JT21

Deutz TD2.9

Operator's Manual

Original Instructions (EN)

Issue: 2.0

053-10101

Disclaimers and Regulatory Information

It is a violation of California Public Resource Code Section 4442 or 4443 to use or operate the engine on any forest-covered, brush-covered, or grass-covered land unless the engine is equipped with a spark arrester, as defined in Section 4442, maintained in effective working order or the engine is constructed, equipped, and maintained for the prevention of fire.

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 Service Dealer. Genuine Ditch Witch spark arresters are approved by the USDA Forestry Service.

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.

⚠ WARNING

CALIFORNIA
Proposition 65

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

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.

Use of this product may cause exposure to chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

FCC

This device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Changes or modifications not expressly approved by Ditch Witch could void the user’s authority to operate the equipment.

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Perry, OK 73077

Contact us at www.DitchWitch.com
Printed in the USA

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Chapter 1

Introduction

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Intended Use

The JT21 is a self-contained horizontal directional drill designed to install buried cable and pipe to distances of 122–183 m (400–600 ft). Using this product for purposes other than its intended use could prove dangerous to yourself and bystanders. Do not modify the machine or attachments.

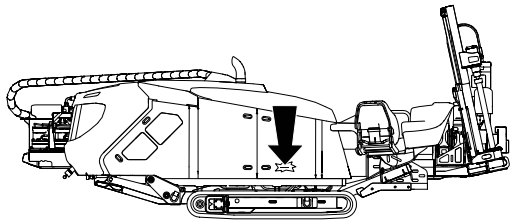
This machine should be used with genuine Ditch Witch fluid machines and Subsite® Electronics tracking equipment. It should be operated, serviced, and repaired only by professionals familiar with its characteristics and acquainted with the relevant safety procedures.

Operate machine in ambient temperatures from -12° to 46°C (10° to 115°F). Contact your Ditch Witch dealer for provisions required for operating in extreme temperatures.

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.

Getting Help

Visit www.DitchWitch.com for product safety and operation training materials, accessory information, help finding a dealer, or to register your product.



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Whenever you need service, genuine Ditch Witch parts, or additional information, contact an Authorized Service Dealer or Ditch Witch Customer Service and have the model and serial numbers of your product ready. These numbers are located on the serial plate on your product ①. Write the numbers in the space provided.

IMPORTANT

With your mobile device, you can scan the QR code on the serial number decal (if equipped) to access warranty, parts, and other product information.

Model Number:		**Serial Number:**	

Manual Conventions

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

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This manual uses 2 words to highlight information. **Important** calls attention to special mechanical information and **Note** emphasizes general information worthy of special attention.

Safety Alert Classifications

The safety-alert symbol shown in this manual and on the machine identifies important safety messages that you must follow to prevent accidents.

Safety-alert symbol appears above information that alerts you to unsafe actions or situations and is followed by the word **DANGER**, **WARNING**, or **CAUTION**.

⚠ DANGER ⚠

Danger indicates an imminently hazardous situation which, if not avoided, *will* result in death or serious injury.

⚠ WARNING ⚠

Warning indicates a potentially hazardous situation which, if not avoided, *could* result in death or serious injury.

⚠ CAUTION ⚠

Caution indicates a potentially hazardous situation which, if not avoided, *may* result in minor or moderate injury.

Chapter 2

Safety

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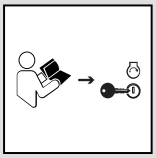
During Operation Safety

General Safety

Guidelines

⚠ WARNING ⚠



Misuse of the machine could cause death or serious injury.

- **Read and understand the operator's manual and all other safety instructions before use.**
- **Know how to use all the controls.**

Follow these guidelines before operating any jobsite equipment:

- Complete proper training.
- Read and understand the *Operator's Manual* before using equipment.
- Wear personal protective equipment including long pants, hard hat, eye protection, hearing protection, and protective footwear.
- Do not wear jewelry or loose clothing.
- Mark the proposed path with white paint and have underground utilities located before working. In the US or Canada, call 811 (US) or 888–258–0808 (US and Canada). Also contact any local utilities that do no participate in the One-Call service. In countries that do not have a One-Call service, contact all local utility companies to have underground utilities located.
- Classify the jobsite based on its hazards and use the correct tools and machinery, safety equipment, and work methods for the jobsite.
- Mark the jobsite clearly and keep spectators away.
- Review jobsite hazards, safety and emergency procedures, and individual responsibilities with all personnel before work begins. Safety videos are available from your Ditch Witch dealer or at www.DitchWitch.com. Safety Data Sheets (SDS) are available at www.DitchWitch.com.
- Fully inspect equipment before operating. Repair or replace any worn or damaged parts. Replace missing or damaged safety shields and safety alert signs. Contact your Ditch Witch dealer for assistance.
- Follow instructions on all safety alert signs on machine.
- Keep access steps and platforms clean and free of obstacles and debris.
- Use equipment carefully per the instructions in this manual. Stop operation and investigate anything that does not look or feel right.
- Do not operate the machine where flammable gas may be present.
- Only operate equipment in well ventilated areas.
- Ensure the jobsite is adequately lit. Arrange for secondary light sources as needed.

General Safety (continued)

- Always tie down equipment and properly stow accessories, even if traveling short distances.
- Contact your Ditch Witch dealer if you have any questions about operations, maintenance, or equipment use.
- Complete the equipment checklist located at www.DitchWitch.com.

Emergency Procedures

WARNING

Contact with underground utilities could cause death or serious injury.

Locate and verify the location of underground utilities before digging or drilling.

Before operating any equipment, review emergency procedures and check that all safety precautions have been taken.

EMERGENCY SHUTDOWN: Shut off the machine or press the remote engine stop button (if equipped). If the emergency stop button is used to stop the machine, inspect the machine to determine the reason for activation before re-enabling. Ensure the ignition switch is in the off position before re-enabling.

Electric Strike Description

When working near electric cables, remember the following:

- Electricity follows all paths to ground, not just the path of least resistance.
- Pipes, hoses, and cables will conduct electricity back to all equipment.
- Low voltage current can injure or kill. Many work-related electrocutions result from contact with less than 440 volts.

Most electric strikes are not noticeable, but indications of a strike include:

- power outage
- smoke
- explosion
- popping noises
- arcing electricity

If any of these occur, assume an electric strike has occurred.

General Safety (continued)

If an Electric Line is Damaged

If you suspect an electric line has been damaged, **do not move**. Take the following actions. The order and degree of action will depend on the situation.

- If you are **on the machine or bonded equipment**:
  - **Remain on the machine.**
  - Reverse the drilling direction and try to break contact. Do not touch the drill pipe with hands or hand-held tools.
  - Press the electric strike system test button.
  - If the alarm sounds again, stay where you are and wait for the electric company to shut off power.
  - If the alarm does not sound or there is no other indication of a strike, wait at least one full minute before moving away from the equipment. The utility might use automatic reclosers which will restart the current flow.
  - If the alarm sounds again while you are waiting, stay where you are until the electric company shuts off power.
  - If the alarm does not sound but all lights in the strike indicator are on, assume a strike is continuing and stay where you are until electric company shuts off power.
- If you are **off the machine or bonded equipment, do not touch any equipment** connected to the machine.
  - If you must leave the area, take small steps with your feet close together to reduce the hazard of being shocked from one foot to the other.
  - If you leave, do not return to the area or allow anyone into the area until given permission by the electric company.
- Warn people nearby that an electric strike has occurred. Instruct them to leave the area.
- Have someone contact the electric company to shut off power.
- Do not resume drilling or allow anyone into the area until given permission by the electric company.

If a Gas Line is Damaged

If you suspect a gas line has been damaged, take the following actions. The order and degree of action will depend on the situation.

- Immediately shut off the engine(s), if this can be done safely and quickly.
- Remove any ignition source(s), if this can be done safely and quickly.
- Warn others that a gas line has been cut and that they should leave the area.
- After warning others to leave the area, leave the jobsite as quickly as possible.
- Immediately call your local emergency phone number and utility company.
- If the jobsite is along a street, stop traffic from driving near the jobsite.

- Do not return to the jobsite until given permission by emergency personnel and the utility company.

If a Fiber Optic Cable is Damaged

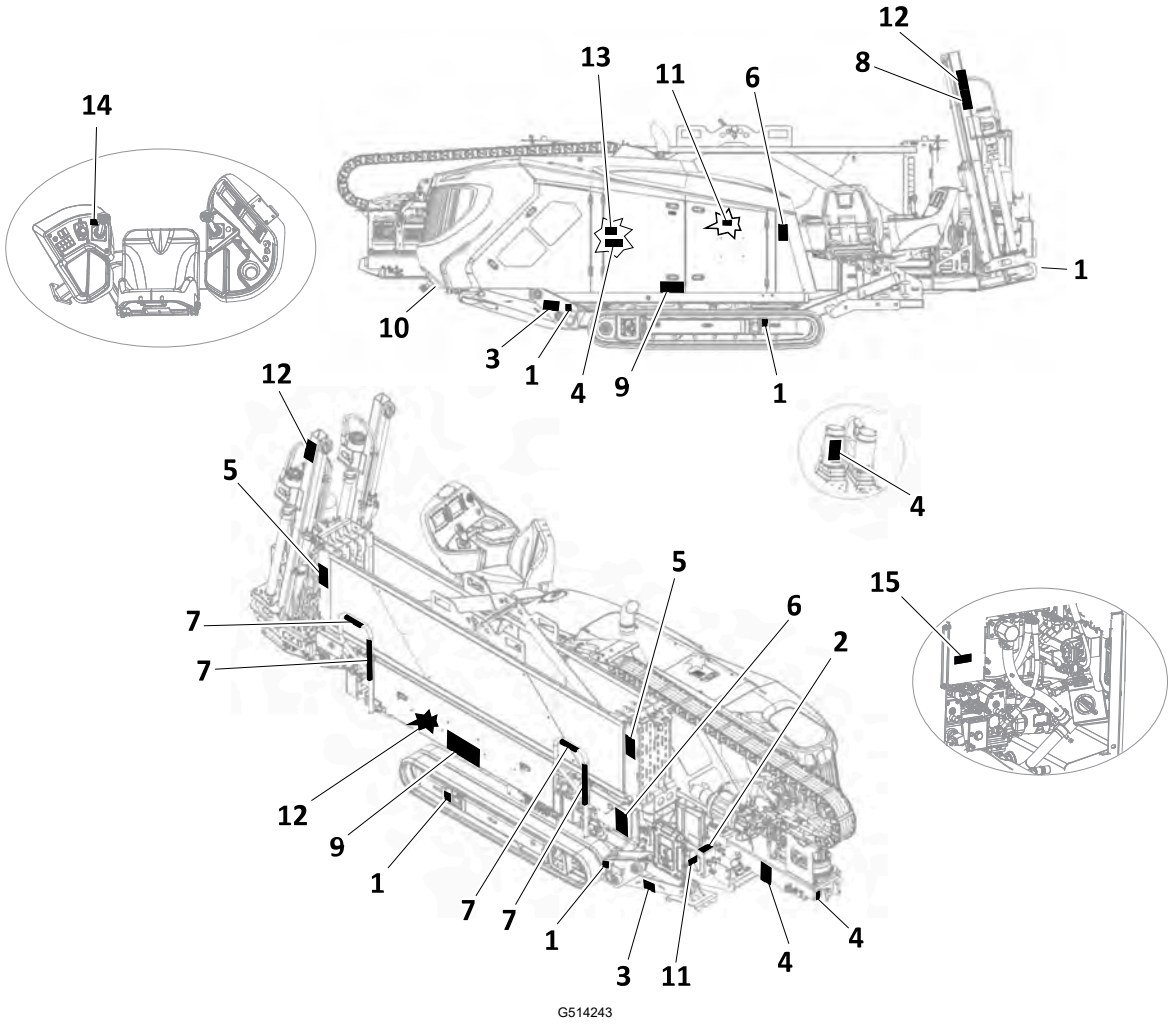
Do not look into the cut ends of fiber optic or unidentified cable. Vision damage can occur. Contact the utility company.

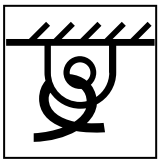
If Machine Catches Fire

Perform emergency shutdown procedure and then take the following actions. The order and degree of action will depend on the situation.

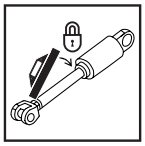
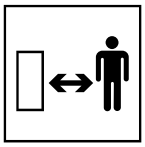
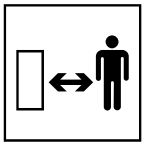
- Immediately move the battery disconnect switch (if equipped and accessible) to the disconnect position.
- If the fire is small and a fire extinguisher is available, attempt to extinguish the fire.
- If the fire cannot be extinguished, leave the area as quickly as possible and contact emergency personnel.

JT21 Safety Alerts

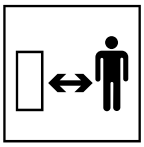
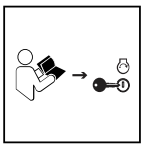
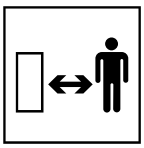


1 	Tiedown location. See the Transport chapter for more information.
2  	**⚠ WARNING ⚠** **Impact from a runaway machine could cause death or serious injury.** **Chock or block the machine when parking.**

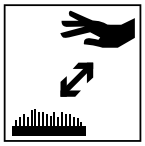
JT21 Safety Alerts (continued)

3  	**⚠ WARNING ⚠** **A raised component could crush operators or bystanders, causing death or serious injury.** • **Stay away or secure the raised component with a locking device.** • **Use the correct equipment and procedures.**
4  	**⚠ WARNING ⚠** **Contact with moving parts could cause serious injury.** **Stay away from them.**
5  	**⚠ WARNING ⚠** **A lifted load could crush the operator or bystanders, causing death or serious injury.** **Stay away from the lifted load and its range of movement.**
6  	**⚠ CAUTION ⚠** **Impact from remote-controlled equipment could cause death or serious injury.** **Stay away.**
7 	Danger stripe decal.

JT21 Safety Alerts (continued)

(8)  	**⚠ DANGER ⚠** **Moving or thrown tools could strike the operator or bystanders. This will cause death or serious injury.** • **Never use pipe wrenches on the drill string.** • **Follow the instructions in this manual for correct procedures.**
(9)  	**⚠ DANGER ⚠** **Contact with the buried electrical lines will cause death or serious injury.** **Know the location of lines and stay away from them.**
(10)  	**⚠ WARNING ⚠** **Contact with pressurized fluid or air could cause death or serious injury.** **Follow the instructions in this manual for correct use.**
(11)  	**⚠ WARNING ⚠** **Exposure to jobsite hazards could cause death or serious injury.** **Read and understand the operator's manual and all safety instructions before use.**
(12)  	**⚠ DANGER ⚠** **Contact with the rotating shaft will cause death or serious injury.** **Stay away from the shaft.**

JT21 Safety Alerts (continued)

(13)  	**⚠ WARNING ⚠** **A fire or an explosion from a pre-heater could cause death or serious injury.** **Never use starter fluid.**
(14)  	**⚠ WARNING ⚠** **Contact with underground utilities could cause death or serious injury.** **Locate and verify the location of underground utilities before digging or drilling.**
(15)  	**⚠ CAUTION ⚠** **Contact with hot parts could cause burns.** **Only touch parts when they are cool or wear gloves.**

Chapter 3

Preparation

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Jobsite Preparation

⚠ WARNING ⚠

Contact with underground utilities could cause death or serious injury.

- **Locate and verify the location of underground utilities before digging or drilling.**
- **Expose lines by hand by careful digging or soft excavation before operating equipment. Use appropriate equipment and procedures for exposing utility lines.**
- **Classify jobsite and follow precautions based on classification.**
- **Follow local regulations for digging near utilities.**

A successful job begins before working. The first step in planning is reviewing information already available about the job and jobsite.

Reviewing the Job Plan

Review the blueprints or other plans and ensure you have taken bore enlargement during backreaming and pullback into account. Check for information about existing or planned structures, elevations, or proposed work that may be taking place at the same time.

Selecting the Start and End Points

Select an end point to use as a starting point. Consider the following when selecting a starting point:

- Always park the equipment on a level site. Consider how the slope will affect setup and operation. Assess the risks on each slope to determine if factors affecting risks create an unsafe condition for working.
- Check that the starting and ending points allow enough space for working. See the Minimum Setback section.
- Consider how shade, wind, fumes, and other site features will affect operator comfort.
- Drill downhill when possible so fluid will flow away from the drill.

Identifying Hazards

Inspect the jobsite before transporting equipment; check for the following:

- Overall grade or slope
- Changes in elevation such as hills or open trenches
- Obstacles such as buildings, railroad crossings, or streams

Identifying Hazards (continued)

- Signs of utilities
  - “Buried utility” notices
  - Gas or water meters
  - Drop boxes
  - Manhole covers
  - Utility facilities without overhead lines
  - Junction boxes
  - Light poles
  - Sunken ground
- Traffic
- Access
- Soil type and condition
- Water Supply
- Sources of locator, tracker, or guidance equipment interference (rebar, railroad tracks, etc.)

  Note: All tracking equipment is subject to magnetic interference. The presence of interference can cause inaccuracies in both location and depth calculations. See the tracker or locator operator’s manual for more information.

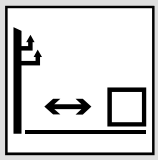
Take soil samples from several locations along the bore path to determine the best bit and backreamer combinations.

Locating Utilities

1. Notify One-Call Services; mark the proposed path with white paint and have the underground utilities located before working.
   - In the US or Canada, call 811 (US) or 888-258-0808 (US and Canada). Also contact any local utilities that do not participate in One-Call service.
   - In countries that do not have a One-Call service, contact all local utility companies to have underground utilities located.
2. Verify underground utilities; have an experienced locating equipment operator sweep the area within 6 m (20 ft) to each side of the proposed excavation to verify previously marked line and cable locations. Mark the location of all buried utilities and obstructions.

Locating Utilities (continued)

⚠ DANGER ⚠



Contact with overhead electrical lines will cause death or serious injury.

