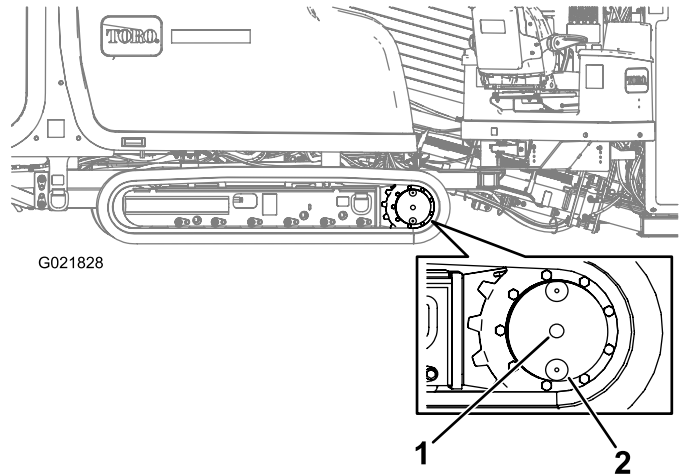


Figure 95

1. Oil-level plug
2. Oil-drain plug (6 o'clock position)

3. Rotate the planetary drive until the oil level and the oil-drain plugs are vertical to the ground (at the 6 o'clock position) as shown in Figure 95.
4. Remove the oil-level plug (Figure 95).

Note: The oil level is correct when it is up to the bottom of the oil-level plug hole.

5. If the oil is below the bottom of the hole, add the specified oil until the oil is level with the bottom of the hole.
6. Install and tighten the oil-level plug.
7. Repeat steps 1 through 6 to check the planetary-drive oil level on the other side of the machine.

Changing the Oil for the Planetary Drive

Service Interval: After the first 250 hours—Change the planetary oil.

Every 800 hours—Change the planetary oil (or yearly, whichever comes first).

Note: Change the oil when it is warm, if possible.

1. Park the machine on a level surface.
2. Clean the area around the oil-level plug (Figure 95).
3. Rotate the planetary drive until the oil-drain plug is directly below the oil-level plug (Figure 95).
4. Stop the engine and remove the key.
5. Place a drain pan under the oil-drain plug.
6. Remove the oil-level plug and the oil-drain plug.
7. Install the oil-drain plug.
8. Fill the chain drive planetary with oil until the oil even with the bottom of the oil-level plug hole.
9. Install the oil-level plug.
10. Repeat steps 1 through 9 to change the planetary-drive oil on the other side of the machine.

Checking the Oil for the Gearbox Drive

Service Interval: After the first 100 hours—Check the gearbox drive oil.

Every 500 hours—Check the gearbox drive oil (or yearly, whichever comes first).

Oil specification: SAE 85W-140 API classification level GL4

Planetary-drive oil capacity: approximately 2.7 L (5.75 US pt)

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Check the oil level on the sight-glass on the gearbox drive (Figure 96).

Note: The oil level should cover half of the sight-glass.

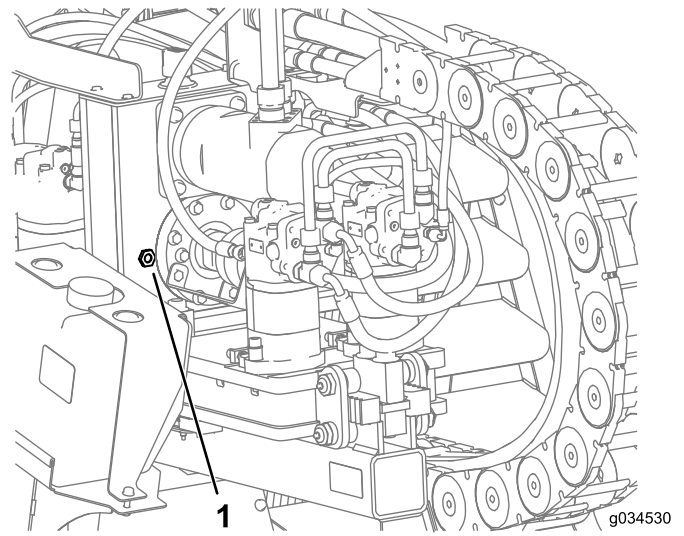


Figure 96

1. Sight-glass

3. Remove the breather cap and add the oil into the gearbox drive until the oil level on the sight-glass is at least half full (Figure 96).

Changing the Oil for the Gearbox Drive

Service Interval: After the first 100 hours—Change the gearbox-drive oil.

Every 500 hours—Change the gearbox-drive oil (or yearly, whichever comes first).

Note: Change the oil when it is warm, if possible.

1. Park the machine on a level surface and move the carriage all the way to the rear stop.

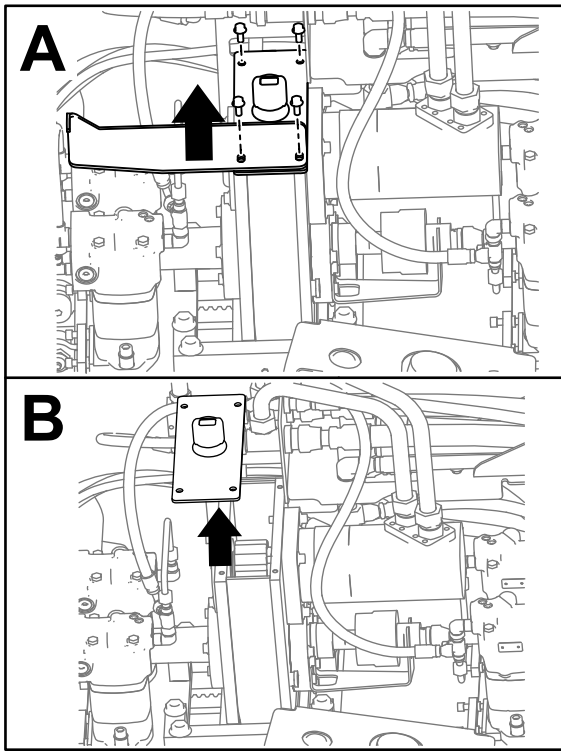


Figure 97

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2. Stop the engine and remove the ignition key.
3. Remove the 4 bolts on the guard plate and gearbox (Box A of Figure 97).
4. Remove the guard plate (Box A of Figure 97).
5. Remove the cover on the gearbox and syphon the oil out (Box B of Figure 97).
6. Fill the gearbox with oil until the oil level in the sight glass is more than half full (Figure 96).
7. Clean the sealant off of the gearbox box and cover (Figure 98).

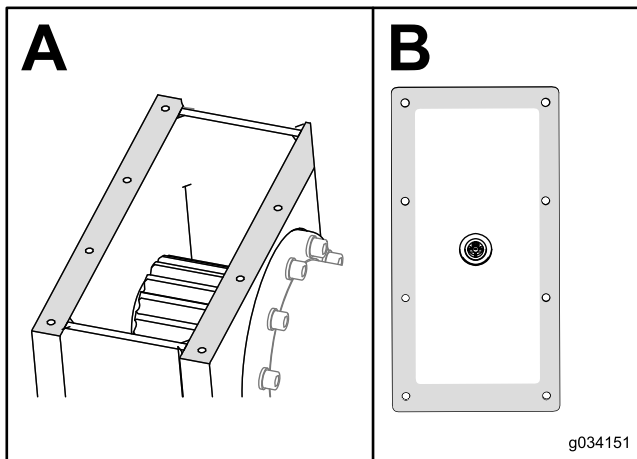


Figure 98

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8. Put new automotive-grade RTV sealant around the edge of the cover (Box B of Figure 98).

9. Place the guard back into place and install the 2 bolts (Box A of Figure 97).
10. Install the 2 other bolts securing the lid onto the gearbox (Box A of Figure 97).
11. Torque the bolts to 23 to 29 N·m (17 to 21 ft-lb).

Servicing the Tracks

Service Interval: Before each use or daily—Check the track tension.

⚠ WARNING

Grease in the hydraulic track is highly pressurized; ensure that the track-tension grease valve is not loosened more than one revolution at a time.

If you remove the track-tension grease valve found in the hydraulic-track tensioner or loosen it too much, grease can be released and may cause serious injury or death.

Tightening the Track Tension

If the track seems loose, tighten the track tension as follows:

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Remove dirt and debris found around the track-tension grease valve (Figure 99).

Important: Ensure that the area surrounding the track-tension grease valve is clean before beginning to adjust the track tension.

3. Remove the retaining bolts and cover that house the track-tension grease valve.
4. Apply grease to the fitting until the tension reaches 22,063 kPa (3,200 psi) as shown in Figure 99.