- **Know the location of lines.**
- **Stay away.**
- **Follow US Occupational Safety and Health Administration (OSHA) guidelines for working around overhead electrical lines.**

3. Locate overhead lines; note the location and height of all overhead lines in the jobsite and ensure that the equipment maintains a proper distance from live lines.

Classifying the Jobsite

Survey the jobsite and classify the hazards that may be present.

Jobsites are classified according to the underground hazards present, not by the line being installed. A jobsite may have more than 1 classification.

If you are working	Classification
within 3 m (10 ft) of a buried electric line	Electric
within 3 m (10 ft) of a natural gas line	Natural gas
in concrete, sand, or granite which is capable of producing crystalline silica dust	Crystalline silica dust
within 3 m (10 ft) of any other hazard	Other

Classify the jobsite as electric if the jobsite is in question or if the possibility of unmarked electric utilities exists.

Once classified, take precautions appropriate for the jobsite. Follow the US Department of Labor regulations on excavating and trenching (Part 1926, Subpart P) and other similar regulations.

Classified Jobsite Precautions

Electric Precautions

In addition to using a directional drilling system with an electric strike system, use one or both of these methods:

- Expose the line by careful hand digging or soft excavation. Use a beacon to track the bore path. If a utility must be crossed, a tracker operator must watch the drill head during drilling and backreaming. The tracker operator must have communication with the drill operator or the DrillLok®/Tracker Control system must be enabled with the DrillLok/Tracker Control key in the tracker operator's possession.
- Have the service shut down while work is in progress.
- Have the electrical company test the lines before returning them to service.

Natural Gas Precautions

Position equipment upwind from the gas lines and use one or more of these methods:

- Expose the line by careful hand digging or soft excavation. Use a beacon to track the bore path. If a utility must be crossed, a tracker operator must watch the drill head during drilling and backreaming. The tracker operator must have communication with the drill operator or the DrillLok®/Tracker Control system must be enabled with the DrillLok/Tracker Control key in the tracker operator's possession.
- Have the service shut down while work is in progress.
- Have the gas company test the lines before returning them to service.

Crystalline Dust Precautions

⚠ WARNING ⚠

Exposure to silica dust could cause lung disease.

Use breathing protection.

Crystalline silica dust is a naturally occurring substance found in soil, sand, concrete, granite, and quartz. To reduce exposure when cutting, drilling, or working these materials:

- Use a water spray or other means to control the dust.

Classifying the Jobsite (continued)

Crystalline Dust Precautions (continued)

- Refer to the US Occupational Safety and Health Administration (OSHA) guidelines or other applicable regulating guidelines for appropriate breathing protection or dust control methods.

Other Precautions

To safely avoid other underground hazards at each site, use different methods to determine the appropriate safety precautions. Talk with those knowledgeable about the hazards present at each site to determine which precautions should be taken or if the job should be attempted.

Clear objects such as landscaping fabric, cable, and wire from the work area. These objects may be underground or partially buried.

Arranging for Traffic Control

Keep the vehicle and pedestrian traffic away from the equipment. Evaluate the jobsite and allow an appropriate buffer zone around the equipment. If the jobsite is near a road or other traffic area, contact the local authorities about safety procedures and regulations.

Planning the Bore Path

Plan the bore path, from entry to end, before drilling begins. Subsite® Electronics bore planning software is available for planning your bore path. This special software can be run in the field using a laptop computer or mobile device. See your Ditch Witch Dealer for details.

Note: If you are not using bore planning software see the Bore Path Calculator section.

1. For complicated bores, consult an engineer. Have the jobsite surveyed and the bore path calculated. Ensure the engineer knows minimum entry pitch, bend limits of the drill pipe, bend and tension limits of pullback material, pipe lengths, and the location of all underground utilities.
2. For less complicated bores, plan the bore based on four measurements:
   - Recommended bend limit
   - Entry pitch
   - Minimum setback
   - Minimum depth

Recommended Bend Limits

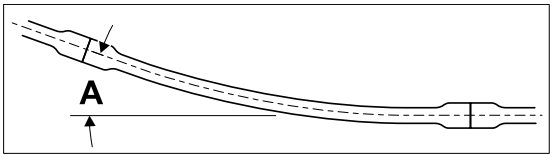
Note: Consider the recommended bend limits during any bend, not just during bore entry.

Ditch Witch drill pipes are designed to bend slightly during operation. Slight bending allows for steering and correcting direction. Bending beyond the recommended limits will cause damage that might not be visible. This damage adds up and will later lead to sudden drill pipe failure.

Drill Pipe Pitch

Ditch Witch drill pipe is tested to bend at a maximum percent pitch.

Ensure pitch (A) changes no more than the following percentages over the full length of each pipe. Monitor the pitch of each pipe with the tracker remote display on the operator console. See the tracking system *Operator's Manual*.



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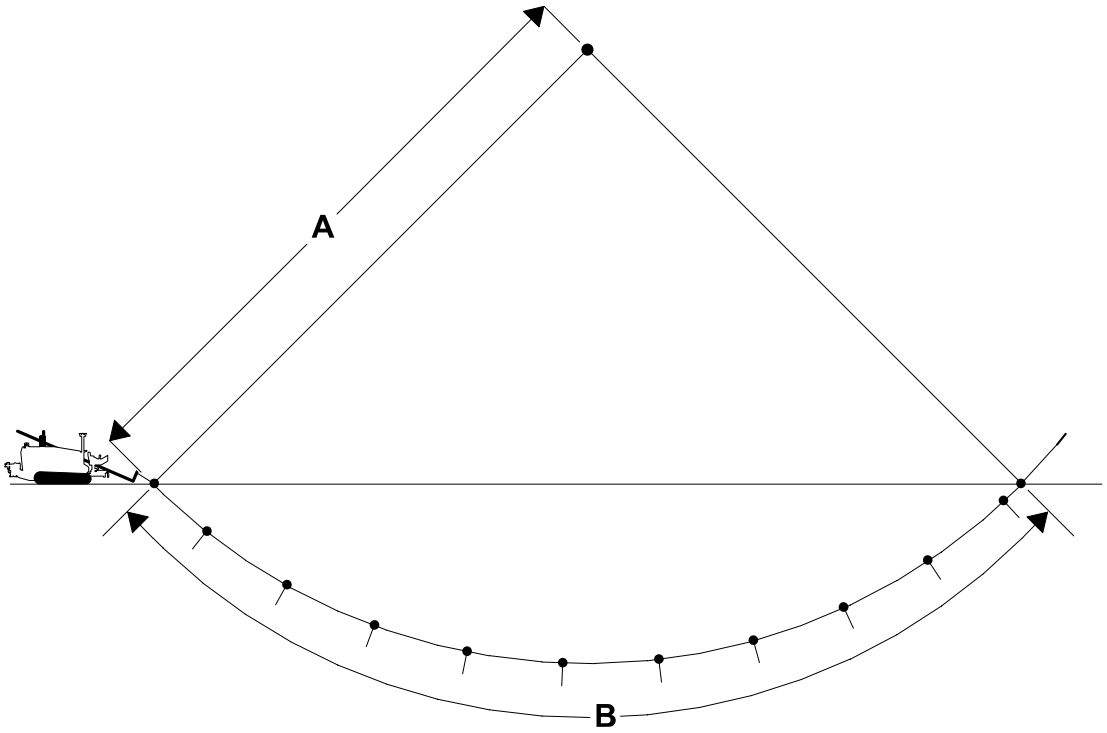
Drill Pipe	Percentage
JT21 Power Pipe®	9.4%
Ditch Witch Forged HD	9.2%
JT21 Forged HDX	8.0%

Drill Pipe Bend Radius

IMPORTANT

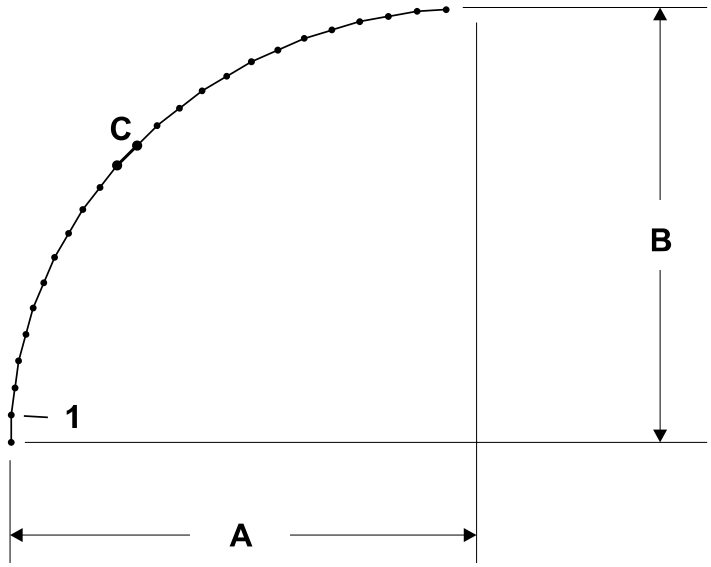
Bending the drill pipe more sharply than recommended will damage the pipe and cause failure over time. If the bend radius is reduced, the drill pipe life is reduced.

Note: Use the following charts to keep the bends within safe limits.



Drill Pipe	Tested Minimum Bend Radius	Radius (A)*	Length Needed (B)*
JT21 Power Pipe® HD	32.6 m (107 ft)	32.6 m (107 ft)	51.2 m (168 ft)
Ditch Witch Forged HD	33.2 m (109 ft)	33.2 m (109 ft)	52.1 m (171 ft)
JT21 Forged HDX	37.5 m (123 ft)	37.5 m (123 ft)	59.1 m (194 ft)
*Measurements are based on a 90° bend in the bore path.			

Pipe-By-Pipe Bend Limits



JT21 Power Pipe® HD				
Pipe (C)	**Forward (B)**		**Deflection (A)**	
1	3 m	10 ft 0 inches	0.1 m	0 ft 5.6 inches
2	6.1 m	19 ft 11 inches	0.6 m	1 ft 10 inches
3	9 m	29 ft 7 inches	1.3 m	4 ft 2 inches
4	11.9 m	39 ft 1 inch	2.2 m	7 ft 5 inches
5	14.7 m	48 ft 2 inches	3.5 m	11 ft 6 inches
6	16 m	56 ft 11 inches	5 m	16 ft 5 inches
7	19.8 m	65 ft 1 inch	6.7 m	22 ft 1 inch
8	22.2 m	72 ft 9 inches	8.7 m	28 ft 7 inches
9	24.3 m	79 ft 9 inches	10.9 m	35 ft 8 inches
10	26.2 m	86 ft 1 inch	13.2 m	43 ft 5 inches
11	27.9 m	91 ft 8 inches	15.8 m	51 ft 9 inches
12	29.4 m	96 ft 5 inches	18.4 m	60 ft 6 inches
13	30.6 m	100 ft 4 inches	21.3 m	69 ft 9 inches
14	31.5 m	103 ft 4 inches	24.2 m	79 ft 3 inches
15	32.1 m	105 ft 6 inches	27.1 m	89 ft
16	32.5 m	106 ft 8 inches	30.2 m	98 ft 11 inches
17	32.6 m	107 ft	32.6 m	107 ft

Planning the Bore Path (continued)

Ditch Witch Forged HD				
Pipe (C)	**Forward (B)**		**Deflection (A)**	
1	3 m	10 ft	0.1 m	0 ft 5.6 inches
2	6.1 m	19 ft 11 inches	0.6 m	1 ft 10 inches
3	9 m	29 ft 8 inches	1.2 m	4 ft 1 inch
4	11.9 m	39 ft 1 inches	3.4 m	7 ft 3 inches
5	14.7 m	48 ft 2 inches	3.4 m	11 ft 3 inches
6	17.4 m	57 ft	4.9 m	16 ft 1 inch
7	19.9 m	65 ft 3 inch	6.6 m	21 ft 9 inches
8	22.3 m	73 ft	8.6 m	28 ft 1 inch
9	24.4 m	80 ft 1 inch	10.7 m	35 ft 1 inch
10	26.4 m	86 ft 7 inches	13 m	42 ft 9 inches
11	28.1 m	92 ft 3 inches	15.5 m	50 ft 11 inches
12	29.6 m	97 ft 2 inches	18.2 m	59 ft 8 inches
13	30.9 m	101 ft 4 inches	20.9 m	68 ft 9 inches
14	31.9 m	104 ft 7 inches	23.8 m	78 ft 3 inches
15	32.6 m	106 ft 11 inches	26.8 m	87 ft 11 inches
16	33 m	108 ft 5 inches	29.8 m	97 ft 10 inches
17	33.2 m	109 ft	32.6 m	107 ft 9 inches
18	33.2 m	109 ft	33.2 m	109 ft

JT21 Forged HDX				
Pipe (C)	**Forward (B)**		**Deflection (A)**	
1	2.1 m	10 ft	0.1 m	0 ft 5 inches
2	6.1 m	19 ft 11 inches	0.5 m	1 ft 7 inches
3	9.1 m	29 ft 9 inches	1.1 m	3 ft 8 inches
4	12 m	39 ft 4 inches	2.0 m	6 ft 5 inches
5	14.8 m	48 ft 8 inches	3.1 m	10ft
6	17.6 m	57 ft 8 inches	4.4 m	14 ft 4 inches
7	20.2 m	66 ft 4 inches	5.9 m	19 ft 4 inches
8	22.7 m	74 ft 6 inches	7.6 m	25 ft
9	25.1 m	82 ft 3 inches	11.7 m	31 ft 5 inches
10	27.3 m	89 ft 5 inches	14 m	38 ft 4 inches
11	29.3 m	96 ft	16.4 m	45 ft 10 inches
12	31.1 m	102 ft	19 m	53 ft 11 inches

JT21 Forged HDX				
Pipe (C)	**Forward (B)**		**Deflection (A)**	
13	32.7 m	107 ft 3 inches	21.7 m	62 ft 5 inches
14	34.1 m	111 ft 10 inches	24.5 m	71 ft 3 inches
15	35.3 m	115 ft 8 inches	27.4 m	80 ft 6 inches
16	36.2 m	118 ft 10 inches	27.4 m	90 ft
17	36.9 m	121 ft 1 inches	30.4 m	99 ft 9binches
18	37.4 m	122 ft 8 inches	33.4 m	109 ft 7 inches
19	37.6 m	123 ft 4 inches	36.4 m	119 ft 7 inches
20	37.5 m	123 ft	37.5 m	123 ft

Entry Pitch

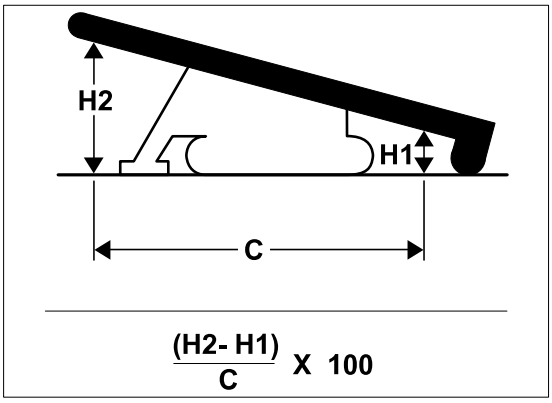
Entry pitch is the slope of the drill frame compared with the slope of the ground. Determine the entry pitch using a pitch beacon or measurements.

Using a Pitch Beacon

1. Lay the pitch beacon on the ground and read the pitch. Record this number.
2. Lay the pitch beacon on the drill frame and read the pitch. Record this number.
3. Subtract the ground pitch from the machine pitch.

Using Measurements

1. Measure from the ground to the front end of the drill frame (H1).
2. Measure from the ground to the back end of the drill frame (H2).
3. Subtract (H2–H1). Record this number.
4. Measure the distance between the front and back points (C).
5. Divide the distance (H2–H1) by C, then multiply the result by 100 as shown. This is the pitch.



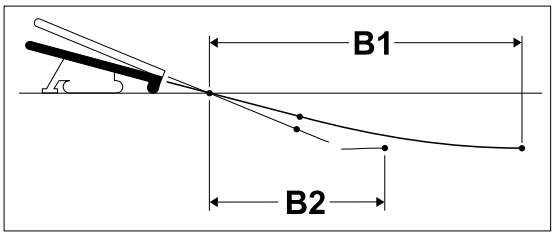
G460210

Minimum Setback

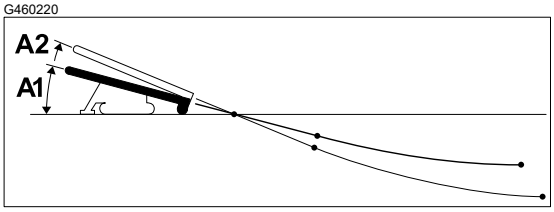
Minimum setback is the distance from the entry point to where the pipe becomes horizontal (B1).

Note: If the setback is too small (B2), the bend limits of the pipe will be exceeded and the pipe will be damaged.

A shallow entry pitch (A1) allows the pipe to become horizontal sooner and with less bending. Increasing the entry pitch (A2) creates a longer and deeper minimum setback.



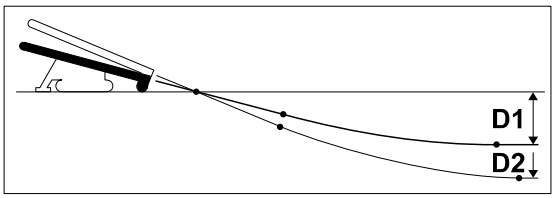
G460220



G460216

Minimum Depth

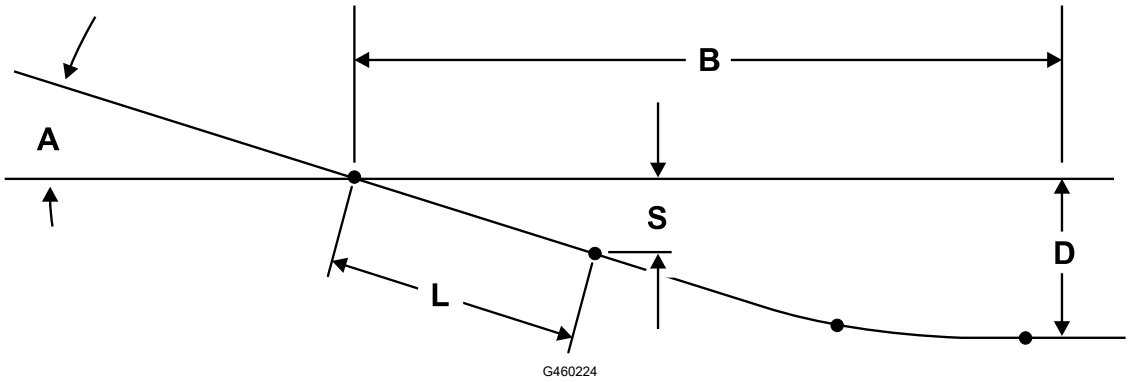
Minimum depth is how deep the pipe will be when it becomes horizontal. Because the pipe must bend gradually, the entry pitch and bend limits determine this measurement.



G460223

- To reduce the minimum depth (D1), reduce the entry pitch. This also decreases setback.
- To increase the minimum depth (D2), increase the entry pitch. This also increases setback.

Bore Path Calculator



JT21 Power Pipe® HD*			
Minimum Depth (D)	**Entry Pitch/Angle (A)**	**Setback (B)**	**Depth to Begin Steering (S)**
0.51 m (1 ft 8 inches)	19%/11°	8.8 m (29 ft)	1.1 m (3 ft 8 inches)
0.56 m (1 ft 10 inches)	21%/11.7°	9.2 m (30 ft 2 inches)	1.2 m (4 ft)
0.58 m (1 ft 11 inches)	22%/12.3°	9.6 m (31 ft 4 inches)	1.3 m (4 ft 4 inches)
0.61 m (2 ft)	23%/13°	9.9 m (32 ft 7 inches)	1.5 m (4 ft 9 inches)
0.64 m (2 ft 1 inch)	24%/13.7°	10.3 m (33 ft 9 inches)	1.6 m (5 ft 1 inch)
0.66 m (2 ft 2 inches)	26%/14.3°	10.6 m (34 ft 11 inches)	1.7 m (5 ft 6 inches)
0.69 m (2 ft 3 inches)	27%/15°	11 m (36 ft 1 inch)	1.8 m (5 ft 11 inches)
*Numbers in table based on 32.6 m (107 ft) minimum bend radius and beacon housing, EZ-Connect connector, transition sub and one-third of first drill pipe (L, totaling 2.6 m (8 ft 8 inches) in the ground before steering.			

Ditch Witch Forged HD			
Minimum Depth (D)	**Entry Pitch (A)**	**Setback (B)**	**Depth to Begin Steering (S)**
0.51 m (1 ft 8 inches)	19%/11°	8.9 m (29 ft 4 inches)	1.1 m (3 ft 8 inches)
0.56 m (1 ft 10 inches)	21%/11.7°	9.3 m (30 ft 7 inches)	1.2 m (4 ft 1 inch)
0.58 m (1 ft 11 inches)	22%/12.3°	9.7 m (31 ft 9 inches)	1.3 m (4 ft 5 inches)
0.61 m (2 ft)	23%/13°	10.1 m (33 ft)	1.5 m (4 ft 9 inches)

Planning the Bore Path (continued)

Ditch Witch Forged HD			
Minimum Depth (D)	**Entry Pitch (A)**	**Setback (B)**	**Depth to Begin Steering (S)**
0.64 m (2 ft 1 inches)	24%/13.7°	10.4 m (34 ft 3 inches)	1.6 m (5 ft 2 inches)
0.66 m (2 ft 2 inches)	26%/14.3°	10.8 m (35 ft 5 inches)	1.7 m (5 ft 7 inches)
0.69 m (2 ft 3 inches)	27%/15°	11.2 m (36 ft 7 inches)	1.8 m (6 ft)
*Numbers in table based on 33.2 m (109 ft) minimum bend radius and beacon housing, EZ-Connect connector, transition sub and one-third of first drill pipe (L, totaling 2.6 m (8 ft 8 inches) in the ground before steering.			

JT21 Forged HDX®			
Minimum Depth (D)	**Entry Pitch (A)**	**Setback (B)**	**Depth to Begin Steering (S)**
0.51 m (1 ft 8 inches)	19%/11°	9.8 m (32 ft)	1.2 m (3 ft 11 inches)
0.56 m (1 ft 10 inches)	21%/11.7°	10.2 m (33 ft 5 inches)	1.3 m (4 ft 4 inches)
0.58 m (1 ft 11 inches)	22%/12.3°	10.6 m (34 ft 9 inches)	1.5 m (4 ft 9 inches)
0.61 m (2 ft)	23%/13°	11 m (36 ft 2 inch)	1.6 m (5 ft 2 inches)
0.64 m (2 ft 1 inch)	24%/13.7°	11.4 m (37 ft 6 inches)	1.7 m (5 ft 7 inches)
0.66 m (2 ft 2 inches)	26%/14.3°	11.9 m (38 ft 11 inches)	1.8 m (6 ft)
0.69 m (2 ft 3 inches)	27%/15°	12.3 m (40 ft 3 inches)	2 m (6 ft 6 inches)
*Numbers in table based on 37.5 m (123 ft) minimum bend radius and beacon housing, EZ-Connect connector, transition sub and one-third of first drill pipe (L, totaling 2.9 m (9 ft 6 inches) in the ground before steering.			

Examining Pullback Material

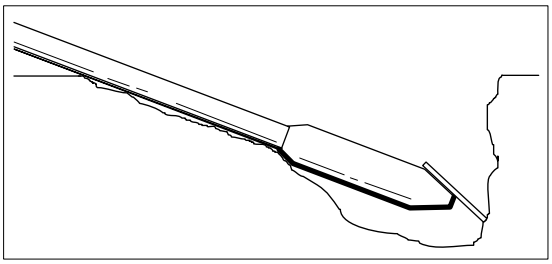
Ask for a sample of the material you will be pulling back. Check its weight and stiffness. Contact the manufacturer for bend radius information. Check that you have appropriate pullback devices.

Preparing Entry Point

For the bore to be successful, the first pipe must be straight as it enters the ground. See the Aligning the Joints section.

Preparing Entry Point (continued)

1. To help ensure that the first pipe does not bend, dig a small starting hole so that the first pipe is drilled into a vertical surface. Steer down as required at the start. The Drill head will tend to move in the easiest direction (toward the surface) when it is rotated near the surface.



G460237

2. To prevent bending or straining of the pipe, position the machine for a straight entry.

Operator Preparation

WARNING

Exposure to jobsite hazards could cause death or serious injury.

- **Read and understand the operator's manual and all safety instructions before use.**
- **Wear personal protective equipment including hard hat, safety eye wear, foot protection, hearing protection, and gloves (except when near rotating equipment).**
- **Remove jewelry.**
- **Wear close-fitting, high visibility clothing.**
- **Have other personal protective equipment, such as insulated boots and gloves, breathing protection, face shield, etc. available for use depending on jobsite hazards or requirements.**

Follow these guidelines before operating any jobsite equipment:

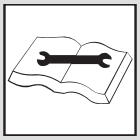
- Complete proper training and read the *Operator's Manual* before using equipment.
- Wear personal protective equipment.
- Plan for emergency services. Have the telephone numbers for local emergency and medical facilities on hand. Check that you will have access to a telephone.
- Review jobsite hazards, safety and emergency procedures, and individual responsibilities with all personnel before work begins. Safety Data Sheets (SDS) are available at www.DitchWitch.com.
- Use equipment carefully. Stop operation and investigate anything that does not look or feel right.

Any time a jobsite is classified as electric, the drill operator and tracker operator must wear protective boots, and the drill operator must have protective gloves within reach, all meeting the following requirements:

- Boots must have high tops and must be rated for the voltage on the jobsite. Tuck the legs of pants completely inside the boots.
- Gloves must be rated for the voltage on the jobsite.

Equipment Preparation

WARNING



Use of improperly functioning controls can cause death or serious injury the operator or bystanders.

If a control does not work as described in the instructions, stop the machine and have it serviced.

Preparation checklists are available at www.DitchWitch.com. Check condition and function of all controls.

Performing Daily Maintenance

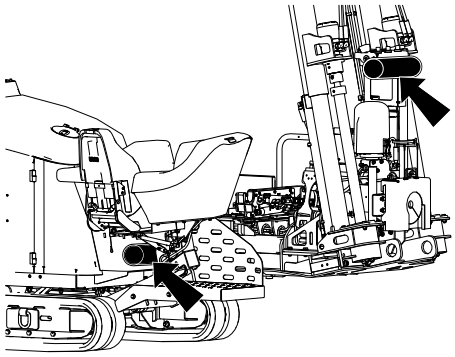
Before starting the machine each day, perform the Each Use/Daily procedures listed in the Maintenance Schedule.

Installing Counterweights

Install counterweights as needed for attachments.

Mounting the Fire Extinguisher

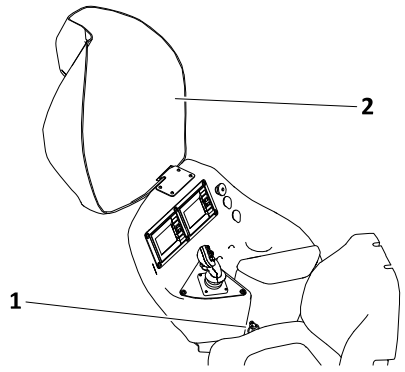
If required, mount a fire extinguisher near the power unit but away from possible points of ignition. The fire extinguisher should always be classified for both oil and electric fires. It should meet legal and regulatory requirements.



G519700

Using Console Cover

Remove pin (1) and pivot the console cover (2) to the back side of the console as shown.



G513609

Chapter 4

Product Overview

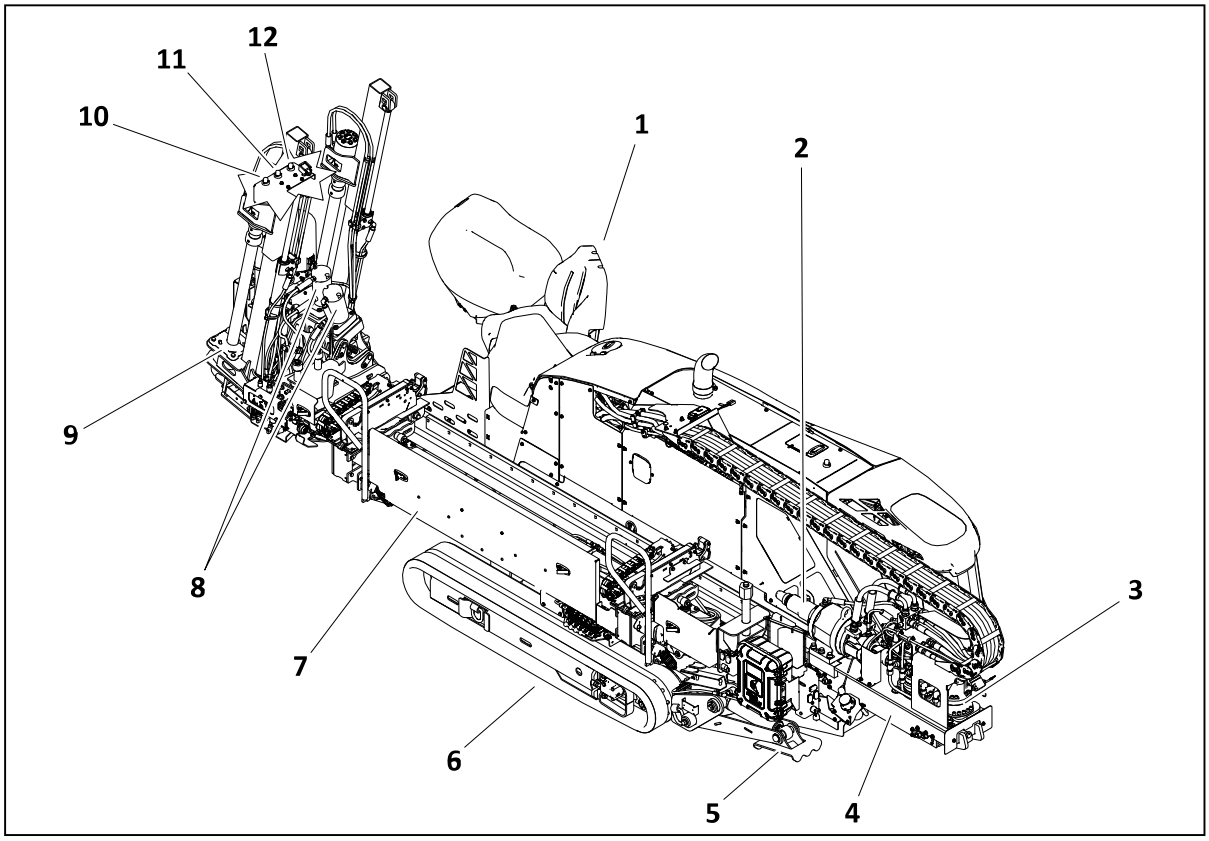
Table of Contents

Attachments/Accessories

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

To ensure optimum performance and continued safety certification of the machine, use only genuine Ditch Witch replacement parts and accessories.

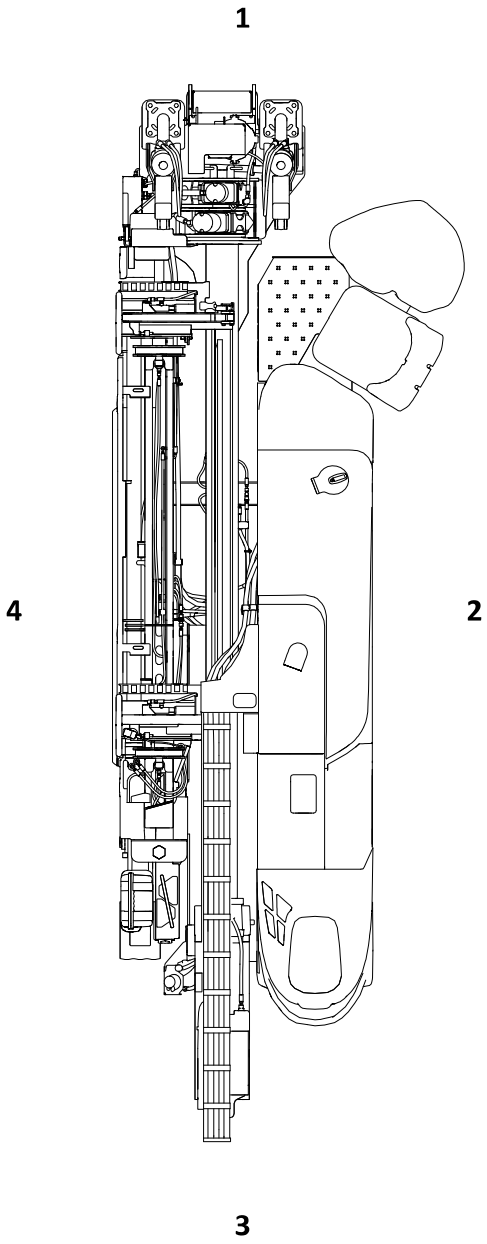
Machine Components



G513600

1. Operator station
2. Spindle
3. Carriage
4. Drill frame
5. Stabilizer
6. Tracks
7. Pipe loader
8. Wrenches
9. Anchoring System
10. Wireless remote indicator (clear)
11. DrillLok® indicator (green)
12. ESID strobe indicator (amber)

Operator Orientation



1. Front
2. Right side
3. Rear
4. Left side

Specifications

JT21 Dimensions

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

Width*	1.41 m (55.5 inches)
Length*	5.53 cm (217.9 inches)
Height*	2.43 m (95.5 inches)
Operating mass*	5634 kg (12 420 lb)
Entry angle*	11–15°
Angle of approach	17°
Angle of departure	17°
*Per SAE J2022	

JT21 Power Pipe

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

Length of drill pipe, nominal*	3.05 m (120 inches)
Diameter of drill pipe tool joint end*	66.8 mm (2.63 inches)
Diameter of drill pipe*	52.3 mm (2.06 inches)
Minimum bend radius (HD)*	32 m (107 ft)
Weight of drill pipe (lined)*	30.4 kg (67 lb)
*Per SAE J2022	

JT21 Operation

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

Maximum spindle speed*	270 rpm
Maximum spindle torque*	3050 N•m (2250 ft•lb)
Carriage thrust travel speed*	65.5 m/min (215 fpm)
Carriage pullback travel speed*	65.5 m/min (215 fpm)
Thrust force*	89 kN (20 000 lb)
Pullback force*	93.4 kN (21 000 lb)
Bore diameter	102 mm (4 inches)
Backream diameter	soil dependent

JT21 Operation (continued)

Ground travel speed (forward)*	4.7 km/h (2.9 mph)
Ground drive travel speed (reverse)*	4.7 km/h (2.9 mph)
*Per SAE J2022	

Vibration Levels
The average vibration transmitted to the operator's hand during normal operation does not exceed 2.5 m/sec^2. The average vibration transmitted to the whole body during normal operation does not exceed 0.2 m/sec^2.

Noise Levels	
Operator sound pressure per EN16228–3, Annex B	83 dBA ±2 dBA
Exterior sound power per EN16228–3, Annex B	101 dBA
Always wear appropriate hearing protection when operating the machine.	