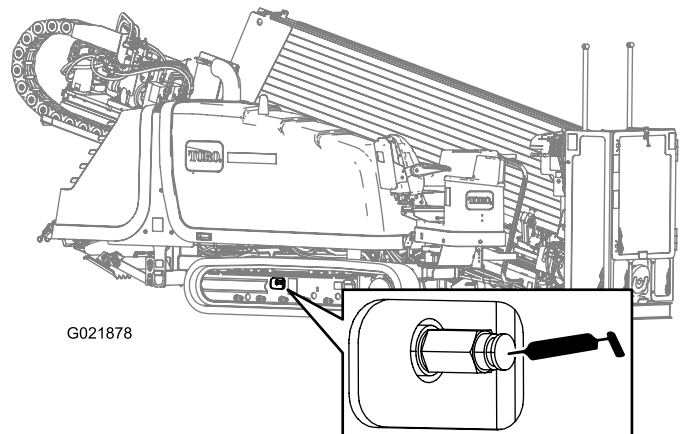


Figure 99

Track-tension grease valve shown

5. Remove excess grease from around the valve.
6. Install the cover and retaining bolts.
7. Repeat steps 2 through 6 to tighten the track tension on the other side.

Loosening the Track Tension

If the track seems tight, loosen the track tension as follows:

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Remove dirt and debris found around the track-tension grease valve (Figure 99).

Important: Ensure that the entire area surrounding the track-tension grease valve is clean before beginning to adjust the track tension.

3. Remove the retaining bolts and cover that house the track-tension grease valve.
4. Turn the track-tension grease valve counterclockwise **no more than 1 revolution** (Figure 99).

Note: A one-revolution turn will release grease and loosen the track.

5. When the tension reaches 3,200 psi, turn the track-tension grease valve clockwise to tighten it.
6. Remove excess grease from around the valve.
7. Install the cover and retaining bolts.
8. Repeat steps 2 through 7 to loosen the track tension on the other side.

Cooling System Maintenance

Coolant specification: 50/50 solution of ethylene-glycol antifreeze and water or equivalent

Engine and Radiator coolant capacity: 16.77 L (17.7 US qt)

⚠ WARNING

If you remove the radiator cap from a hot engine, hot coolant could spray, causing scalding.

- Wear face protection when opening the radiator cap.
- Allow the cooling system to cool down to below 50°C (120°F) before removing the radiator cap.
- Follow the instructions for checking the maintaining the engine cooling system.

⚠ WARNING

Coolant is toxic.

- Keep coolant away from children and pets.
- If you are not using the same coolant again, dispose of it according to local environmental regulations.

Checking the Coolant Level in the Reservoir

Service Interval: Before each use or daily

Important: Do not remove the radiator filler cap during this procedure.

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Allow the engine to cool.
3. Open the front hood and rear hood.
4. Check the coolant level in the reservoir (Figure 100).

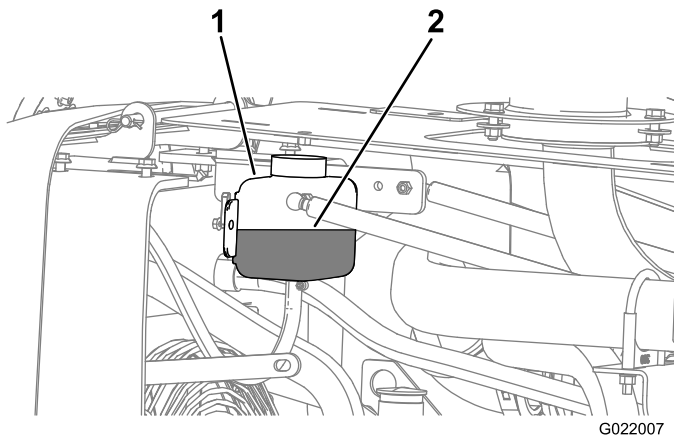


Figure 100

1. Reservoir
2. Coolant level (1/2 reservoir height)

5. Add the specified coolant until the coolant level is 1/2 the reservoir capacity.

Note: Ensure that the coolant solution is thoroughly mixed before filling the reservoir.

Checking the Coolant Level in the Radiator

Service Interval: Every 50 hours

⚠ WARNING

If the engine has been running, the radiator will be pressurized and the coolant inside will be hot. If you remove the cap, coolant may spray out, causing severe burns.

- Do not remove the radiator cap to check coolant levels.
- Do not remove the radiator cap when the engine is hot. Allow the engine to cool for at least 15 minutes or until the radiator cap is cool enough to touch without burning your hand.

Note: The cooling system is filled with a 50/50 solution of water and ethylene glycol antifreeze.

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Allow the engine to cool.
3. Open the front hood and rear hood.
4. Remove the radiator cap from the filler neck of the radiator and check the coolant level (Figure 100 and Figure 101).

Note: The coolant should be up to the filler neck.

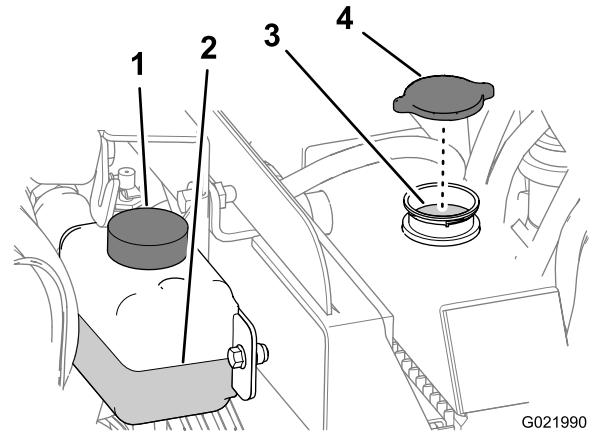


Figure 101

1. Reservoir
2. Coolant level (1/2 reservoir height)
3. Coolant level (bottom of radiator neck)
4. Radiator cap

5. If the coolant level is low, add coolant until the level is up to the bottom of the filler neck (Figure 101).

Important: Do not overfill the radiator.

Note: If the radiator coolant level is low and the coolant reservoir level is at the Full mark, check for air leaks in the hose between the radiator and the coolant reservoir.

6. Install the radiator filler cap, ensuring that it is tightly sealed (Figure 101).
7. If the air temperature is below 0°C (32°F), mix the ethylene glycol and water completely by running the engine at operating temperature for 5 minutes.

Checking the Condition of Cooling-System Components

Service Interval: Every 300 hours/Yearly (whichever comes first)

Check the condition of the cooling system for leaks, damage, dirt, and loose hoses and clamps. Clean, repair, tighten, and replace the components as necessary.

Checking the Concentration of the Coolant

Service Interval: Every 1,000 hours/Yearly (whichever comes first)—Check the concentration of the coolant before the winter season.

Test the concentration of ethylene glycol-based antifreeze in the coolant. Ensure that the coolant has a 50% ethylene glycol and 50% water mixture or equivalent.

Note: A 50% ethylene glycol and 50% water mixture will protect the engine to -37° C (-34° F) throughout the year.

Using a concentration tester, check the concentration of the coolant mixture to ensure that it is 50% ethylene glycol and 50% water or equivalent; refer to the manufacturer's instructions for testing.

Cleaning the Cooling System

Service Interval: Every 1,000 hours/Yearly (whichever comes first) (Clean the cooling system if the coolant becomes dirty or rust colored.)

Draining the Coolant from the System

Important: Do not pour coolant onto the ground or into an unapproved container that can leak.

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Allow the engine to cool.
3. Open the front hood.
4. Remove the radiator cap ([Figure 101](#)).
5. Place a drain pan under the drain plug ([Figure 102](#)).

Note: The coolant capacity of both the engine and the radiator is 16.8 L (17.7 US qt).

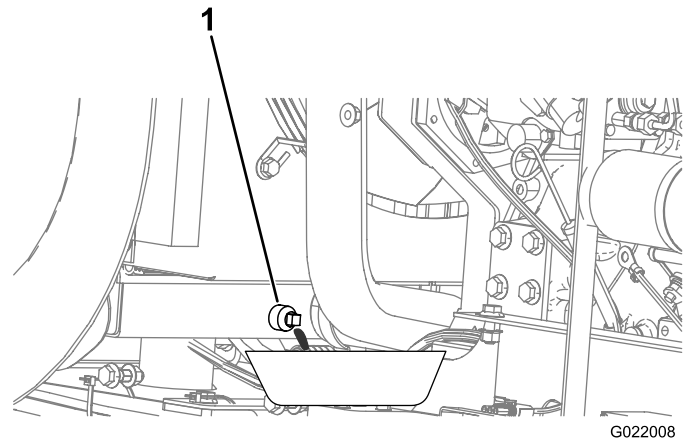


Figure 102

1. Radiator drain plug

6. Open the drain plug for the radiator and allow the coolant system to drain completely.

Note: Dispose of the used coolant properly according to local codes.

7. Clean the threads on the drain plug and apply 3 layers of PTFE sealing tape.
8. Close the drain plug ([Figure 102](#)).

Flushing the Cooling System

Engine and radiator coolant capacity: 16.8 L (17.7 US qt)

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Condition the cooling system as follows:
 - A. Ensure that the coolant is drained from the radiator and that the drain plug is closed; refer to [Draining the Coolant from the System](#) (page 79).
 - B. Add a cooling system cleaning solution to the radiator through the filler neck ([Figure 103](#)).