JT21 Power

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

Engine	Deutz TD2.9
Fuel	Diesel
Cooling medium	Liquid
Injection	Direct
Aspiration	Turbocharged
Number of cylinders	4
Displacement	2.9 L (177 cubic inches)
Bore	92 mm (3.62 inches)
Stroke	110 mm (4.33 inches)
Manufacturer's gross power rating**	55 kW (74 hp)
Rated speed	2600 rpm
Emissions compliance (highly regulated)	EPA Tier 4, EU Stage V
Emissions compliance (less regulated)	EPA Tier 4i, EU Stage IIIA
**Per SAE J1995	

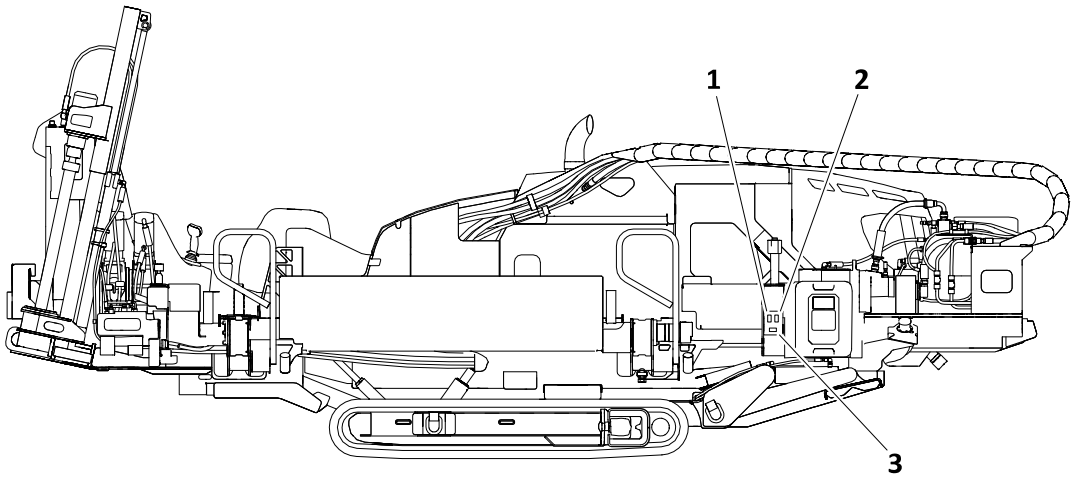
JT21 Drilling Fluid System

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

Maximum drilling fluid pressure*	69 bar (1000 psi)
Maximum drilling fluid flow*	132 L/min (35 gpm)
*Per SAE J2022	

Controls

Auxiliary Pipe Loading Controls



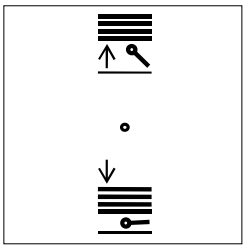
G513566

1. Auxiliary pipe lifter switch
2. Auxiliary pipe shuttle switch
3. Auxiliary pipe load restricted operating mode switch

Auxiliary Pipe Lifter Switch

To raise, press the top.

To lower, press the bottom.

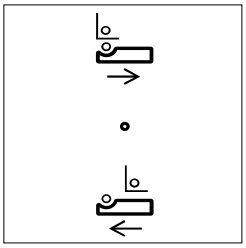


G462279

Auxiliary Pipe Shuttle Switch

To move toward the spindle (retract), press the top.

To move away from the spindle (extend), press the bottom.

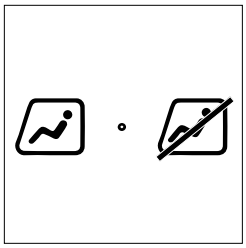


G462281

Auxiliary Pipe Loading Controls (continued)

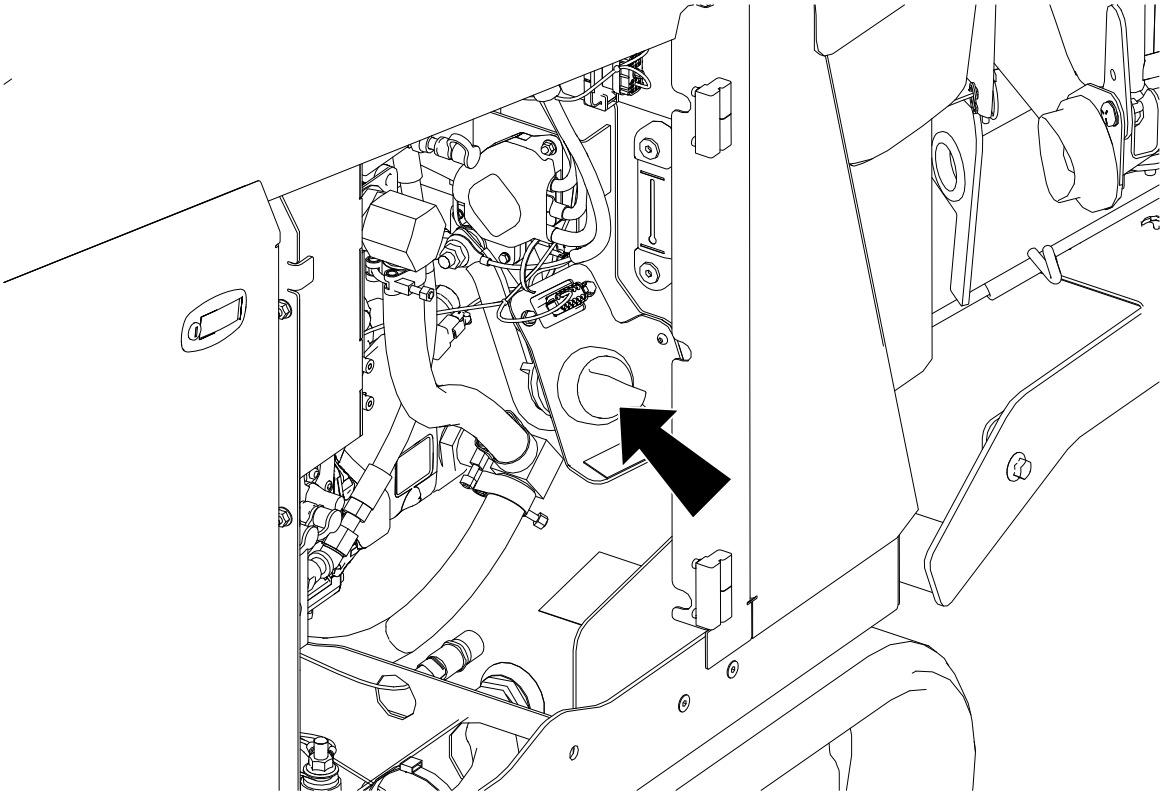
Restricted Operating Mode

To override drill operator control of the shuttles and lifters, press right.



G462280

Battery Disconnect Switch

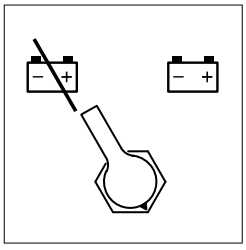


G513567

Battery Disconnect

To connect, move right.

To disconnect, move left.



G443679

Battery Disconnect Switch (continued)

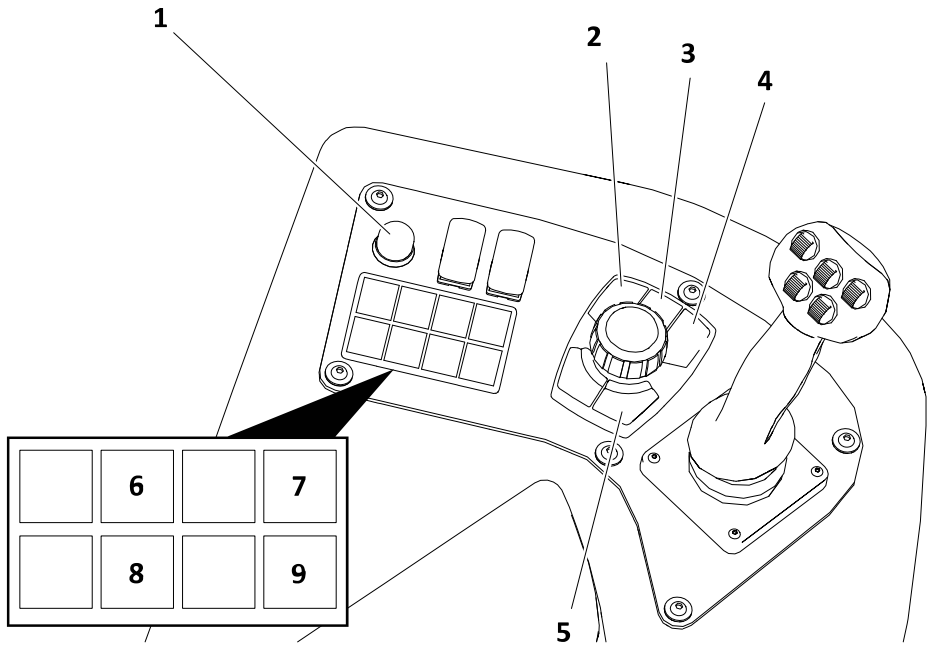
Battery Disconnect (continued)

IMPORTANT

- **Do not disconnect with engine running.**
- **To avoid equipment damage, wait 2 minutes after turning engine off before disconnecting battery.**

Console, Left

Drilling/Operation



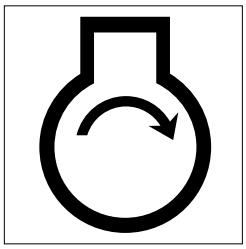
G522480

1. Remote engine start
2. Not used
3. Pipe count/Thrust limit/Torque limit selector
4. Not used
5. Fluid flow selector
6. Two-speed rotation control
7. Autothrottle control
8. Autocarve control
9. Throttle down control

Console, Left (continued)

Remote Engine Start Control

To start the engine from the operator station, press.

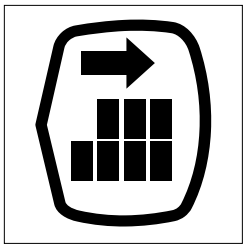

G462314

Note:

- This control works only when the key in the set-up console is on, the operator is in the seat, and the battery disconnect switch is off.
- See the Drive section.

Pipe Count /Thrust Limit/Torque Limit Selector

To move through functions, press.


G516372

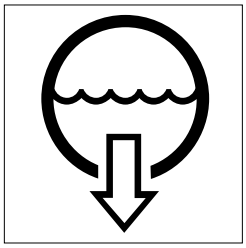
Note:

- The display will indicate which control is enabled.
- Use the rotary operation control to adjust the pipe count, thrust limit, or torque limit. See the Rotary Operation Control.

Fluid Flow Selector

To enable fluid flow, press.

To disable, press again.


G462303

Note:

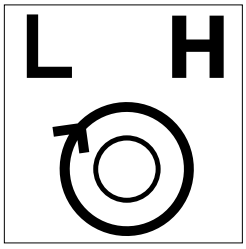
- Drilling fluid pump must be enabled. See the Drilling fluid pump switch section.
- Use the rotary operation control to adjust fluid flow. See the Rotary Operation Control section.

Two-Speed Rotation Control

To rotate in high speed, press.

To rotate in low speed, press again.

Note: When using autocarve, the multi-use button controls the rotation speed.



G462325

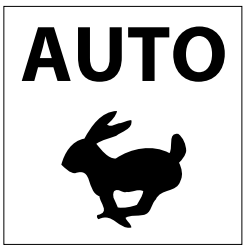
Console, Left (continued)

Autothrottle Control

To turn on, press.

To turn off, press again.

Note: Autothrottle mode slows the engine to low throttle after 15 seconds of inactivity. To return to high speed, activate thrust, rotation, drilling fluid, or an add/remove pipe cycle.



G462294

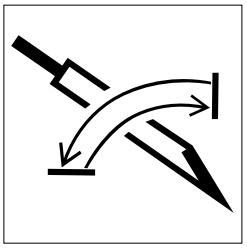
Autocarve Control

To enable autocarve, press.

To disable, press again.

Note:

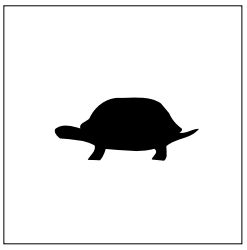
- Carve window selector must be on. See the Carve Window Selector section.
- Use the rotary operation control to adjust the carve window. See the Rotary Operation Control section.
- Autocarve is disabled while the front wrench is clamped.
- Two-speed carriage control and cruise control are disabled while in autocarve mode.


G462291

Throttle Down Control

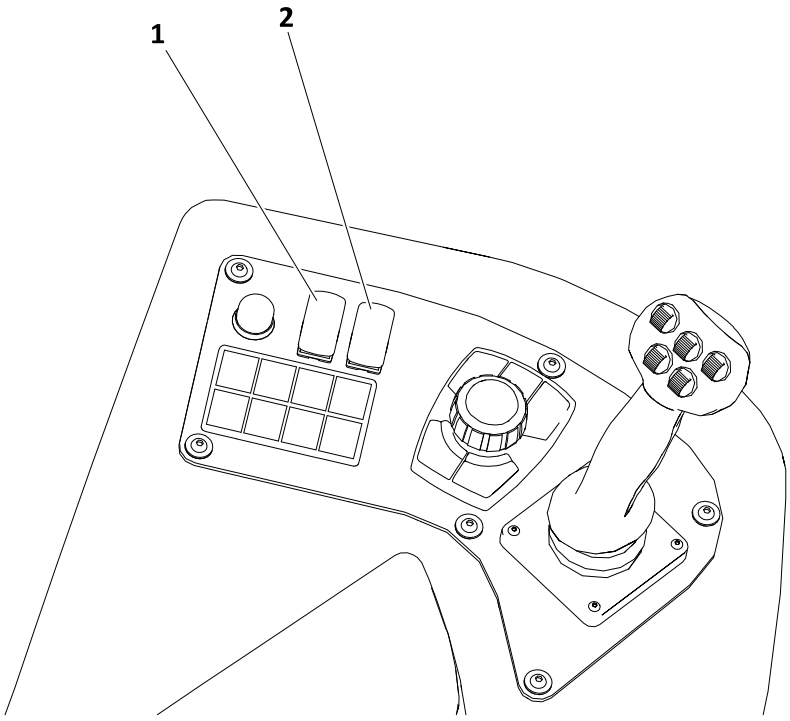
To decrease engine speed, press.

Note: Engine speed will be decreased incrementally each time the control is pressed.


G462324

Console, Left (continued)

Miscellaneous



G522481

(1) ESID test switch

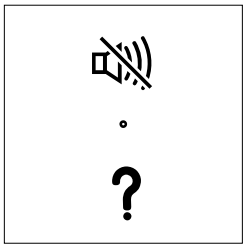
(2) Work light switch

ESID Test Switch

To turn off the strike alarm at the drill, press the top.

To start a manual test, press the bottom.

To reset the system after a strike has been detected, press the bottom.



G462301

Note:

- A test checks all systems and circuits except the voltage limiter. See the Performing Voltage Check section.
- See the If an Electric Line is Damaged section.

Console, Left (continued)

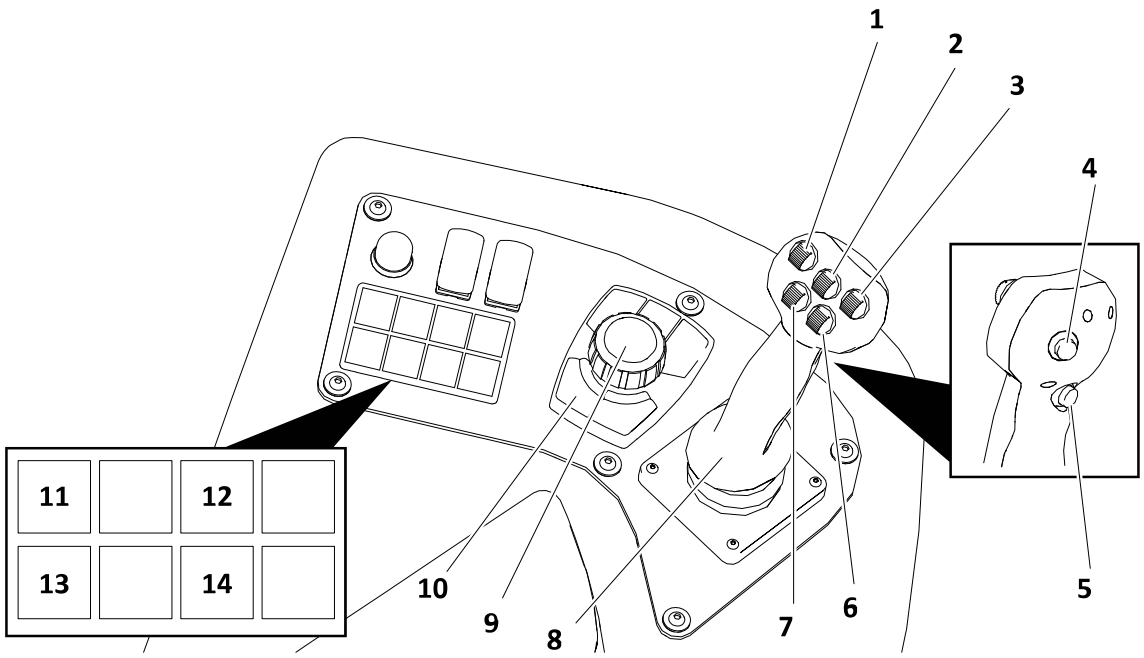
Work Light Switch

To turn on, press the top.

To turn off, press the bottom.

G444215

Pipe Loading



G522482

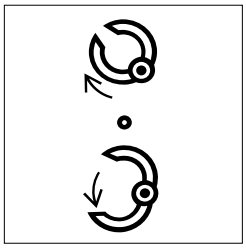
1. Pipe gripper switch
2. Pipe shuttle control
3. Pipe lift switch
4. Display left joystick/Map switch
5. Pipe lubricator switch
6. Set/Resume switch
7. Not used
8. Left joystick/Wrench control
9. Rotary control
10. Carve window selector switch
11. Select next row control
12. Add pipe control
13. Select previous row control
14. Remove pipe control

Console, Left (continued)

Pipe Gripper Switch

To close, press top.

To open, press bottom.

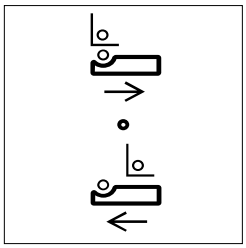


G462345

Pipe Shuttle Control

To move toward the pipe box (retract), press top.

To move toward spindle (extend), press bottom.

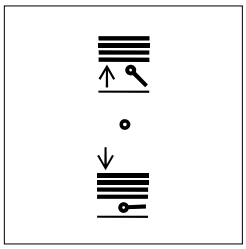


G462312

Pipe Lift Switch

To raise, press top.