Note: Use cleaning solution of 21 g (12 oz dry) of sodium carbonate for every 17 L (18 US qt) of water; otherwise, use a commercially available equivalent. Follow the directions that come with the cleaning solution.

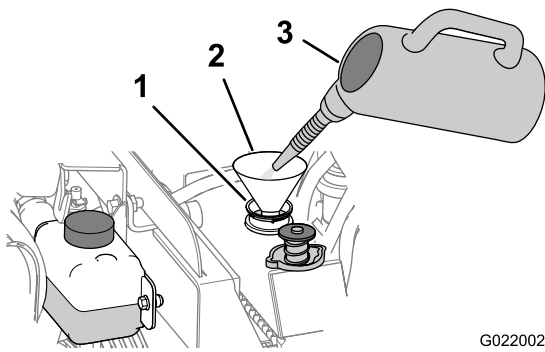


Figure 103

1. Filler neck (radiator)
2. Funnel
3. Coolant system cleaning solution

- C. Close the drain plug (Figure 102).

Important: Do not install the radiator cap.

- D. Operate the engine for 5 minutes or until the coolant temperature indicates 82° C (180° F), and then stop the engine.

⚠ CAUTION

The cleaning solution is hot and can cause burns.

Stay away from the discharge end of the coolant drain.

- E. Open the drain plug for the radiator, and drain the cleaning solution into a drain pan.
- F. Clean the threads on the drain plug and apply 3 layers of PTFE sealing tape.
- G. Close the drain plug.
3. Flush the cooling system as follows:
 - A. Open the filler-neck cap.
 - B. Fill the radiator with clean water (Figure 104).

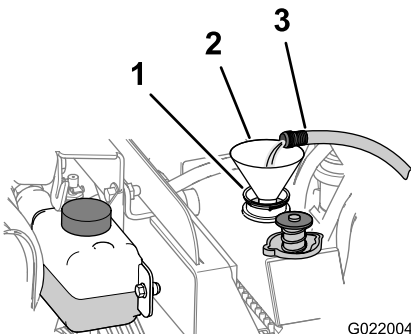


Figure 104

1. Filler neck
2. Funnel
3. Clean water

- C. Close the filler-neck cap.

- D. Operate the engine for 5 minutes or until the coolant temperature indicates 82°C (180°F), and then stop the engine.

⚠ CAUTION

The water is hot and can cause burns.

Stay away from the discharge end of the coolant drain plug.

- E. Open the drain plug and drain the water into a drain pan.
- F. Clean the threads on the drain plug and apply 3 layers of PTFE sealing tape.
- G. If the water drained from the radiator is dirty, perform steps 3-A through 3-E until the water drained from the radiator is clean.
- H. Close the drain plug (Figure 102).

Filling the System with Coolant

Important: You must fill the cooling system properly to prevent air locks in the cooling passages. Failing to vent the cooling system properly can severely damage the cooling system and engine.

Important: Use a mixture of 50% ethylene glycol and 50% water mixture or equivalent in the machine. The lowest ambient operating temperature for this mixture is above -37° C (-34° F). If the ambient temperature is lower, adjust the mixture. Use a mixture of ethylene glycol and water or equivalent in the machine all year.

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Remove the radiator cap (Figure 101).
3. Fill the radiator with coolant until the fluid level is up to the bottom of the filler neck (Figure 105).

Note: The coolant capacity of both the engine and the radiator is 16.8 L (17.7 US qt).

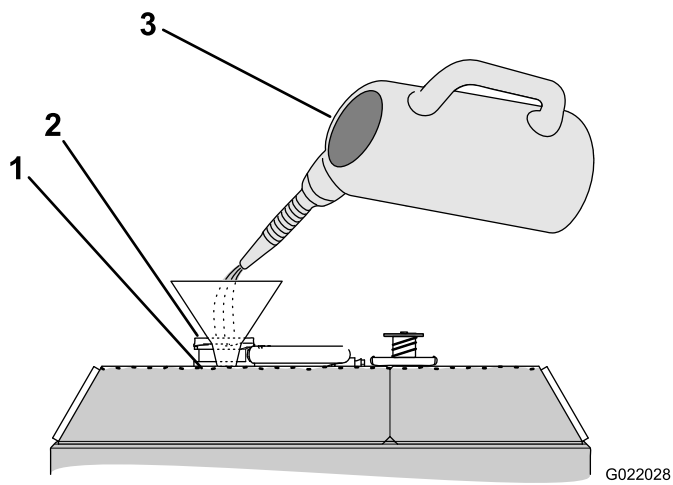


Figure 105

1. Coolant level (at the bottom of the filler neck)
 2. Filler neck
 3. Coolant (50/50 ethylene glycol and water or equivalent)
-
4. Install the radiator cap ([Figure 101](#)).
 5. Fill the coolant reservoir with coolant until it is full.
 6. Install the coolant reservoir cap.
 7. Start the engine and run it at half throttle for 5 minutes.
 8. Stop the engine and remove the key.
 9. Wait 30 minutes, then check the fluid level in the coolant reservoir. If it is low, add coolant.

Belt Maintenance

Servicing the Engine-Drive Belt

⚠ WARNING

Contacting a rotating belt can cause serious injury or death.

Stop the engine and remove the ignition key before working near belts.

Checking the Condition of the Belt

Service Interval: Every 250 hours

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Open the front hood.
3. Inspect the belt for cuts, cracks, loose cords, grease, oil, twisting, or signs of abnormal wear ([Figure 106](#)).

Note: Replace the belt if it is excessively worn or damaged.

Checking the Tension of the Belt

Service Interval: Every 1,000 hours

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Open the front hood.
3. Align a straight edge over the drive belt and across the pulleys as shown in [Figure 106](#).

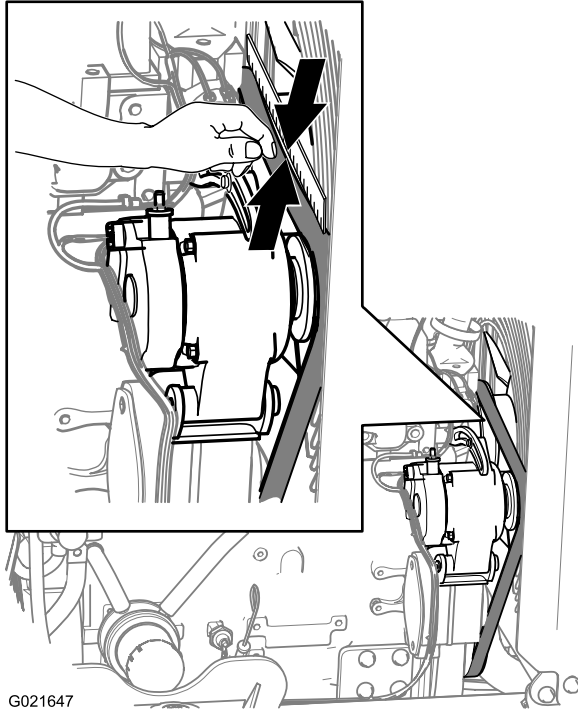


Figure 106

4. Press the belt down at the midway point between the fan pulley and the alternator pulley as shown in [Figure 106](#).

Note: The range of belt deflection between the straight edge and the belt should be 7 to 9 mm (0.28 to 0.35 inches), under a load of 10 kg (22 lb).

5. If the tension of the belt is above or below the specified range, adjust the drive belt tension; refer to [Adjusting the Tension of the Belt](#) (page 82).

Adjusting the Tension of the Belt

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Open the front hood.
3. Loosen the nut and bolt at the pivot point for the alternator ([Figure 107](#)).

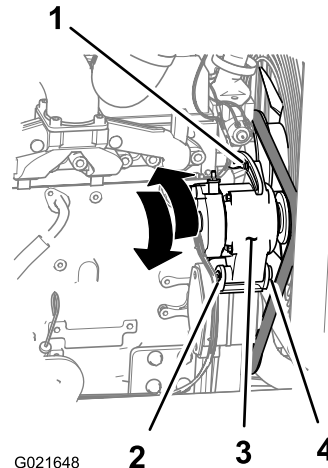


Figure 107

- | | |
|---------------------------------|----------------------------------|
| 1. Adjustment bolt | 3. Alternator |
| 2. Nut (alternator pivot point) | 4. Bolt (alternator pivot point) |

4. Loosen the adjustment bolt on the alternator ([Figure 107](#)).
5. Move the alternator away from the engine to increase the belt tension; move the alternator toward the engine to decrease the belt tension ([Figure 107](#)).
6. Tighten the alternator adjustment bolt ([Figure 107](#)).
7. Check the tension of the belt; refer to [Checking the Tension of the Belt](#) (page 82).
8. If the belt tension is correct, tighten the nut and bolt at the pivot point for the alternator ([Figure 107](#)); otherwise repeat steps 4 through 7.