To lower, press bottom.



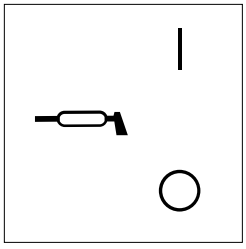
G462310

Display Left Joystick/Map Switch

To display left joystick map, press.

Pipe Lubricator Switch

To apply tool joint compound, press.



G462311

Console, Left (continued)

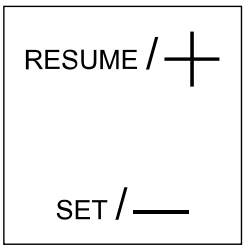
Set/Resume Switch

To resume operation or increase operation levels, press top.

To set operating conditions or reduce operation levels, press bottom.

Note:

- See the Cruise Control section.
- See the Using Autocarve Mode section.
- See the Pipe Loader section.



G462323

Left Joystick/Wrench Control

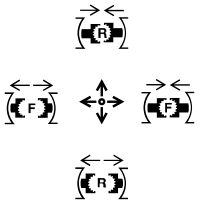
To clamp the rear wrench, push forward.

To unclamp the rear wrench, pull back.

To clamp the front wrench, move right.

To unclamp the front wrench, move left.

Note: Joystick function can be set in the display. See the *Display Operator's Manual* for more information.


G527262

Rotary Control

Turn the knob to control the following functions:

- fluid flow
- pipe counter adjustment
- carve window
- thrust limit
- torque limit.

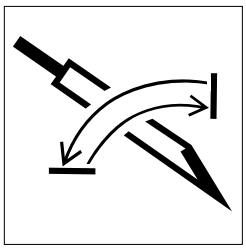
To increase, move right.

To decrease, move left.

Note: Press and turn the knob to allow finer control of functions.

Console, Left (continued)

Carve Window Selector Button


G462296

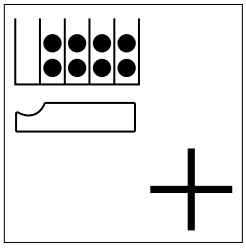
To enable carve window, press.

To disable, press again.

Note:

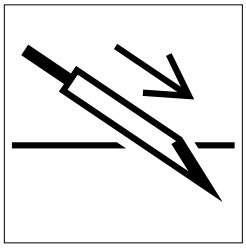
- Autocarve control must be on. See the Autocarve Control section.
- Use the rotary operation control to adjust the carve window. See the Rotary Operation Control section.

Select Next Row Control


G462321

To move the shuttle to the previous row in the pipe box, press.

Add Pipe Control

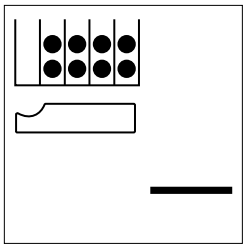

G462288

To enable automated add pipe function, press.

To enable manual pipe loader controls, press again.

Note: See the Using Automated Pipe Loader section.

Select Previous Row Control


G462322

To move the shuttle to the previous row in the pipe box, press.

Note: See the Row Select section.

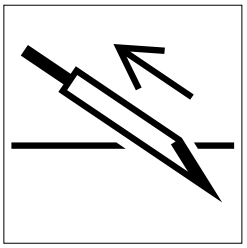
Console, Left (continued)

Remove Pipe Control

To enable automated remove pipe function, press.

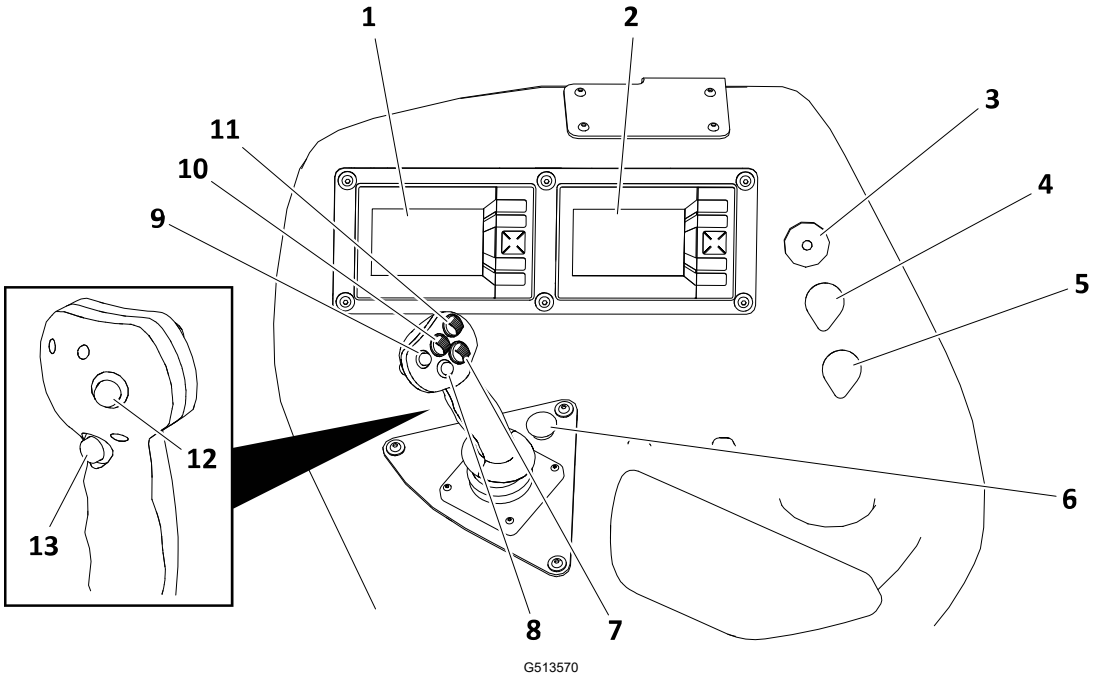
To enable manual pipe loader controls, press again.

Note: See the Using Automated Pipe Loader section.



G462316

Console, Right



G513570

1. Left display*
2. Right display*
3. Emergency stop button
4. Power port
5. Power port
6. Remote engine stop switch
7. Not used
8. Drilling fluid quick-fill switch
9. Drilling fluid pump switch
10. Not used
11. Not used
12. Display right joystick map switch
13. Two-speed carriage control

*See display manual for more information.

Console, Right (continued)

Emergency Stop Button

To stop machine, press.

To re-enable the emergency stop, pull.

Note:

- If this control is used to stop the machine, inspect the machine to determine the reason for activation before re-enabling.

G516396

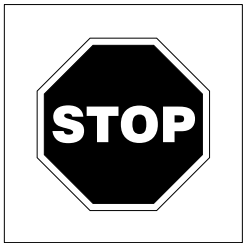
- If this control is used to stop the machine, ensure the ignition switch is in the off position before re-enabling.

Remote Engine Stop Switch

To stop the engine, press.

Note:

- If this switch is used to stop the machine, ensure the ignition switch is in the off position.
- If the wrenches are clamped when the remote engine stop is pressed, wrenches could gradually unclamp.



G516396

Drilling Fluid Quick-Fill Switch

To fill pipe with fluid, press and hold.

To return fluid flow to flow control setting, release.

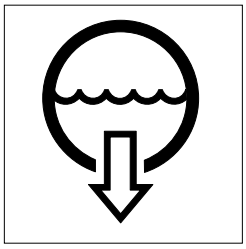
Note: Control overrides the fluid control setting for full pump flow. It Also overrides temporary fluid shutdown when the front wrench is clamped.

G462300

Drilling Fluid Pump Switch

To turn on, press.

To turn off, press again.


G462299

Console, Right (continued)

Drilling Fluid Pump Switch (continued)

Note:

- Use the rotary operation control to control the drilling fluid flow. See the Rotary Operation Control section.
- The drilling fluid pump switch and the fluid flow selector must be on before using the rotary operation control to control the drilling fluid control. See the Fluid Flow Selector section.

Display Right Joystick Map Switch

To display right joystick map, press.

Two-Speed Carriage Control

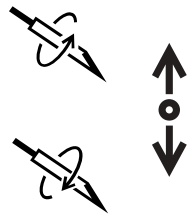
To thrust in high speed, press and hold.

To return to regular speed, release.

Rotation/Thrust Control

To rotate the spindle counterclockwise (breakout), move left.

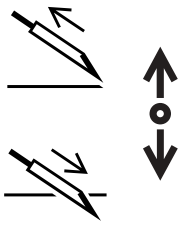
To rotate the spindle clockwise (make up), move right.



G527264

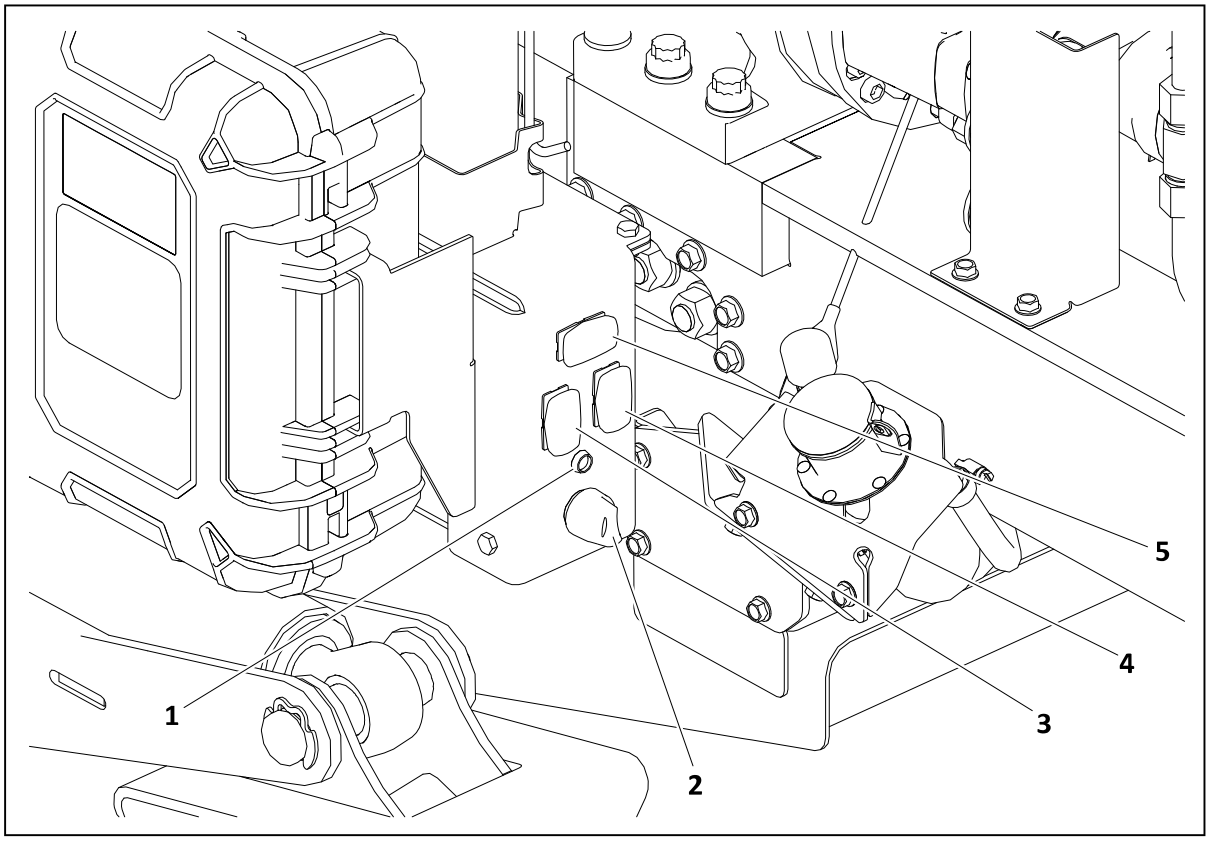
To move the carriage forward (thrust), push.

To move the carriage backward (pull back), pull.



G527266

Console, Setup



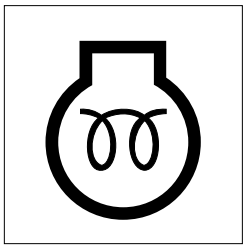
G513571

1. Cold start wait indicator
2. Ignition switch
3. Left track switch
4. Right track switch
5. Engine shutdown override switch

Cold Start Wait Indicator

Lights when the intake air-preheater is operating.

Note: See the Start section.



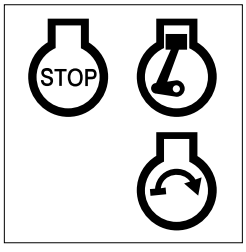
G462297

Ignition Switch

To activate accessories, turn right.

To start the engine, turn right and hold.

To shut off the machine, turn left.



G516398

Console, Setup (continued)

Ignition Switch (continued)

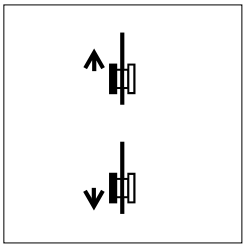
Note:

- Wrenches can unclamp after the machine is shut off. Wrenches will clamp when the engine is started.
- See the Drive section.

Left Track Switch

To move the left track forward, press the top.

To move in reverse, press the bottom.



G516399

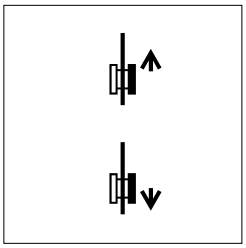
Note:

- Use only if the wireless control is inoperable.
- The ground drive override enable switch must be enabled for this control to function.

Right Track Switch

To move the right track forward, press top.

To move in reverse, press bottom.



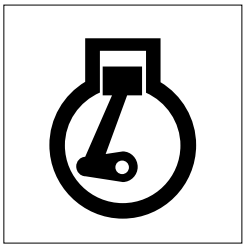
G516400

Note:

- Use only if the wireless control is inoperable.
- The ground drive override enable switch must be enabled for this control to function.

Engine Shutdown Override Switch

If the engine shutdown indicator lights, press to delay engine shutdown for 30 seconds.



G516505

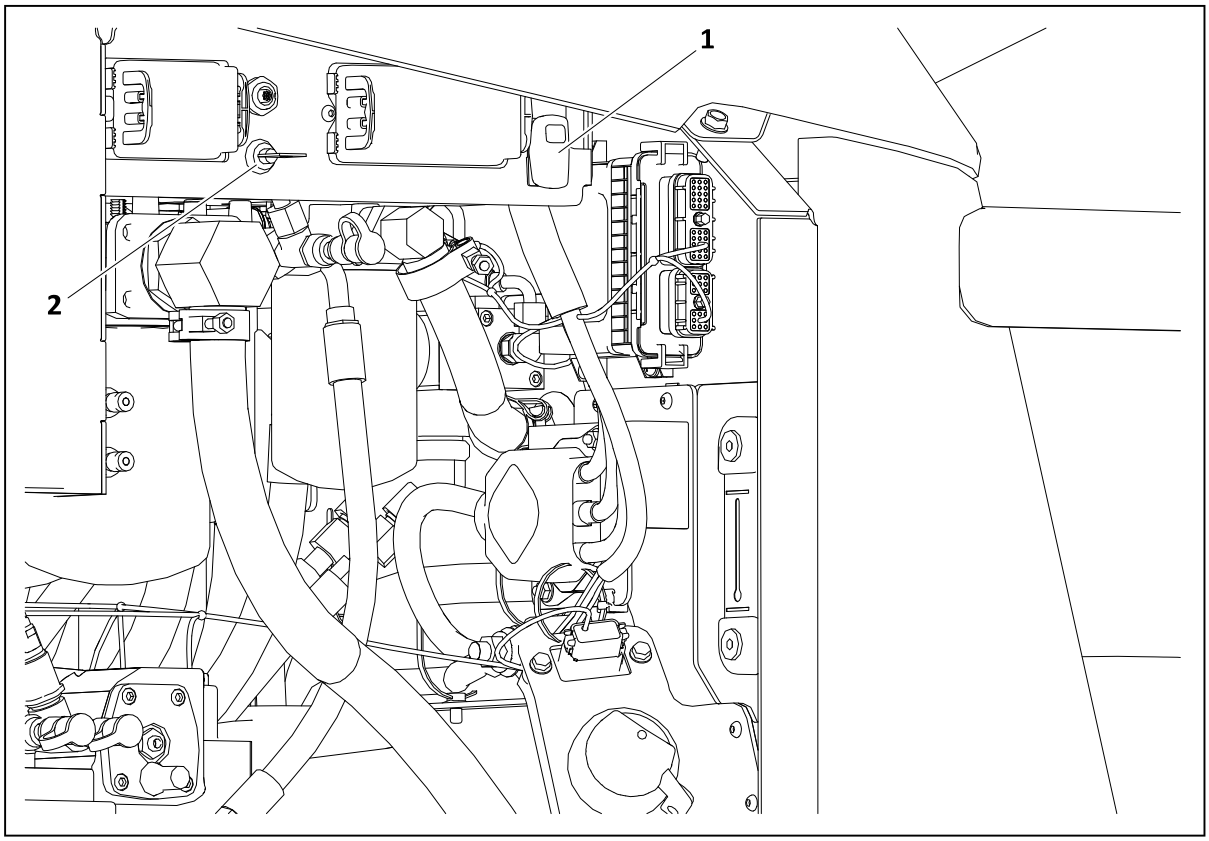
Console, Setup (continued)

Engine Shutdown Override Switch (continued)

IMPORTANT

After 30 seconds, the engine will shut down unless fault condition has been corrected.

Engine Compartment Controls



G513568

1 Ground drive override enable switch

2 DrillLok key

Ground Drive Override Enable Switch

Enables left and right track controls at the setup console. See the Console, Setup section.

Engine Compartment Controls (continued)

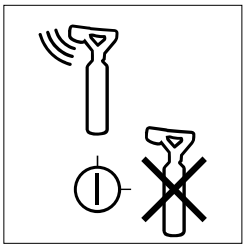
DrillLok Key

To allow the tracker operator to stop thrust and rotation, turn the key left.