Hydraulic System Maintenance

Servicing the Hydraulic Fluid

The hydraulic reservoir is filled at the factory with approximately 102 L (27 US gallons) of high-quality hydraulic fluid. **Check the level of the hydraulic fluid before the engine is first started and daily thereafter.** The recommended replacement fluid follows:

Toro Premium All Season Hydraulic Fluid (Available in 5 gallon pails or 55 gallon drums. Contact your Authorized Toro Dealer for part numbers.)

Alternate fluids: If the Toro fluid is not available, other fluids may be used provided they meet all the following material properties and industry specifications. We do not recommend the use of synthetic fluid. Consult with your lubricant dealer to identify a satisfactory product.

Note: Toro will not assume responsibility for damage caused by improper substitutions, so use only products from reputable manufacturers who will stand behind their recommendation.

High Viscosity Index/Low Pour Point Anti-wear Hydraulic Fluid, ISO VG 46

Material Properties:	
Viscosity, ASTM D445	42.2 cSt at 40° C (104° F)
	7.8 cSt at 100° C (212° F)
Viscosity Index ASTM D2270	158
Pour Point, ASTM D97	-6° C (-42° F)
Industry Specifications:	Vickers I-286-S (Quality Level), Vickers M-2950-S (Quality Level), Denison HF-0

Note: Many hydraulic fluids are almost colorless, making it difficult to spot leaks. A red dye additive for the hydraulic system oil is available in 20 mL (2/3 oz) bottles. One bottle is sufficient for 15-22 L (4-6 gallons) of hydraulic oil. Order the hydraulic oil from your Authorized Toro Dealer.

Note: If ambient operating temperatures exceed 43° C (110° F), contact Toro for fluid recommendations.

⚠ WARNING

Hydraulic fluid escaping under pressure can penetrate skin and cause injury.

- If hydraulic fluid is injected into the skin it must be surgically removed within a few hours by a doctor familiar with this type of injury. Gangrene may result if this is not done.
- Keep your body and hands away from pin-hole leaks or nozzles that eject high-pressure hydraulic fluid.
- Use cardboard or paper to find hydraulic leaks.
- Safely relieve all pressure in the hydraulic system before performing any work on the hydraulic system.
- Make sure that all hydraulic-fluid hoses and lines are in good condition and all hydraulic connections and fittings are tight before applying pressure to hydraulic system.

Checking the Hydraulic Fluid

Service Interval: Before each use or daily

Check the hydraulic fluid as follows:

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Wait 10 minutes to allow the engine to cool and the hydraulic oil to stabilize.
3. Open the front hood.
4. Look at the sight gauge on the hydraulic tank and check the level of the oil ([Figure 108](#)).

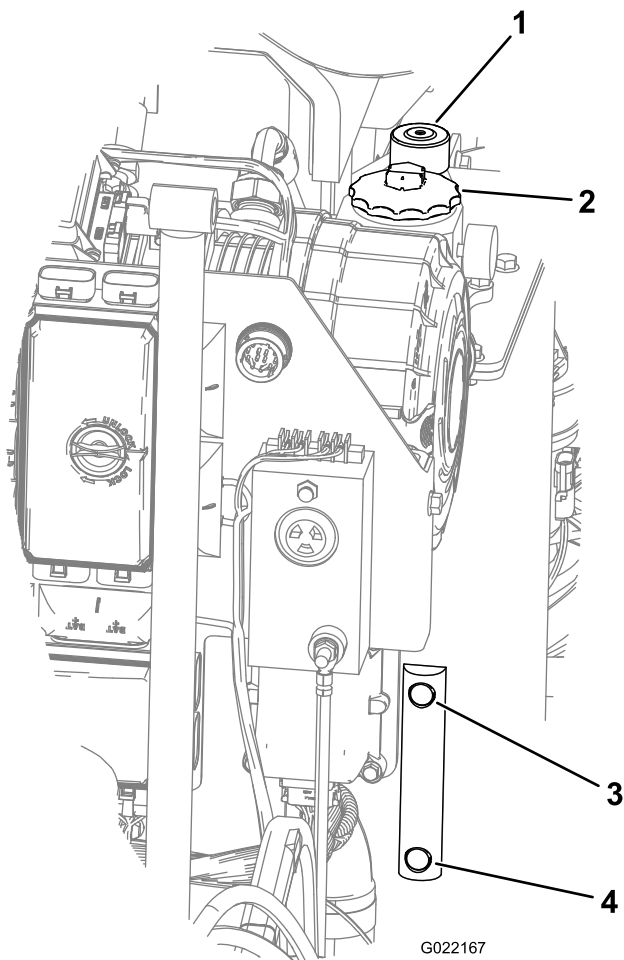


Figure 108

1. Hydraulic-tank breather
 2. Hydraulic-tank cap
 3. Full oil level (operating temperature)
 4. Low oil level
-
5. If the level is low, open the hydraulic-tank cap, add a small amount of oil and wait 2 minutes for the oil level to stabilize in the sight gauge (Figure 108).
- Note:** The oil level is between 1/2 to 2/3 full in the sight gauge when the oil is at ambient temperature or if the engine has not yet been started for the day.
6. Continue to add the appropriate fluid in small increments until it reaches Full on the sight gauge (Figure 108).
 7. Install cap onto the filler neck.

Changing the Hydraulic-Fluid Return Filter

Service Interval: Every 500 hours/Every 6 months (whichever comes first)

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Open the front hood.
3. Clean the area around the filler neck and cap of the hydraulic tank.
4. Open the hydraulic-tank cap (Figure 109).

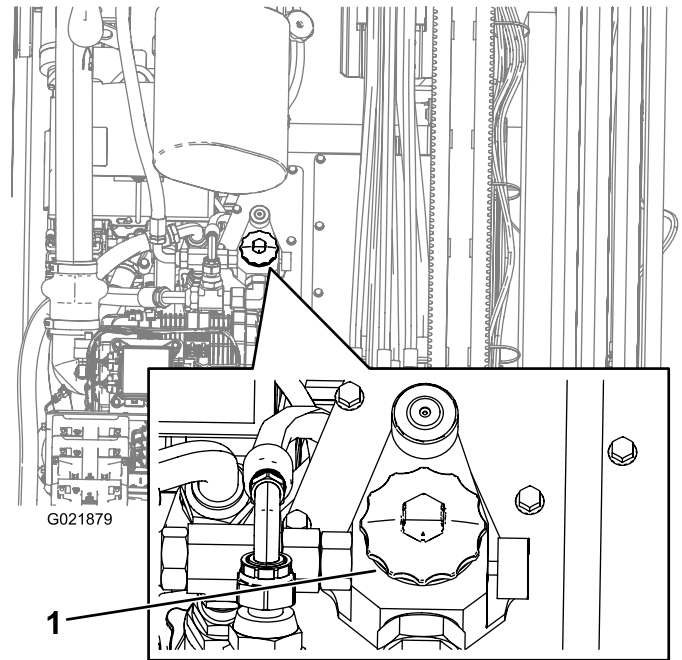


Figure 109

1. Hydraulic-tank cap
-
5. Discard the old hydraulic-fluid return filter.
 6. Install a new hydraulic-fluid return filter.

Changing the Hydraulic-Pressure Filter

Service Interval: Every 500 hours/Every 6 months (whichever comes first)

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Open the front hood.
3. Place a drain pan under the filter.
4. Using a filter wrench, remove the hydraulic-pressure filter (Figure 110).

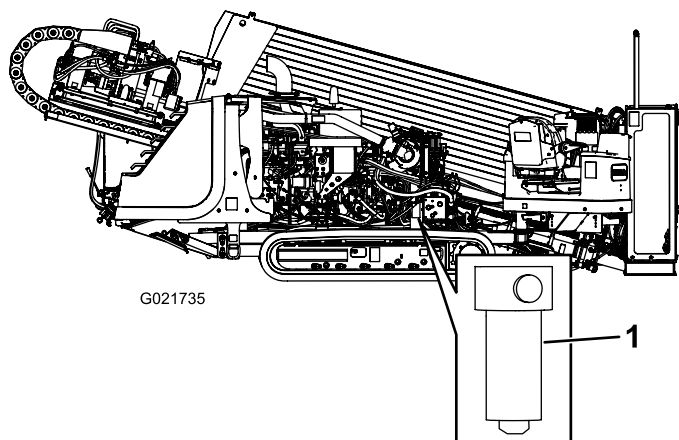


Figure 110

1. Hydraulic-pressure filter

5. Discard the old filter.
6. Apply a thin layer of hydraulic oil to the o-ring of the filter.
7. Install and tighten the new filter with a filter wrench.
8. Start the engine, let it run idle for approximately 1 minute, then check for leaks around the hydraulic-pressure filter.

Changing the Hydraulic Fluid

Service Interval: Every 1,000 hours/Yearly (whichever comes first)

Important: If the fluid becomes contaminated, contact your Authorized Toro Dealer, because the system must be flushed. Contaminated fluid looks milky or black when compared to clean oil.

Important: Use of any other filter may void the warranty on some components.

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Open the front hood.
3. Raise the machine using proper equipment.

⚠ WARNING

Raising the rear of the unit relying solely on mechanical or hydraulic jacks could be dangerous. The mechanical or hydraulic jacks may not be enough support or may malfunction allowing the unit to fall, which could cause injury or death.

Do not rely solely on mechanical or hydraulic jacks for support.

Use adequate jack stands or equivalent support.

4. Place a large draining container under the hydraulic fluid tank.
5. Remove the drain plug from the bottom of the tank.
6. Clean the threads on the drain plug and apply 3 layers of PTFE sealing tape.
7. Drain the hydraulic fluid flow into the container.

Important: The capacity of the hydraulic-fluid tank is 102 L (27 US gallons), so ensure that you have a container of at least 114 L (30 US gallons) to drain the fluid into.

8. Install the drain plug when the hydraulic fluid stops draining.
 9. Clean the area around the filter mounting areas.
 10. Place a drain pan under the filter and remove the filter (Figure 109).
 11. Lubricate the filter gasket of each new filter and fill them with hydraulic fluid.
 12. Ensure that the filter mounting areas are clean.
 13. Screw the filters on until the gaskets contacts the mounting plates; then tighten the filter an additional 1/2 turn.
 14. Fill the reservoir with hydraulic fluid.
- Important:** Use only the hydraulic fluids specified. Other fluids could cause system damage.
15. Install the reservoir cap. Start the engine and use all of the hydraulic controls to distribute hydraulic fluid throughout the system. Also check for leaks; then stop the engine.
 16. Check the fluid level and add enough to raise level the level to the Full mark on the dipstick. **Do not overfill.**

Checking the Hydraulic Lines and Hoses

Service Interval: Every 2 years—Replace moving hoses.

Inspect the hydraulic lines and hoses daily for leaks, kinked lines, loose mounting supports, wear, loose fittings, weather deterioration, and chemical deterioration. Make all necessary repairs before operating.

⚠ WARNING

Hydraulic fluid escaping under pressure can penetrate skin and cause injury.

- **Make sure that all hydraulic fluid hoses and lines are in good condition and all hydraulic connections and fittings are tight before applying pressure to the hydraulic system.**
- **Keep your body and hands away from pin hole leaks or nozzles that eject high pressure hydraulic fluid.**
- **Use cardboard or paper to find hydraulic leaks.**
- **Safely relieve all pressure in the hydraulic system before performing any work on the hydraulic system.**
- **Seek immediate medical attention if fluid is injected into skin.**

Hydraulic System Test Ports

The test ports are used to test the pressure in the hydraulic circuits. Contact your Authorized Toro Dealer for assistance.

Drilling-fluid Pump Maintenance

Servicing the Drilling-Fluid-Pump Oil

The drilling-fluid pump is shipped with oil in the crankcase; however, check the oil level before and after you first start the engine.

The crankcase capacity is 1.9 L (2 US qt).

Use only high-quality engine oil that meets the following specifications:

- **API Classification Level Required:** CH-4, CI-4 or higher
- **Oil:** SAE 30-weight, non-detergent oil above 0° C (32° F)

Toro Premium Engine Oil is available from your dealer. See the parts catalog for part numbers. Also, refer to the *Engine Operator's Manual*, included with the machine, for further recommendations.

Checking the Drilling-Fluid-Pump Oil Level

Service Interval: Before each use or daily—Check the drilling-fluid-pump oil level.

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Open the rear hood.
3. Remove the oil dipstick (Figure 111).

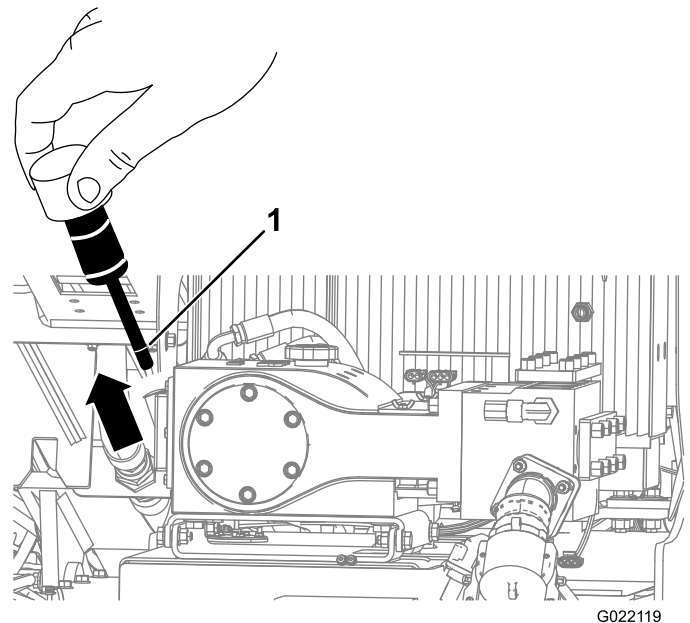


Figure 111

1. Oil-fill line

4. Ensure that the oil is at the oil-fill line as shown in [Figure 111](#).

Note: If the oil is below the oil-fill line, refer to step 8 of [Changing the Drilling-Fluid Pump Oil](#) (page 87) and add the necessary amount of oil.

Changing the Drilling-Fluid Pump Oil

Service Interval: Every 500 hours—Change the drilling-fluid pump oil.

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Open the rear hood.
3. Allow the engine to cool.
4. Remove the drain plug and place a drain pan under the drain-plug hole ([Figure 112](#)).

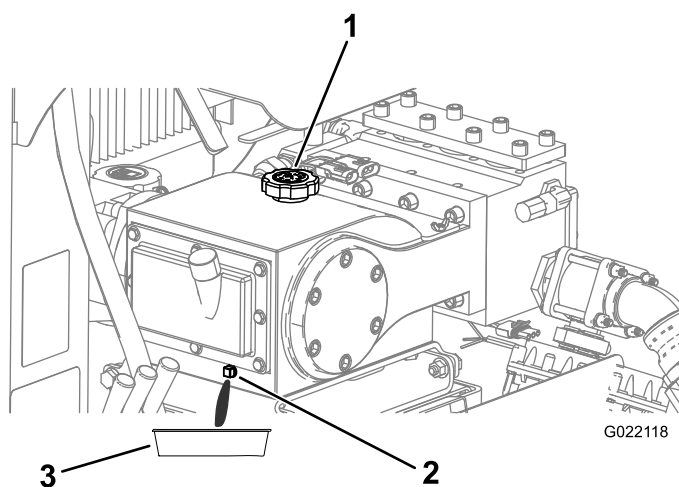


Figure 112

1. Oil-filler cap
2. Drain plug
3. Drain pan

5. Clean the threads on the drain plug and apply 3 layers of PTFE sealing tape.
6. Allow all of the oil to drain from drain plug into the oil pan ([Figure 112](#)).
7. Install the drain plug.
8. Remove the oil-filler cap ([Figure 112](#)) and add approximately 1.9 L (2 qt) of oil, or until the oil reaches the oil-fill line on the dipstick as shown in [Figure 111](#).

Preparing the Drilling-Fluid System for Cold Weather

Prepare the machine as follows after drilling if the temperature will be below 0° C (32° F).

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Prepare the machine to circulate the antifreeze as follows:
 - A. Open the rear hood.
 - B. Place a drain pan under the drill spindle for the leaked antifreeze ([Figure 113](#)).

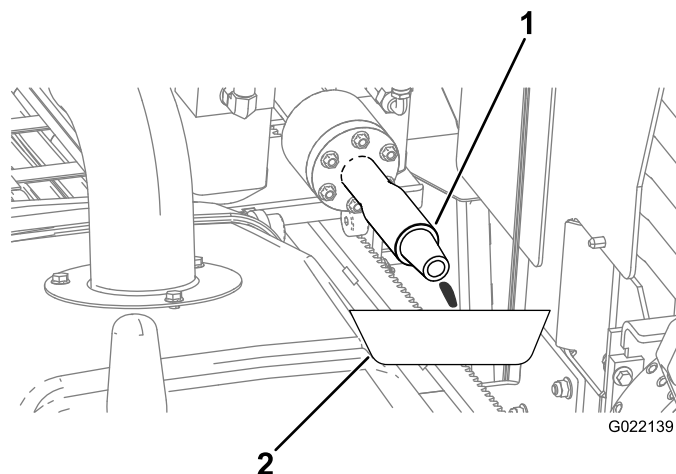


Figure 113

1. Drill spindle
2. Drain pan

- C. Ensure that the cap is installed on the drilling-fluid pump inlet ([Figure 114](#)).