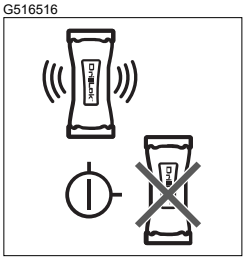
To override DrillLok mode, turn the key right.

Note:

- The top icon is shown when operating with a Subsite Electronics tracker.
- The bottom icon is shown when operating without a Subsite Electronics tracker.
- Remove the key and keep it in the tracker operator's possession.

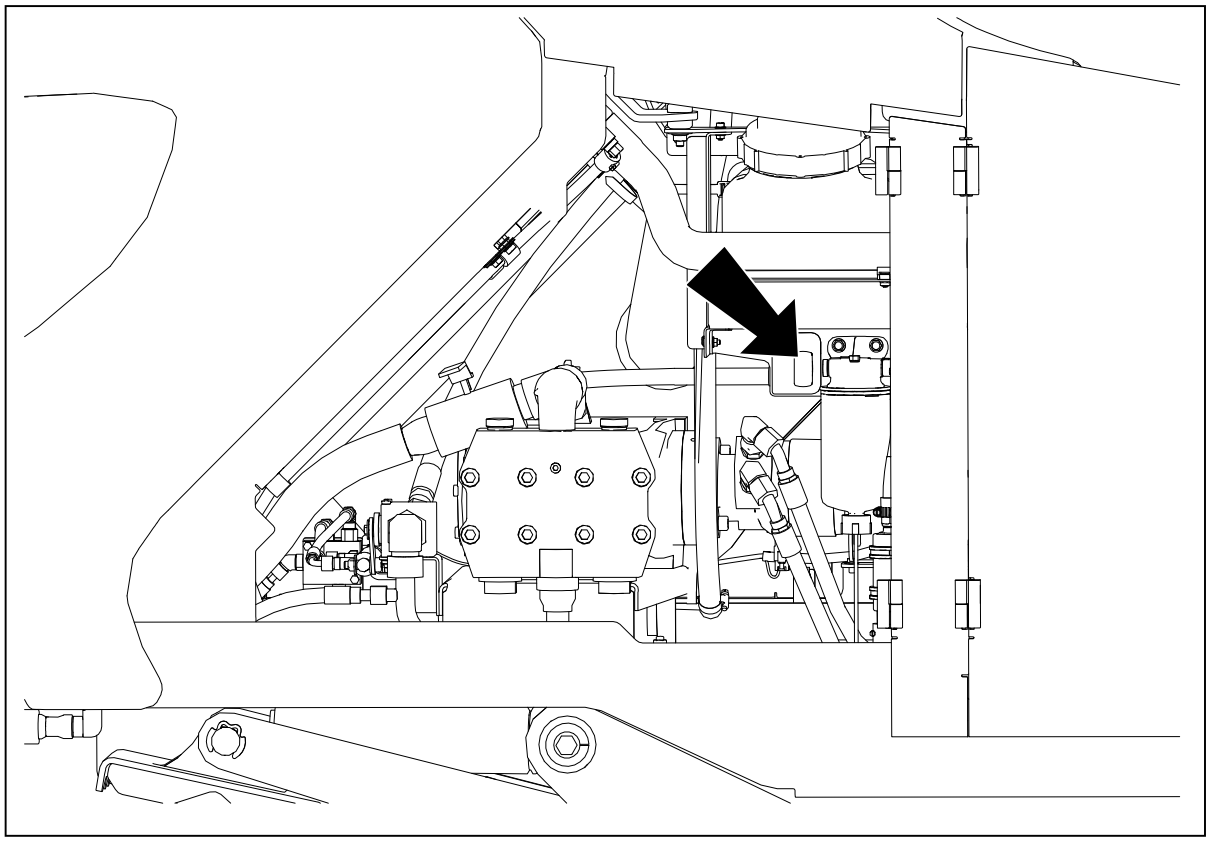


G516516



G516517

Wash Wand Controls



G513572

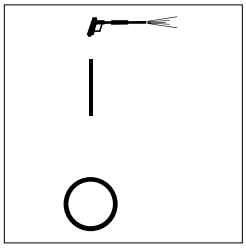
(1) Wash wand switch

Wash Wand Controls (continued)

Wash Wand Switch

To turn on, press top.

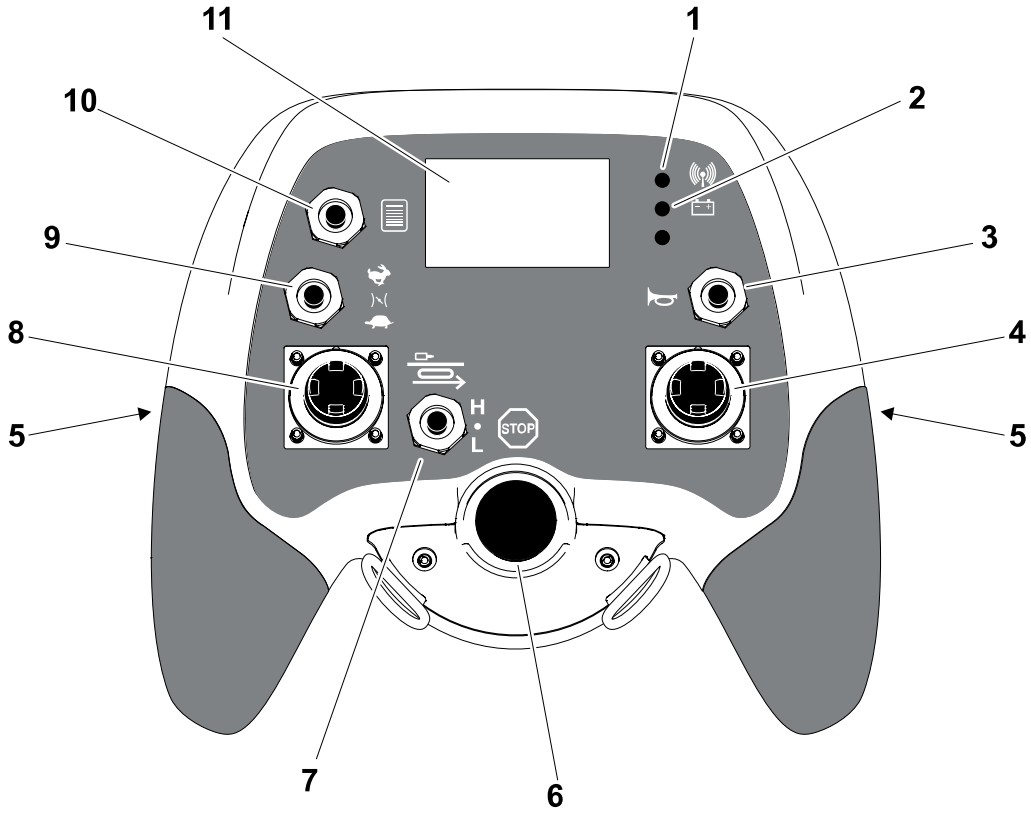
To turn off, press bottom.



G516518

Wireless Remote Control

Note: The operator station must be empty to operate the wireless remote control.



G516519

1. Communication link indicator
2. Power status indicator
3. Power/Enable/Horn switch
4. Right multifunction joystick
5. Operator presence switch
6. Engine stop
7. Drive mode switch
8. Left multifunction joystick
9. Throttle switch
10. Ground drive mode select switch
11. LCD display

Wireless Remote Control (continued)

Communication Link Indicator

Indicates the status of communication link between the wireless remote control and the machine.

Note: An active communication link is required to operate the wireless remote control.

G516578

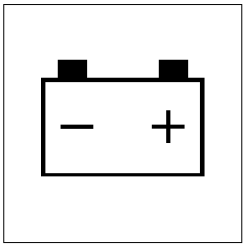
- Flashing yellow indicates no communication link.
- Flashing green indicates a good communication link.
- Steady red indicates an internal problem. Contact your Ditch Witch dealer.

Power Status Indicator

Indicates battery status and cable connection.

Note:

- Off indicates good battery level.
- Flashing red indicates low battery level.
- Solid green indicates transmitter is connected to and powered by the machine.



G516593

Power/Enable/Horn Switch

To turn power on, move and hold until the communication link indicator lights yellow and then flashes green.

Note:

- Wireless remote control indicator will light.
- Ensure the left and right multifunction joysticks are in the neutral position.

G516597

To start operation, move up and hold until the horn sounds.

Note: Control must be moved up after changing modes to enable new function. See the Ground Drive Mode Select Switch section.

To use the horn, move up.

To turn the power off, move down until the indicator turns off.

Note: The wireless remote control turns off and the communication link indicator flashes after one minute of inactivity. Move up twice to restart.

Right Multifunction Joystick

To control the selected system, move.

Note: See the Multifunction Joystick Control Modes section.

Operator Presence Switch

To operate the wireless remote control, press one or both switches.

Note: Must be released and pressed again after changing modes to enable a new function. See the Ground Drive Mode Select Switch section.

G516586

Engine Stop

To stop the engine, press.

Note: To restart the engine, turn the ignition switch off and then back on.

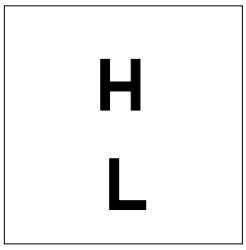
G516396

Drive Mode Switch

To select normal driving mode (high), move up.

To select transport mode (low), move down.

Note: Use transport mode when loading and unloading the machine.



G516579

Left Multifunction Joystick

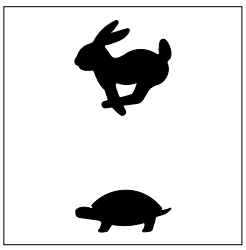
To control the selected system, move.

Note: See the Multifunction Joystick Control Modes section.

Throttle Switch

To increase engine speed, move up.

To decrease, move down.



G516596

Ground Drive Mode Select Switch

To move up through modes, move up.

To move down through modes, move down.

Note: The enable switch must be pressed after changing modes to enable a new function.

LCD Display

Displays the selected mode of operation.

Multifunction Joystick Control Modes

The multifunction joystick controls can be used to control multiple systems by selecting various modes.

Note: To switch between modes, see the Ground Drive Mode Select Switch section.

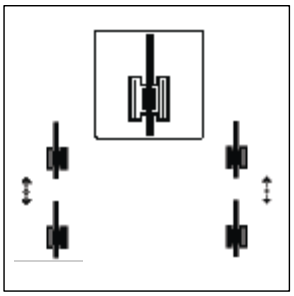
Left Multifunction Joystick Modes

Dual Joystick Ground Drive Control

To move the right track forward, move up.

To move in reverse, move down.

Note: Operator presence switch(es) must be pressed and operator seat must be empty for control to work. See the Steering section.



G516580

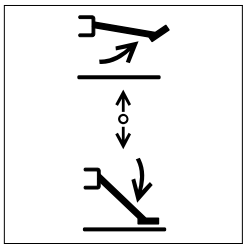
Multifunction Joystick Control Modes (continued)

Left Stabilizer Control

To raise, move up.

To lower, move down.

Note: Lower left and right stabilizers to the ground together, then adjust individually.

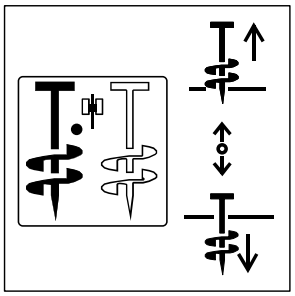


G516584

Dual Joystick Left Anchor Lift Control

To raise, move down.

To lower, move up.

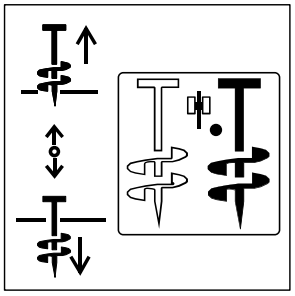


G516576

Dual Joystick Right Anchor Lift Control

To raise, move down.

To lower, move up.



G516594

Right Multifunction Joystick Modes

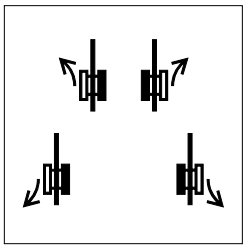
Single Joystick Ground Drive Control

To move tracks forward, move up.

To move in reverse, move down.

To steer, move left or right.

Note: Operator presence switch(es) must be pressed and the operator seat must be empty for the control to work. See the Steering section.



G516582

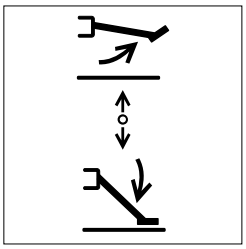
Multifunction Joystick Control Modes (continued)

Right Stabilizer Control

To raise, move up.

To lower, move down.

Note: Lower left and right stabilizers to the ground together, then adjust individually.

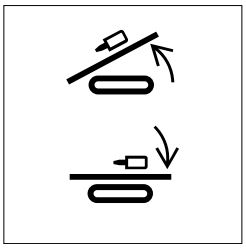


G516584

Frame Tilt Control

To raise, pull.

To lower, push.

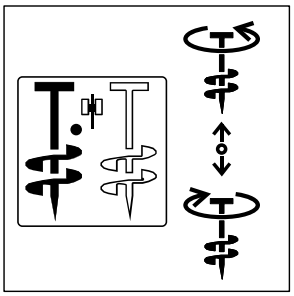


G516581

Dual Joystick Left Anchor Rotation Control

To drive, move up.

To remove, move down.

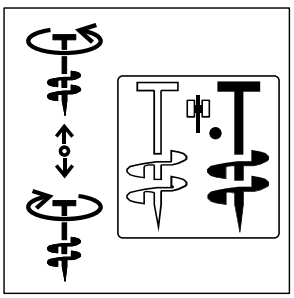


G516583

Dual Joystick Right Anchor Rotation Control

To drive, move up.

To remove, move down.



G516595

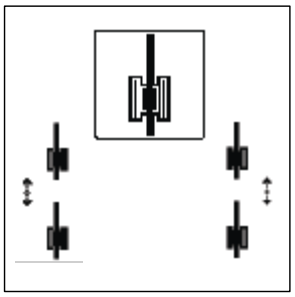
Multifunction Joystick Control Modes (continued)

Dual Joystick Ground Drive Control

To move the right track forward, move up.

To move in reverse, move down.

Note: Operator presence switch(es) must be pressed and operator seat must be empty for control to work. See the Steering section.



G516580

Chapter 5

Operation

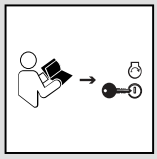
Table of Contents

Starting the Machine

IMPORTANT

EMERGENCY SHUTDOWN: Shut off the machine or press the remote engine stop button (if equipped).

⚠ WARNING ⚠



Misuse of the machine could cause death or serious injury.

- **Allow hydraulic fluid time to warm before operating in cold weather. Cold hydraulic fluid can lengthen ground drive stopping time.**
- **For starting in extreme temperatures, contact your Ditch Witch dealer.**

⚠ WARNING ⚠

A fire or an explosion from a pre-heater could cause death or serious injury.

Never use starter fluid.

Note: If the engine turns but does not start within 30 seconds, the ECU will prevent starting to allow the starter to cool. Wait at least 2 minutes and try again.

1. Ensure all the controls are in neutral and tracks are chocked.
2. Insert the key and activate the accessories using the ignition switch.
3. If starting the machine in normal conditions, start the engine and run at slow throttle under a light load before applying a heavier load.

   Note: If starting the machine in cold weather, do as follows.

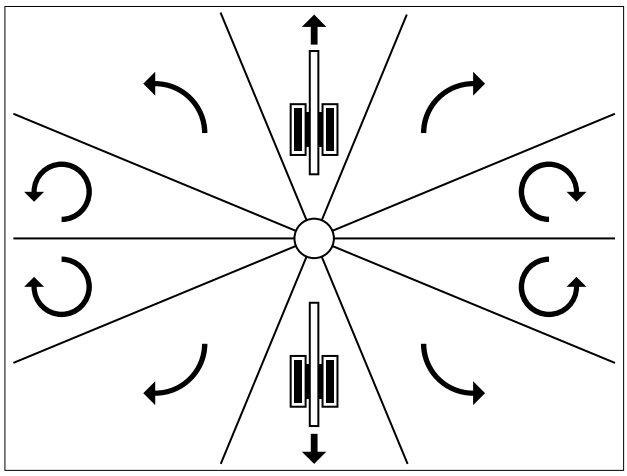
   A. When the cold start indicator turns off, start the engine.

   B. Warm the engine and hydraulic fluid by gradually increasing the engine speed for up to 30 minutes.

   C. After the warmup, carefully operate all the hydraulic controls at slow throttle until the control operate as described in the controls chapter.

Steering

Single Joystick Ground Drive



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Reference	Direction
	Forward
	Forward to the right
	Clockwise counter rotation to the right
	Counterclockwise counter rotation to the right
	Reverse to the right
	Reverse
	Reverse to the left
	Clockwise rotation to the left
	Counterclockwise rotation to the left
	Forward to the left

Dual Joystick Ground Drive

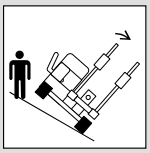
To steer while moving forward, move one joystick slightly more than the other to turn in the desired direction. The machine will gradually turn.

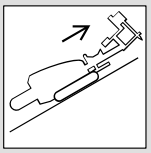
To steer while moving in reverse, move one joystick slightly more than the other to turn in the desired direction. The machine will gradually turn.

For tight steering at low speed, pull one joystick and push the other to turn in the desired direction. Tracks will counter-rotate and the machine will turn in a tight circle.

Slope Safety

⚠ WARNING ⚠





A machine tipover could crush the operator or bystanders, causing death or serious injury.