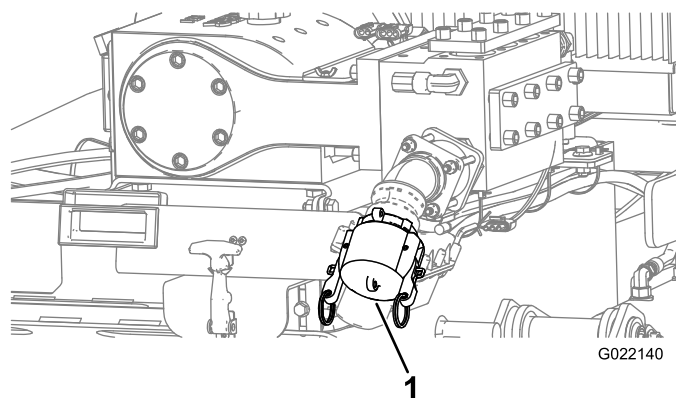


Figure 114

1. Drilling-fluid pump inlet

- D. Remove the cap from the antifreeze tank for the drilling-fluid pump ([Figure 115](#)).

Cleaning

Cleaning with the Spray-Hose Attachment

Service Interval: Before each use or daily

The machine comes with a spray-hose attachment that you can use to clean the machine and pipes.

Important: Do not spray any electronic component of the machine and ensure that the hood is down before cleaning the machine with the spray-hose attachment.

Important: If the outside temperature is below freezing, refer to [Preparing the Drilling-Fluid System for Cold Weather](#) (page 87) before cleaning the machine.

To use the spray-hose attachment, perform the following procedure:

1. Park the machine on a level surface, stop the engine, and remove the ignition key.
2. Ensure that the spray-hose attachment switch is in the OFF position ([Figure 117](#)).

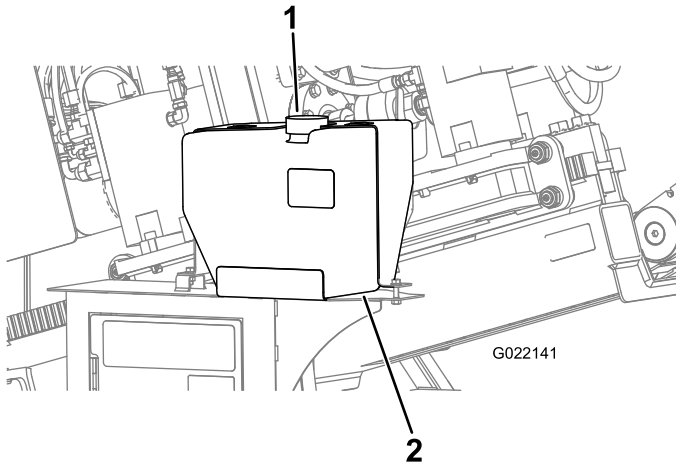


Figure 115

1. Antifreeze-tank cap
2. Antifreeze tank

E. Ensure that the tank is full of antifreeze ([Figure 115](#)).

3. Circulate the antifreeze as follows:

A. Open the antifreeze valve on the front side of the drilling-fluid pump (the lower valve) as shown in [Figure 116](#).

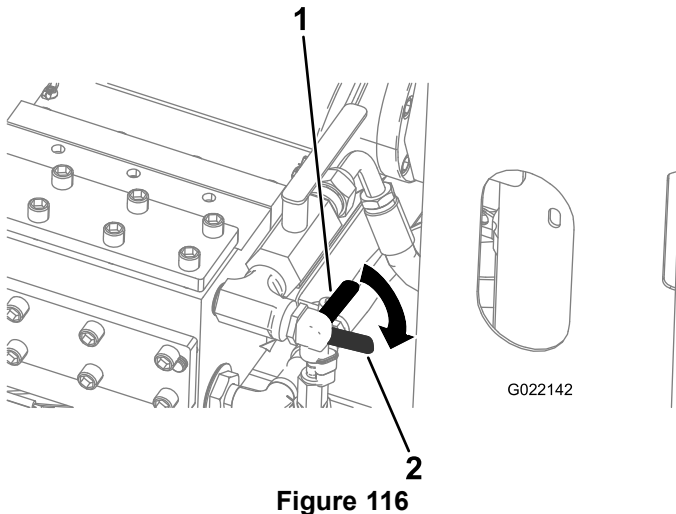


Figure 116

1. Valve in the closed position
2. Valve in the open position

B. Start the machine and turn On the drilling-fluid pump.

C. Add antifreeze to the tank as needed ([Figure 115](#)).

D. When the antifreeze comes out of the drill spindle ([Figure 113](#)), turn the pump off.

4. Turn the machine off.

5. Install the cap onto the antifreeze tank ([Figure 115](#)).

6. Close the antifreeze valve ([Figure 116](#)).

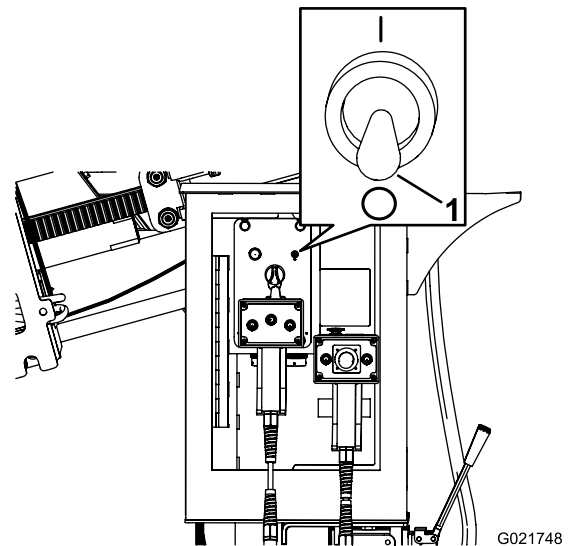


Figure 117

1. Spray-hose attachment switch (Off position)

3. Open the rear hood.

4. Turn the drilling-fluid valve clockwise to the OFF position ([Figure 118](#)).

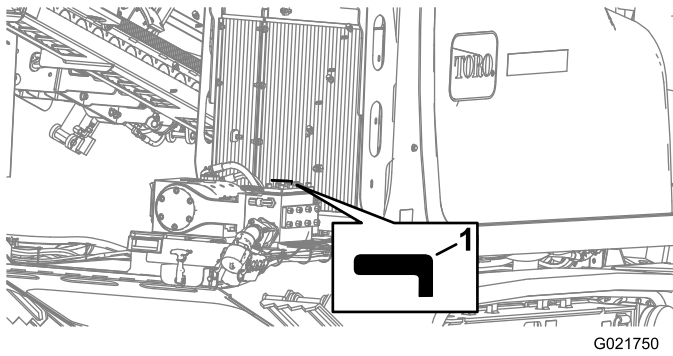


Figure 118

1. Drilling-fluid valve (Off position)

5. Connect the spray-hose attachment to the fitting (Figure 119).

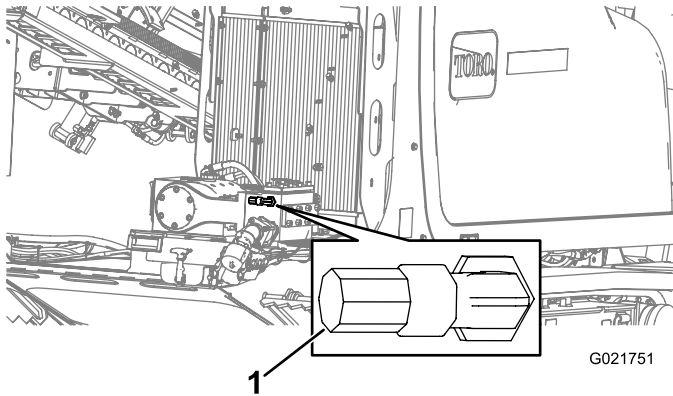


Figure 119

1. Fitting for the spray-hose attachment (end)

6. Turn the spray-hose attachment switch to the ON position (Figure 120).

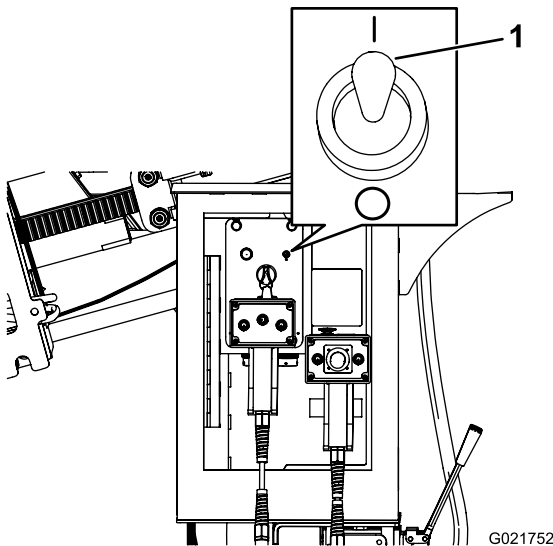


Figure 120

1. Spray-hose attachment switch (On position)

7. Turn the drilling-fluid pump to the ON position through the display screen; refer to the Main Drill Functions Displayed in the Pressure Screen in the *Software Guide*.
8. Using the spray-hose attachment, hold down the lever and spray down the machine and pipes.