- **When loading or unloading the machine, run it at slow throttle.**
- **Operate at slow speed when on rough terrain.**
- **Avoid driving across slopes.**
- **Never jerk the control levers. Use steady even motion.**
- **Always operate with the heavy end uphill.**

Operating safely on a slope depends upon many factors including:

- The distribution of machine weight, including front loading and absence of load.
- The height of load and attachments
- Even or rough ground conditions
- The potential for ground giving way causing unplanned tilt forward, reverse, or sideways.
- The nearness of ditches, ruts, stumps, or other obstructions and sudden changes in slope.
- Speed
- Turning
- Braking performance
- Operator skill

Follow procedures and rules for operating on slopes. These procedures must include:

- Survey the site to determine which slopes are safe for machine operation. Always use common sense and good judgement when performing this survey.
- Avoid starting or stopping on a slope. If the machine loses traction, proceed slowly, straight down the slope.
- Avoid turning on slopes. If turning is required, turn slowly and keep the heavy end of the machine uphill.
- Keep all movement on slopes slow and gradual. Do not make sudden changes in speed or direction.
- If a slope seems unsafe for machine operation, do not operate the machine on it.

Reduce Track Wear

Rubber tracks are best suited at soil-based jobsites with minimal rocks and debris. To reduce track wear drive slowly and make wide turns. Avoid the following:

- Spinning the tracks under heavy load
- Turning on sharp objects suck as stones, broken concrete, or debris
- Quick turns on asphalt or concrete
- Driving over curbs or ledges
- Driving with the track edges pressed against hard walls or curbs
- Operating on corrosive materials such as salt or fertilizer

Shutting Down the Machine

1. When the job is complete, move the machine to level ground.
2. Stop machine movement.
3. Lower the stabilizers to the ground.
4. Lower the drill frame to the ground.
5. Return all controls to neutral.
6. Chock the tracks.
7. Run the engine at low throttle with no load for at least 3 minutes to cool.
8. Shut off the machine.
9. If the machine will be left unattended, remove the key.
10. For maintenance or long-term storage, disconnect the battery using the battery disconnect switch.

IMPORTANT

Wait 2 minutes after shutting off the machine before disconnecting the battery.

Positioning the Equipment

1. Move the equipment into the positions selected in “Selecting Start and End Points”.
2. Connect and test the electric strike system. See the Electric Strike System section.
3. Drive the anchors.

Connecting the Fluid System

IMPORTANT

Do not connect the machine to a public or private water supply.

1. Connect the fluid hose from the fluid mixer to the fluid pump. A 50.8 mm (2 inch) or larger, non-collapsible hose is required.
2. Install a y-strainer between the fluid mixer and the fluid pump. Position the y-strainer so that fluid flows in the direction of the arrow.

Note:

- In most cases positioning the y-strainer at the outlet of the fluid mixer gives the best results.
- Clean the y-strainer regularly.

Starting the System

1. Start the engine.
2. Start the fluid mixer.

   Note: Ensure the mixture of drilling fluid matches the drilling conditions.
3. Enable DrillLok mode, if equipped. See the Controls chapter.
4. Set the throttle to fast.
5. Fill the pipe with drilling fluid until pressure begins to rise.

Priming the Fluid Pump

Prime the fluid pump each time the tank is changed.

IMPORTANT

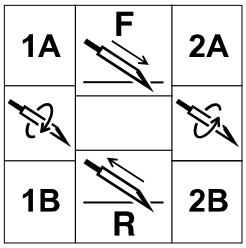
Failure to prime the fluid pump will cause flow fluctuations, which will make it difficult to control the wash wand.

1. Fill the drilling fluid hose.
2. Connect the hose to the machine.
3. Operate the mixing/transfer pump on the fluid mixer at full speed for 1 to 3 minutes to discharge the air from the system.
4. Return the mixing/transfer pump on the fluid mixer to normal operating speed and continue the bore.
5. If drilling fluid pressure surges, repeat step 3.

Carriage Control Operation

Note: Counterclockwise rotation can unthread pipe in the ground.

During normal operation, the carriage control joystick controls both thrust and rotation and allows any combination of the two based on the position of the joystick.



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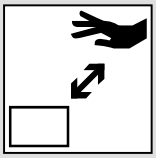
Reference	Function
1A	Forward thrust with clockwise rotation
2A	Forward thrust with counterclockwise rotation
1B	Reverse thrust with clockwise rotation
2B	Reverse thrust with counterclockwise rotation
F	Forward thrust with no rotation
R	Reverse thrust with no rotation

Clamp Pipe

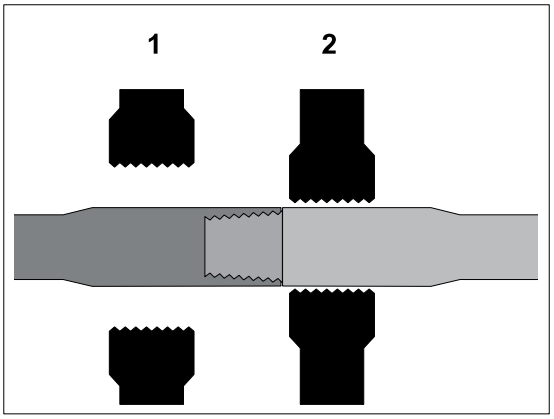
⚠ WARNING ⚠



Moving parts could crush, causing death or serious injury.

Stay away from them and their range of movement.

Clamp pipe when the joint is between the wrenches (1 and 2) as shown.



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IMPORTANT

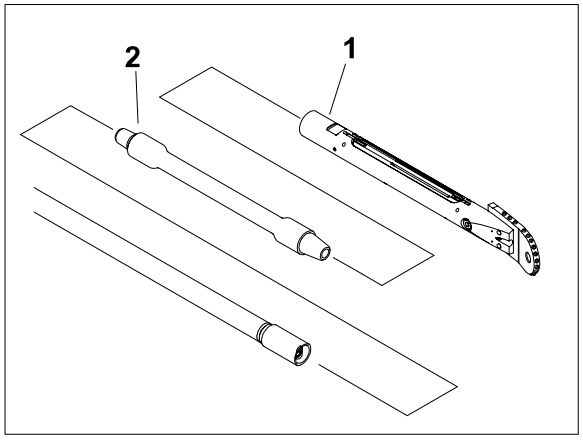
Clamp only where indicated. Clamping anywhere else on the pipe will weaken the pipe. Pipe can later break, even when operating under normal loads.

Assemble the Drill String

DANGER

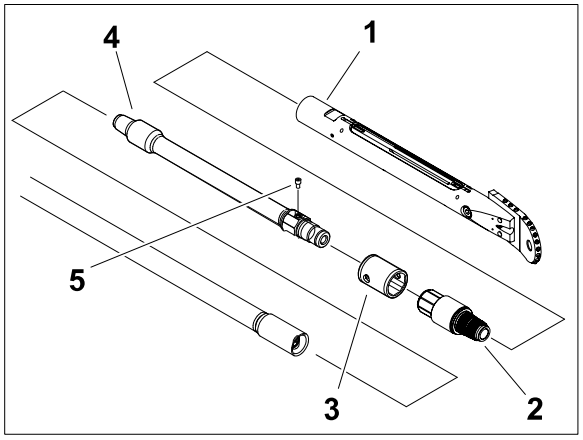
Moving or thrown tools could strike the operator or bystanders. This will cause death or serious injury.

- **Never use pipe wrenches on the drill string.**
- **Follow the instructions in this manual for correct use.**



Direct Connect Method

1. Beacon housing
2. Transition sub



EZ Connect Method

1. Beacon housing
2. Connector
3. Collar
4. Transition sub
5. Bolt

Preparing the Beacon Housing

IMPORTANT

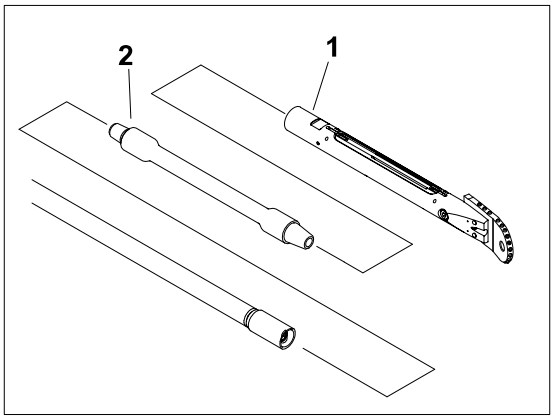
The Beacon must be calibrated after installation in the beacon housing. See the beacon operator's manual.

Note: Nozzle and bit selection depends on job conditions.

1. Select nozzle, if needed.
2. Select bit.
3. Attach the bit to the beacon housing.
4. Install the beacon. See the beacon operator's manual.
5. Install the beacon housing lid.

Using the Direct Connect Method

1. Start the engine.
2. Position the transition sub (2) in the front wrench.
3. Apply tool joint compound.
4. Clamp front wrenches.
5. Slowly move the carriage forward until the SaverLok meets the transition sub.
6. Rotate the spindle clockwise until the SaverLok threads onto the transition sub.
7. Stop the engine.
8. Connect the beacon housing (1) to the transition sub.
9. Start the engine.
10. Position the joint between the wrenches.
11. Use the machine torque to tighten the joint fully.



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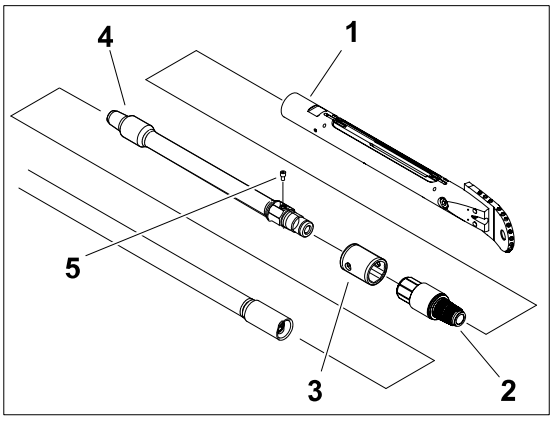
Using the EZ Connect Method

1. Apply tool joint compound to the adapter threads.
2. Use the quick wrench to connect the adapter(2) to the beacon housing(1).
3. Slide the collar(3) onto the transition sub (4).
4. Apply tool joint compound to the threads.
5. Connect the adapter to the transition sub
6. Unthread the connection at least one full flat to align flats.



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Note: The joint will not be tight. The assembly should have a visible gap at the shoulder.

7. Slide the collar over the flats on both the transition sub and adapter, ensuring the hole in the collar is aligned with the hole in the transition sub.
8. Install the bolt(5).

Connecting the Drill Pipe to the Downhole Tool

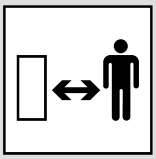
1. Start the engine.
2. Clamp the tool in the front wrench.
3. Load pipe.
   A. Ensure the shuttle stop is positioned correctly.
   B. Apply tool joint compound to the threads in the front wrench.
   C. Lower the pipe lifters.
   D. Close the grippers.
   E. Extend the shuttles.
4. Connect the pipe to the SaverLok body.

   Note: Always rotate clockwise unless breaking a pipe joint. Rotating counterclockwise will separate the joints.

   A. Move the carriage forward until the SaverLok meets the pipe.
   B. Rotate the spindle clockwise until the SaverLok threads onto the pipe.
   C. Relax the grippers.
5. Connect the pipe.
   A. Slowly move the carriage forward to allow the pipe to match up.
   B. Rotate the spindle clockwise until the pipe threads together.
   C. To fully tighten the joint, slowly rotate pipe until the spindle stops turning.
   D. Unclamp the wrench.
   E. Open the grippers fully.
   F. Raise the pipe lifters.
   G. Retract the shuttles.

Drilling the First Pipe

⚠ DANGER ⚠

Contact with the rotating shaft will cause death or serious injury.

- **Stay away from the shaft.**
- **The tracker operator must have communication with the drill operator or DrillLok system must be enabled with the DrillLok key in the operator's possession.**
- **Do not stand or walk over the bore path while drill string is moving during drilling and backreaming.**

⚠ WARNING ⚠


Contact with underground utilities could cause death or serious injury.

- **Locate and verify the location of underground utilities before digging or drilling.**
- **Use the electric strike system.**
- **Expose the line by careful hand digging or soft excavation. Use a beacon to track the bore path. If a utility must be crossed, the tracker operator must watch the drill head during drilling and backreaming. Consider the type and stability of soil. Take precautions to ensure the ground does not give way under the tracker operator.**

---

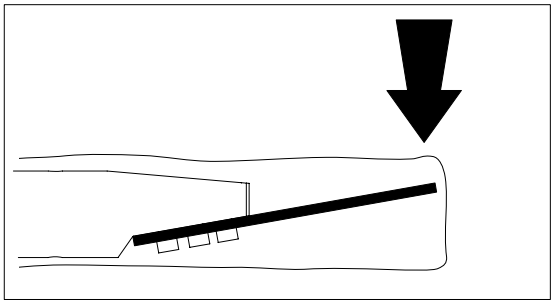
1. Turn on the drilling fluid.
2. Visually check for drilling fluid flow.
3. Slowly move the carriage forward. Drill the first pipe as straight as possible.
4. Monitor the gauges.

Swabbing the Hole

Swab the hole as needed after each pipe is drilled to remove cuttings and keep the bore clear.

Note: Some conditions may require more frequent swabbing.

1. Move the carriage forward until it reaches the front of the drill frame.
2. Move the carriage to the rear of the drill frame with drilling fluid on.
3. Move the carriage forward until the pipe joint is properly located between the wrenches for joint breakout.



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Using the Automated Pipe Loader System

Note: If the operator leaves the seat during an add or remove pipe cycle, the pipe cycle will pause. When the operator returns to the seat, the system must be re-enabled.

Adding Pipe

1. Enable automated add pipe function.
2. Ensure the pipe box is properly positioned. If the pipe box row is empty, select the next full row.
3. Unclamp the front wrench.
4. Retract shuttles.
5. Set the throttle to full.
6. Add pipe. Grippers will open, pipe will be lifted, pipe box checked, then lowered into the shuttles.

Removing Pipe

1. Enable automated remove pipe function.
2. Ensure the pipe box is properly positioned.
3. If the pipe box row is full, select the next empty row.
4. Unclamp the front wrench.
5. Retract the shuttles.
6. Set the throttle to full.
7. Remove pipe. Grippers will open, pipe will be lowered and lifted out of the shuttles.

Adding Pipe

1. Enable autothrottle.
2. Enable automated pipe loader system (optional).
3. Break the joint at the SaverLok.
   A. Position the pipe between the wrenches.
   B. Locate the drill head.
   C. Rotate the pipe to achieve the strongest signal from the beacon/transmitter.
   D. Clamp the front wrench.
   E. Rotate the spindle counterclockwise. The carriage will slowly move back as threads separate.
   F. After the threads are fully separated, stop the rotation and move the carriage back until the rear stop indicator lights. If automated pipe loader mode is selected, tool joint compound will be applied while the carriage is moving.
4. Load pipe.

   Manual Pipe Loader Controls:

   A. Ensure that pipe lifters are completely lowered.
   B. Close the grippers.
   C. Extend the shuttles.
   D. Apply tool joint compound at the wrench.
   E. Raise the pipe lifters

   Automated Pipe Loader Controls:

   A. If the pipe box row is empty, select the next full row.
   B. With the carriage at the rear stop position, resume.
5. Connect pipe to the SaverLok.

   Note: Counterclockwise rotation can unthread pipe in the ground.

   A. Move the carriage forward until the SaverLok meets the pipe.
   B. Rotate the spindle clockwise until the SaverLok threads onto the pipe.
   C. Relax the grippers, or resume if using automated pipe loader mode.
6. Connect new pipe.

   Manual Pipe Loader Controls:

   A. Slowly move the carriage forward to allow pipe to match up.
   B. Rotate the spindle clockwise until the pipe threads together.
   C. To fully tighten the joint, slowly rotate the pipe until the spindle stops turning.
   D. Unclamp the wrench.
   E. Open the grippers fully.
   F. Retract the shuttles.

   Automated Pipe Loader Controls:

A. Slowly move the carriage forward to allow pipe to match up.
B. Rotate the spindle clockwise until pipe threads together.
C. Resume. Grippers will open, shuttles will retract, and pipe lifters will lower.
D. To fully tighten the joint, slowly rotate pipe until the spindle stops turning.
E. Unclamp the wrench.

7. Turn on drilling fluid until pipe fills and fluid pressure begins to rise.
8. Adjust fluid flow.
9. Rotate the spindle.
10. Slowly move the carriage forward.
11. Adjust rotation speed according to bit size and soil conditions.
12. Set cruise control (optional).
13. Monitor gauges.
14. Locate the drill head with the tracker at least every half-length of pipe.

IMPORTANT

All tracking equipment is subject to magnetic interference. The presence of interference can cause inaccuracies in both location and depth calculations. See the tracker operator's manual for more information.

Correcting Direction

Correcting direction is a skill operators gain with experience and knowledge of equipment and soil conditions. These instructions cover only basic procedures. For information about specific equipment or jobsites, contact your Ditch Witch dealer.

To track progress and make corrections, one crew member locates the drill head and sends instructions to the operator. Corrections are made by tracking the drill head, comparing the current position to bore plan, and steering drill head as needed.

Basic Rules

- Steering ability depends on soil condition; bit, drill head, and nozzle used; roll of drill head; and distance pushed without rotation.
- All corrections should be made as gradually as possible. See the Recommended Bend Limits section.
- Over correcting will cause “snaking.” This can damage pipe and will make drilling and pullback more difficult. Begin to straighten out of each correction as early as possible.
- Do not push an entire piece of drill pipe into ground without rotation. This can exceed bend radius and cause pipe failure.

Procedure

1. Locate the drill head. Take the reading available with the beacon and tracking equipment such as:
   - depth

     IMPORTANT

     Depth estimate improves if the drill head is at the 3 o’clock position Ⓑ rather than the 12 o’clock or 6 o’clock position Ⓐ.

   - pitch
   - left/right information
   - temperature
   - beacon roll
2. Compare position to the bore plan and determine the direction.
3. Position the drill head.
4. Drill the pipe.

Drill Head Position

The drill head position is determined by reading the beacon roll. Roll is displayed as a clock face position.

1. Read the beacon roll.
2. Slowly rotate pipe until tracking equipment displays the desired beacon roll.

Changing Direction

1. Rotate pipe to the intended clock position.
2. Push pipe into the ground.

Moving Forward Without Changing Direction

1. Rotate pipe.
2. Push pipe into the ground.

Using Autocarve Mode

Note:

- Two-speed carriage control and cruise control are disabled while in autocarve mode.
- Autocarve mode is disabled while front wrench is clamped.
- Adding or removing pipe does not affect autocarve mode.