Cleaning Plastic and Resin Parts

Avoid using gasoline, kerosene, paint thinner, etc. when cleaning plastic windows, the console, the instrument cluster, the monitor, gauges, etc. Use only water, mild soap, and a soft cloth when you clean these parts.

Using gasoline, kerosene, paint thinner, etc. to clean a plastic or resin part will cause it to discolor, crack, or deform.

Storage

1. Stop the engine and remove the key.
2. Remove dirt and grime from the entire machine.

Important: You can wash the machine with mild detergent and water. Avoid excessive use of water, especially near the control panel, engine, hydraulic pumps, and motors.

3. Service the air cleaner; refer to [Servicing the Air-Cleaning System \(page 63\)](#).
4. Grease the machine; refer to [Greasing the Machine \(page 60\)](#).
5. Charge the battery; refer to [Charging the Battery \(page 73\)](#).
6. Check and adjust the track tension; refer to [Servicing the Tracks \(page 76\)](#).
7. Check the coolant before winter storage; refer to [Checking the Cooling System \(page 43\)](#).
8. Prepare the drilling-fluid pump for cold weather; refer to [Preparing the Drilling-Fluid System for Cold Weather \(page 87\)](#).
9. Check and tighten all bolts, nuts, and screws. Repair or replace any part that is damaged.
10. Paint all scratched or bare metal surfaces. Paint is available from your Authorized Service Dealer.
11. Store the machine in a clean, dry garage or storage area. Remove the key from the ignition switch and keep it in a memorable place.
12. Cover the machine to protect it and keep it clean.

Troubleshooting

Problem	Possible Cause	Corrective Action
The starter will not crank.	1. The BATTERY-DISCONNECT switch is in the OFF position. 2. The electrical connections are corroded or loose. 3. A fuse is blown or loose. 4. The battery is discharged. 5. The relay or switch is damaged. 6. A starter or starter solenoid is damaged. 7. The internal engine components have seized.	1. Turn the BATTERY-DISCONNECT switch to the ON position. 2. Check the electrical connections for good contact. 3. Correct or replace the fuse. 4. Charge the battery or replace it. 5. Contact your Authorized Service Dealer. 6. Contact your Authorized Service Dealer. 7. Contact your Authorized Service Dealer.
The engine cranks, but will not start.	1. An incorrect starting procedure was used. 2. The fuel tank is empty. 3. The fuel shut-off valve is closed. 4. Dirt, water, stale fuel, or incorrect fuel is in the fuel system. 5. The fuel line is clogged. 6. There is air in the fuel. 7. The glow plugs are inoperative. 8. The cranking speed is slow. 9. The air cleaner filters are dirty. 10. The fuel filter is clogged. 11. The fuel grade is improper for cold weather use. 12. There is low compression. 13. The injection nozzles or pump are malfunctioning. 14. The ETR solenoid is broken.	1. Refer to Starting and Stopping the Engine. 2. Fill the tank with fresh fuel. 3. Open the fuel shut-off valve. 4. Drain and flush the fuel system, then add fresh fuel. 5. Clean or replace the fuel line. 6. Bleed the nozzles and check for air leaks at the fuel hose connections and fittings between the fuel tank and the engine. 7. Check the fuse, glow plugs, and wiring. 8. Check the battery, oil viscosity, and starting motor (contact your Authorized Service Dealer). 9. Service the air filters. 10. Replace the fuel filter. 11. Drain the fuel system and replace the fuel filter. Add fresh fuel of the proper grade for ambient temperature conditions. You may need to warm the entire machine. 12. Contact your Authorized Service Dealer. 13. Contact your Authorized Service Dealer. 14. Contact your Authorized Service Dealer.

Problem	Possible Cause	Corrective Action
The engine starts, but will not keep running.	1. The fuel tank vent is restricted. 2. Dirt or water is in the fuel system. 3. The fuel filter is clogged. 4. There is air in the fuel. 5. The fuel grade is improper for cold weather use. 6. The spark arrestor screen is clogged. 7. The fuel pump is damaged.	1. Loosen the cap. If the engine runs with the cap loosened, replace the cap. 2. Drain and flush the fuel system; add fresh fuel. 3. Replace the fuel filter. 4. Bleed the nozzles and check for air leaks at fuel hose connections and fittings between the fuel tank and engine. 5. Drain the fuel system and replace the fuel filter. Add fresh fuel of proper grade for ambient temperature conditions. 6. Clean or replace the spark arrestor screen. 7. Contact your Authorized Service Dealer.
The engine runs, but knocks or misses.	1. Dirt, water, stale fuel, or incorrect fuel is in the fuel system. 2. The engine is overheating. 3. There is air in the fuel. 4. The injection nozzles are damaged. 5. There is low compression 6. The injection pump timing is incorrect. 7. There is excessive carbon build-up. 8. There is internal wear or damage.	1. Drain and flush the fuel system; add fresh fuel. 2. Refer to Engine Overheats. 3. Bleed nozzles and check for air leaks at the fuel hose connections and fittings between the fuel tank and engine. 4. Contact your Authorized Service Dealer. 5. Contact your Authorized Service Dealer. 6. Contact your Authorized Service Dealer. 7. Contact your Authorized Service Dealer. 8. Contact your Authorized Service Dealer.
The engine will not idle.	1. The fuel tank vent is restricted. 2. Dirt, water, stale fuel, or incorrect fuel is in the fuel system. 3. The air cleaner filters are dirty. 4. The fuel filter is clogged. 5. There is air in the fuel. 6. The fuel pump is damaged. 7. There is low compression	1. Loosen the cap. If the engine runs with the cap loosened, replace the cap. 2. Drain and flush the fuel system; add fresh fuel. 3. Service the air filters. 4. Replace the fuel filter. 5. Bleed the nozzles and check for air leaks at fuel hose connections and fittings between the fuel tank and engine. 6. Contact your Authorized Service Dealer. 7. Contact your Authorized Service Dealer.

Problem	Possible Cause	Corrective Action
The engine overheats.	1. More coolant is needed. 2. There is restricted air flow to the radiator. 3. The crankcase oil level is incorrect. 4. There is excessive loading. 5. The incorrect fuel is in the fuel system. 6. The thermostat is damaged. 7. The fan belt is loose or broken. 8. Injection timing is incorrect. 9. The coolant pump is damaged.	1. Check and add coolant. 2. Inspect and clean the side panel screens with every use. 3. Fill or drain to the full mark. 4. Reduce the load and use a lower ground speed. 5. Drain and flush the fuel system; add fresh fuel. 6. Contact your Authorized Service Dealer. 7. Contact your Authorized Service Dealer. 8. Contact your Authorized Service Dealer. 9. Contact your Authorized Service Dealer.
There is excessive black smoke in the exhaust.	1. There is excessive loading. 2. The air cleaner filters are dirty. 3. Incorrect fuel is in the fuel system. 4. The injection pump timing is incorrect. 5. The injection pump is damaged. 6. The injection nozzles are damaged.	1. Reduce the load and use a lower ground speed. 2. Service the air filters. 3. Drain the fuel system and refill with specified fuel. 4. Contact your Authorized Service Dealer. 5. Contact your Authorized Service Dealer. 6. Contact your Authorized Service Dealer.
There is excessive white smoke in the exhaust.	1. The engine temperature is low. 2. The glow plugs are inoperative. 3. The injection pump timing is incorrect. 4. The injection nozzles are damaged. 5. There is low compression	1. Check the thermostat. 2. Check the fuse, glow plugs, and wiring. 3. Contact your Authorized Service Dealer. 4. Contact your Authorized Service Dealer. 5. Contact your Authorized Service Dealer.
The engine loses power.	1. The engine load is excessive. 2. The crankcase oil level is incorrect. 3. The air cleaner filters are dirty. 4. Dirt, water, stale fuel, or incorrect fuel is in the fuel system. 5. The engine is overheating. 6. The spark arrestor screen is clogged. 7. There is air in the fuel. 8. There is low compression 9. The fuel tank vent is restricted. 10. The injection pump timing is incorrect. 11. The injection pump is damaged.	1. Reduce ground speed. 2. Fill or drain to the full mark. 3. Service the air filters. 4. Drain and flush the fuel system; add fresh fuel. 5. Refer to Engine Overheats. 6. Clean or replace the spark arrestor screen. 7. Bleed the nozzles and check for air leaks at fuel hose connections and fittings between the fuel tank and engine. 8. Contact your Authorized Service Dealer. 9. Contact your Authorized Service Dealer. 10. Contact your Authorized Service Dealer. 11. Contact your Authorized Service Dealer.

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International Distributor List

Distributor:	Country:	Phone Number:	Distributor:	Country:	Phone Number:
Agrolanc Kft	Hungary	36 27 539 640	Maquiver S.A.	Colombia	57 1 236 4079
Balama Prima Engineering Equip.	Hong Kong	852 2155 2163	Maruyama Mfg. Co. Inc.	Japan	81 3 3252 2285
B-Ray Corporation	Korea	82 32 551 2076	Mountfield a.s.	Czech Republic	420 255 704 220
Casco Sales Company	Puerto Rico	787 788 8383	Mountfield a.s.	Slovakia	420 255 704 220
Ceres S.A.	Costa Rica	506 239 1138	Munditol S.A.	Argentina	54 11 4 821 9999
CSSC Turf Equipment (pvt) Ltd.	Sri Lanka	94 11 2746100	Norma Garden	Russia	7 495 411 61 20
Cyril Johnston & Co.	Northern Ireland	44 2890 813 121	Oslinger Turf Equipment SA	Ecuador	593 4 239 6970
Cyril Johnston & Co.	Republic of Ireland	44 2890 813 121	Oy Hako Ground and Garden Ab	Finland	358 987 00733
Equiver	Mexico	52 55 539 95444	Parkland Products Ltd.	New Zealand	64 3 34 93760
Femco S.A.	Guatemala	502 442 3277	Perfetto	Poland	48 61 8 208 416
ForGarder OU	Estonia	372 384 6060	Pratoverde SRL.	Italy	39 049 9128 128
G.Y.K. Company Ltd.	Japan	81 726 325 861	Prochaska & Cie	Austria	43 1 278 5100
Geomechaniki of Athens	Greece	30 10 935 0054	RT Cohen 2004 Ltd.	Israel	972 986 17979
Golf international Turizm	Turkey	90 216 336 5993	Riversa	Spain	34 9 52 83 7500
Guandong Golden Star	China	86 20 876 51338	Lely Turfcare	Denmark	45 66 109 200
Hako Ground and Garden	Sweden	46 35 10 0000	Solvart S.A.S.	France	33 1 30 81 77 00
Hako Ground and Garden	Norway	47 22 90 7760	Spypros Stavrinides Limited	Cyprus	357 22 434131
Hayter Limited (U.K.)	United Kingdom	44 1279 723 444	Surge Systems India Limited	India	91 1 292299901
Hydroturf Int. Co Dubai	United Arab Emirates	97 14 347 9479	T-Markt Logistics Ltd.	Hungary	36 26 525 500
Hydroturf Egypt LLC	Egypt	202 519 4308	Toro Australia	Australia	61 3 9580 7355
Irrimac	Portugal	351 21 238 8260	Toro Europe NV	Belgium	32 14 562 960
Irrigation Products Int'l Pvt Ltd.	India	0091 44 2449 4387	Valtech	Morocco	212 5 3766 3636
Jean Heybroek b.v.	Netherlands	31 30 639 4611	Victus Emak	Poland	48 61 823 8369

European Privacy Notice

The Information Toro Collects

Toro Warranty Company (Toro) respects your privacy. In order to process your warranty claim and contact you in the event of a product recall, we ask you to share certain personal information with us, either directly or through your local Toro company or dealer.

The Toro warranty system is hosted on servers located within the United States where privacy law may not provide the same protection as applies in your country.

BY SHARING YOUR PERSONAL INFORMATION WITH US, YOU ARE CONSENTING TO THE PROCESSING OF YOUR PERSONAL INFORMATION AS DESCRIBED IN THIS PRIVACY NOTICE.

The Way Toro Uses Information

Toro may use your personal information to process warranty claims, to contact you in the event of a product recall and for any other purpose which we tell you about. Toro may share your information with Toro's affiliates, dealers or other business partners in connection with any of these activities. We will not sell your personal information to any other company. We reserve the right to disclose personal information in order to comply with applicable laws and with requests by the appropriate authorities, to operate our systems properly or for our own protection or that of other users.

Retention of your Personal Information

We will keep your personal information as long as we need it for the purposes for which it was originally collected or for other legitimate purposes (such as regulatory compliance), or as required by applicable law.

Toro's Commitment to Security of Your Personal Information

We take reasonable precautions in order to protect the security of your personal information. We also take steps to maintain the accuracy and current status of personal information.

Access and Correction of your Personal Information

If you would like to review or correct your personal information, please contact us by email at legal@toro.com.

Australian Consumer Law

Australian customers will find details relating to the Australian Consumer Law either inside the box or at your local Toro Dealer.



The Toro Underground Warranty

A Limited Warranty

Underground
Equipment

Conditions and Products Covered

The Toro Company and its affiliate, Toro Warranty Company, pursuant to an agreement between them, jointly warrant your Toro Underground Equipment ("Product") to be free from defects in materials or workmanship. Where a warrantable condition exists, we will repair the Product at no cost to you including diagnostics, labor, and parts.

The following warranty applies from the date the Product is delivered to the original retail purchaser or rental owner.

Products

Engine Powered Units & Fluid Mixers

All Serialized Attachments

Rock Hammer

Engines

Warranty Period

1 year or 1000 operating hours, whichever occurs first

1 year

6 months

Through engine manufacturers:
2 years or 2000 operating hours, whichever occurs first

drive, or track chains, track pads, drive sprockets, idlers, rollers, blades, cutting edges, or other ground engaging components.

- Failures caused by outside influence. Conditions considered to be outside influence include, but are not limited to, weather, storage practices, contamination, use of unapproved fuels, coolants, lubricants, additives, water, or chemicals, etc.
- Failure or performance issues due to the use of fuels (e.g. gasoline, diesel, or biodiesel) that do not conform to their respective industry standards.
- Normal noise, vibration, wear and tear, and deterioration.
- Normal "wear and tear" includes, but is not limited to, damage to seats due to wear or abrasion, worn painted surfaces, scratched decals, etc.
- Hauling expenses, travel time, mileage, or overtime associated with transporting product to the authorized Toro dealer.

Instructions for Obtaining Warranty Service

You are responsible for notifying the Underground Dealer from whom you purchased the Product as soon as you believe a warrantable condition exists. If you need help locating a Underground Dealer, or if you have questions regarding your warranty rights or responsibilities, you may contact us at:

Toro Customer Care
Toro Warranty Company
8111 Lyndale Avenue South
Bloomington, MN 55420-1196
Toll Free at 855-493-0088 (U.S. Customers)
1-952-948-4318 (International Customers)

Owner Responsibilities

As the Product owner, you are responsible for required maintenance and adjustments stated in your *Operator's Manual*. Failure to perform required maintenance and adjustments can be grounds for disallowing a warranty claim.

Items and Conditions Not Covered

Not all product failures or malfunctions that occur during the warranty period are defects in materials or workmanship. This warranty does not cover the following:

- Product failures which result from the use of non-Toro replacement parts, or from installation and use of add-on, or modified non-Toro branded accessories and products. A separate warranty may be provided by the manufacturer of these items.
- Product failures which result from failure to perform recommended maintenance and/or adjustments. Failure to properly maintain your Toro product per the Recommended Maintenance listed in the *Operator's Manual* can result in claims for warranty being denied.
- Product failures which result from operating the Product in an abusive, negligent, or reckless manner.
- Parts subject to consumption through use unless found to be defective. Examples of parts which are consumed, or used up, during normal Product operation include, but are not limited to: brakes, filters, lights, bulbs, belts, tracks or tires, digging teeth, digging booms, digging,

Parts

Parts scheduled for replacement as required maintenance in the *Operator's Manual*, are warranted for the period of time up to the scheduled replacement time for that part. Parts replaced under this warranty are covered for the duration of the original product warranty and become the property of Toro. Toro will make the final decision whether to repair any existing part or assembly or replace it. Toro may use remanufactured parts for warranty repairs.

Maintenance is at Owner's Expense

Engine tune-up, lubrication, cleaning and polishing, replacement of filters, coolant, and completing recommended maintenance are some of the normal services Toro products require that are at the owner's expense.

General Conditions

Repair by an Authorized Toro Underground Dealer is your sole remedy under this warranty.

Neither The Toro Company nor Toro Warranty Company is liable for indirect, incidental or consequential damages in connection with the use of the Toro Products covered by this warranty, including any cost or expense of providing substitute equipment or service during reasonable periods of malfunction or non-use pending completion of repairs under this warranty. Except for the Emissions warranty referenced below, if applicable, there is no other express warranty. All implied warranties of merchantability and fitness for use are limited to the duration of this express warranty.

Some states do not allow exclusions of incidental or consequential damages, or limitations on how long an implied warranty lasts, so the above exclusions and limitations may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Note regarding engine warranty:

The Emissions Control System on your Product may be covered by a separate warranty meeting requirements established by the U.S. Environmental Protection Agency (EPA) and/or the California Air Resources Board (CARB). The hour limitations set forth above do not apply to the Emissions Control System Warranty. Refer to the Engine Emission Control Warranty Statement supplied with your product or contained in the engine manufacturer's documentation for details.

Countries Other than the United States or Canada

Customers who have purchased Toro products exported from the United States or Canada should contact their Toro Distributor (Dealer) to obtain guarantee policies for your country, province, or state. If for any reason you are dissatisfied with your Underground Dealer's service or have difficulty obtaining guarantee information, contact the Toro importer.

Australian Consumer Law: Australian customers will find details relating to the Australian Consumer Law either inside the box or at your local Toro Dealer.