Autocarve helps the operator change direction when thrust stalls in difficult soil conditions while drilling. Autocarve rotates the bit clockwise and counterclockwise to grind away soil, clearing a path to improve steering through tough formations.

Movement	Description
Alternating clockwise and counterclockwise rotation	Enables downhole tool to carve tough soil formations. Rotation speed can be adjusted during autocarving. **IMPORTANT** **To reduce the chance of unthreading pipe sections downhole, rotation pressure is limited during counterclockwise rotation. However, the operator should monitor carve operation and adjust thrust and rotation to prevent unthreading.**
Carve window	The range of alternating rotation.
Thrust	In autocarve mode, initial thrust speed is very slow or fully stopped. Adjust speed anytime during carving.
Pullback	Thrust and rotation operate normally when the joystick is pulled. High-speed pullback is not available in autocarve mode.

1. Rotate the drill head to the desired position to position downhole tool for carving.
2. Enable autocarve.
3. Move the carriage control joystick forward and return to neutral to begin carving.

   Note: Pull the carriage control joystick to pause carving.
4. Adjust thrust speed using the set/resume switch. Adjust as needed while carving.
5. Set the carve window. Adjust as needed while carving.
6. Adjust rotation speed using the set/resume switch. Adjust as needed while carving. Use the multi-use button for finer adjustment.

   Note: Using the multi-use button activates reaming function and will change steering direction unless the tool is stopped at its original position before releasing the multi-use button.
7. After carving a few inches, press and hold the mult-use button and rotate clockwise for several full rotations to drill out the carved section. When the tool rotates freely, reduce rotation speed and stop at the desired carve position. Release the multi-use button and resume carving.

Note: If rotation is restricted, move the carriage back slightly until full rotation is possible, then move the carriage forward while rotating.

8. Exit autocarve mode and continue normal drilling.

   Note: Autocarve settings are retained until the machine is turned off.

Recording Bore Path

Locate the drill head every half-length of pipe. As the job is completed, record the actual data for each drill pipe. List pitch and depth of each joint and a brief description of the procedure. In addition, draw a simple sketch of the jobsite and record the depth and rough location of the pullback.

Subsite Electronics bore tracking software is also available for plotting and tracking the bore path. This software utilizes a Subsite Electronics tracking system, including tracker, display, tracking beacon, and special software. The display can store jobs in its memory or the system can be run in the field using a laptop computer. Contact your Ditch Witch dealer for more information.

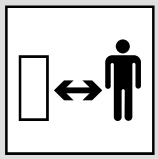
Surfacing the Drill Head

⚠ DANGER ⚠


Moving or thrown tools could strike the operator or bystanders. This will cause death or serious injury.

- **Never use pipe wrenches on the drill string.**
- **Follow the instructions in this manual for correct use.**

⚠ DANGER ⚠

Contact with the rotating shaft will cause death or serious injury.

- **Stay away from the shaft.**
- **The tracker operator and drill operator should maintain two-way communication.**
- **The drill operator should be instructed to discontinue drill string rotation as soon as the drill bit exits the bore. Use only thrust to extend the drill string beyond the exit hole.**
- **Keep everyone clear of the exposed drill string.**
- **Only enter the pit when clear communication is given by the drill operator that the machine is shut down. If using DrillLok mode, only enter pit when DrillLok mode is turned off and DrillLok indicator is lit. See the DrillLok System section.**

1. Steer the drill head to the target pit or up through the surface.

IMPORTANT

See the Recommended Bend Limits section.

2. Turn the drilling fluid off as soon as the drill head emerges. Keep the spindle connected to the drill pipe.
3. **If using DrillLok mode,** allow the tracker operator to remotely disable thrust/pullback and rotation. Tracker operator must ensure the DrillLok indicator is lit before changing downhole tools. **If not using DrillLok mode,** turn off the machine and keep the key in the tracker operator's possession before changing downhole tools.
4. Clean the drill head.

   Note: Ensure the threads remain clean.
5. Disconnect the EZ Connect joint or use a quick wrench to remove the drill head. See the Quick Wrench section.

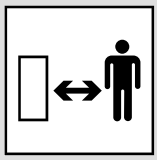
Backream

DANGER

Moving or thrown tools could strike the operator or bystanders. This will cause death or serious injury.

- **Never use pipe wrenches on the drill string.**
- **Follow the instructions in this manual for correct use.**

DANGER



Contact with the rotating shaft will cause death or serious injury.

- **Stay away from the shaft.**
- **Ensure the swivel turns freely with product attached.**
- **The tracker operator and drill operator should maintain two-way communication.**
- **Begin to backream only when the tracker operator has communicated that everyone is clear of the exposed backream string or has enabled thrust and rotation hydraulics using the DrillLok system.**
- **Never allow anyone to stand to the side of the exposed drill string. Drill string and backreamer can move sideways suddenly if rotated while away from the exit hole.**

WARNING

Contact with underground utilities could cause death or serious injury.

- **Locate and verify the location of underground utilities before digging or drilling.**
- **Continue to use the electric strike system during backreaming.**
- **Watch utility crossings. Consider the size of the backreamer and ensure there is adequate space between existing utility and the backreamer.**

IMPORTANT

Number of passes needed depends on soil conditions. Do not attempt to increase the hole size too much in one pass. Several passes using successively larger reamers will be more successful.

If needed, enlarge the pilot hole to accommodate larger product. The final hole should be 1.5 times larger than the diameter of the product being installed.

Assembling the Backream String

IMPORTANT

The beacon must be calibrated after installation in the beacon housing. See the beacon *Operator's Manual*.

1. Select backreamers. See the Backreamers section.
2. Determine drilling fluid flow requirements and install appropriate nozzles to provide sufficient fluid flow. See the Systems and Equipment chapter.
3. If tracking the backream:
   A. Attach the backreamer to the beacon housing.
   B. Install the beacon. See the beacon operator's manual.
   C. Install the beacon housing lid.
4. Attach the transition sub to the drill pipe string.
5. Attach the backreamer assembly to the transition sub.
6. Attach additional pullback devices or product to the end of the backreamer assembly.

Beginning the Backream

1. After the backream assembly is attached to the pipe, allow the tracker operator to leave the pit and stand away from exposed drill string.
2. **If using DrillLok mode,** allow the tracker operator to turn on the tracker to enable thrust/pullback and rotation. **If not using DrillLok mode,** wait for the tracker operator to communicate that the backream string is clear.
3. Turn on drilling fluid until the pipe fills and fluid pressure begins to rise.
4. Without rotating, slowly pull back until the reamer contacts the bore opening.
5. Begin slow rotation and pullback.
6. Increase drilling fluid flow and rotation as the backream string enters the ground.
7. Monitor the gauges.
8. Locate the backreamer with the tracker at least every half-length of pipe.

Pipe Removal

Preparing to Break Pipe

1. Enable automated pipe loader system (optional).
2. If the pipe box row is full, select the next empty row.
3. Position the pipe joint between the wrenches.
4. Clamp the pipes in both wrenches.

Breaking the Front Joint

1. Turn the rear wrench counterclockwise.
2. Unclamp the rear wrench and rotate clockwise to the original position.
3. Retrieve the pipe.

   Manual Pipe Loader Controls:

   A. Raise the pipe lifters. Grippers will open as the pipe is lifted.

   B. Extend the shuttles.

   C. Relax the grippers to allow pipe to rotate.

   D. Lower pipe lifters.

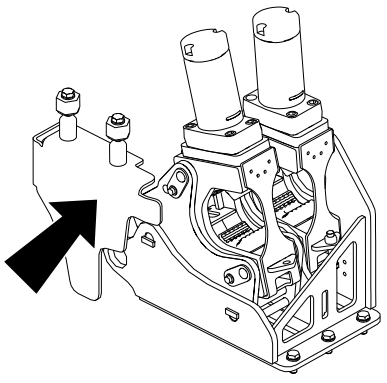
   Automated Pipe Loader Controls:

   Resume. Shuttles will extend, grippers will close fully and then relax, and pipe lifters will lower.
4. Rotate the spindle counterclockwise to separate the pipe.

Breaking the Rear Joint

1. Clamp the rear wrench.
2. Rotate the spindle counterclockwise one revolution to loosen the joint at the transition sub.

   Note: Do not fully unthread the joint.
3. Unclamp the rear wrench.
4. Move the carriage back until the front end of the pipe clears the front face of the wrench mount plate (shown).



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5. Close grippers. If automated pipe loader mode is selected, press resume.
6. Rotate the spindle counterclockwise until the SaverLok is separated from the pipe.
7. Move the carriage back until the rear stop indicator lights.

Breaking the Rear Joint (continued)

Manual Pipe Loader Controls:

A. Fully close the grippers.

B. Ensure the pipe lifters are fully lowered.

C. Retract the shuttle to the current pipe row.

D. Raise the pipe lifters to place the pipe in the current row.

E. Open the grippers.

Automated Pipe Loader Controls:

Resume. Shuttles will retract and the pipe lifters will raise the pipe into the pipe box.

8. Attach the SaverLok to the next pipe.

   A. Move the carriage forward until the saver sub touches the pipe.

   B. Rotate the spindle clockwise. The carriage will slowly move forward as the pipe is connected.

   C. To fully tighten the joint, slowly rotate the pipe until the spindle stops turning.

9. Unclamp the front wrench to release the pipe.

Removing Pullback Device

DANGER

Moving or thrown tools could strike the operator or bystanders. This will cause death or serious injury.

- **Never use pipe wrenches on the drill string.**
- **Follow the instructions in this manual for correct use.**

Pullback device can be removed when the last pipe is on the drill frame.

Note: Pullback device can also be removed when the target pit along the bore path has been reached. Remaining pipe is then pulled back and removed.

1. Set the throttle to slow.
2. Turn the drilling fluid off.
3. Shut off the machine.
4. Clean the pullback device.
5. Disconnect the pullback material.
6. Remove the pullback device using a quick wrench. See the Quick Wrench section.

After Operation

After Operation Precautions

- Shut off the engine, remove the key, wait for all movement to stop, and allow the machine to cool before adjusting, cleaning, storing, or servicing it.
- Do not touch parts that may be hot from operation. Allow them to cool or wear gloves before attempting to maintain, adjust, or service the machine.
- Clean debris from the attachments, drives, mufflers, and engine to help prevent fires. Clean up oil or fuel spills.

Finishing the Job

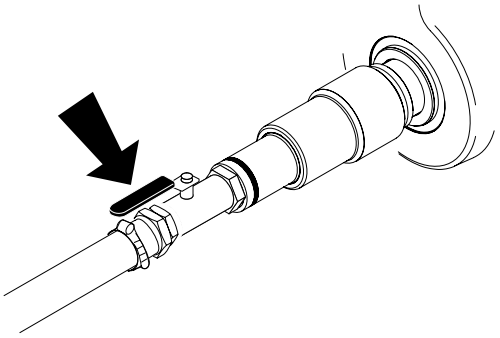
1. After the product is installed, return the spoils to the trench with shovels or small earth-moving equipment.
2. Clean the machine.
3. Ensure that tools and accessories are loaded and properly secured on the trailer or truck.

Antifreeze

This machine can be left overnight in freezing conditions by filling fluid lines with a polypropylene glycolbased, RV antifreeze with optional antifreeze system before shutdown.

Adding Antifreeze

1. Add antifreeze to the antifreeze tank. See the Maintenance chapter for specifications.
2. Install the plug on the suction side of the drilling fluid pump.
3. Open the valve below the antifreeze tank.
4. Install the optional antifreeze reclaimer adapter in the spindle.
5. Ensure the valve is open as shown.



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6. Start the engine and set the throttle to SLOW.
7. Enable drilling fluid control.
8. Slowly turn the drilling fluid control until antifreeze comes out of the spindle.
9. Disable the drilling fluid control.

Antifreeze (continued)

Reclaiming Antifreeze

Note: Antifreeze can be removed from the antifreeze tank and disposed of properly or it can be reused until it is too diluted with drilling fluid to protect against freezing.

1. Hold the hose on the optional antifreeze reclaimer over the top of antifreeze tank.
2. Open the valve on the reclaimer.
3. Connect the drilling fluid transfer hose from the tank to the drilling fluid pump inlet.
4. Close the valve below the antifreeze tank.
5. Start the engine.
6. Set the throttle to SLOW.
7. Enable the drilling fluid control.
8. Set the drilling fluid control to low.
9. Turn the drilling fluid off when drilling fluid comes out of the reclaimer hose.
10. Remove the antifreeze reclaimer.

Cleaning

Rinsing Equipment

⚠ WARNING ⚠

Contact with pressurized fluid or air could cause death or serious injury.

Follow the instructions in this manual for correct use.

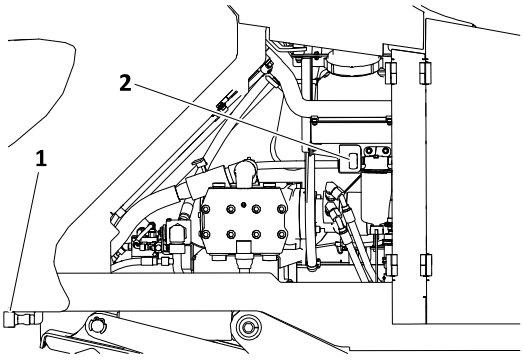
- **Never use high flow when using the wash wand.**
- **Never point or aim the wand at yourself or anyone else. Keep the nozzle low to the ground.**
- **Prime the drilling fluid pump before operating the wash wand. Failure to prime the drilling fluid pump will cause flow fluctuations, which will make it difficult to control the wash wand.**

IMPORTANT

- **Do not spray water onto the operator console or electrical center in the engine compartment. Water can damage electrical components. Wipe them down instead.**
- **Ensure all mud and debris is rinsed from the tracks before parking the machine overnight.**

Cleaning (continued)

1. Turn the fluid flow to low.
2. Turn off the fluid pump.
3. Connect the wash wand at the quick connect① at the rear of the machine.
4. Press the wash wand switch② to close the discharge valve.
5. Turn on the fluid pump.
6. Check surroundings before pressing the handle to start pressurized fluid flow.



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7. Spray water onto equipment to remove dirt and mud. Some pressure might be needed to remove dried mud from the wrench area. Thoroughly rinse the operator station and step.

   Note: If the front wrench is clamped, fluid will not flow to the wash wand.

8. Release the handle to stop the flow.

Disconnect

Disconnect and store the following hoses and cables (if used):

- electric strike system voltage stake
- fluid hose

Stowing Tools

Ensure the tools and the accessories are loaded and properly secured on the trailer or truck.

Chapter 6

Transport

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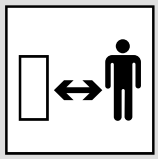
Lifting the Machine

⚠ WARNING ⚠



A lifted load could crush the operator or bystanders, causing death or serious injury.

Stay away from the lifted load and its range of movement.

This machine is not configured for lifting. If the machine must be lifted, load it into a container or onto a platform appropriate for lifting. See Specifications for size and weight of machine.

IMPORTANT

For pipe box lifting procedures, see the Pipe Box section.

Hauling the Machine

Use a heavy-duty trailer or truck to haul the machine. Use a full-width ramp. Ensure that the trailer or truck has all the necessary brakes, lighting, and marking as required by law. Please carefully read all the safety instructions. Knowing this information could help you or bystanders avoid injury. Refer to your local ordinances for trailer and tie-down requirements.

⚠ WARNING ⚠

Driving on the street or roadway without turn signals, lights, reflective markings, or a slow-moving-vehicle emblem is dangerous and can lead to accidents causing personal injury.

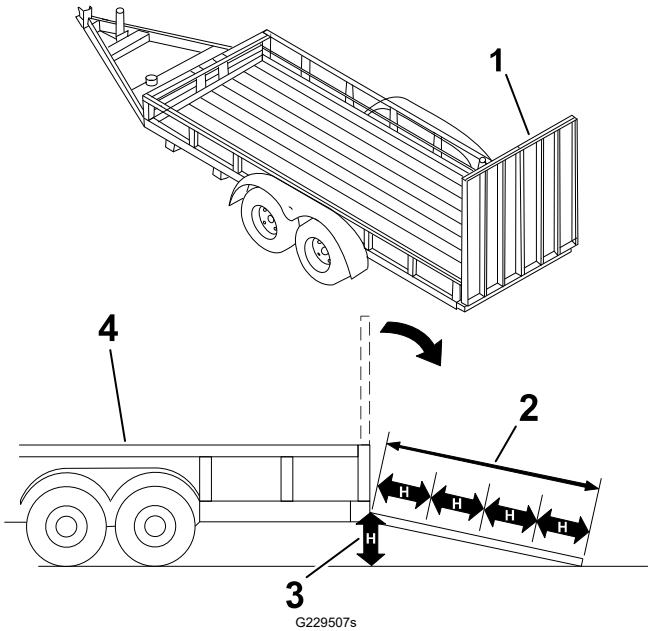
Do not drive the machine on a public street or roadway.

Trailer Requirements

⚠ WARNING ⚠

Loading a machine onto a trailer or truck increases the possibility of tip-over and could cause serious injury or death.

- **Use only a full-width ramp; do not use individual ramps for each side of the machine.**
- **Ensure that the length of ramp is at least 4 times as long as the height of the trailer or truck bed to the ground.**



(1) Full-width ramp in stowed position

(2) Ramp is at least 4 times as long as the height of the trailer or truck bed to the ground

(3) H = height of the trailer or truck bed to the ground

(4) Trailer

Loading the Machine

⚠ WARNING ⚠

Loading a machine onto a trailer or truck increases the possibility of tip-over and could cause serious injury or death.

- **Use extreme caution when operating a machine on a ramp.**
- **Load and unload the machine with the heavy end up the ramp.**
- **Avoid sudden acceleration or deceleration while driving the machine on a ramp as this could cause a loss of control or a tip-over situation.**

⚠ WARNING ⚠

Crushing weight could cause death or serious injury. Stay away.

To help avoid injury:

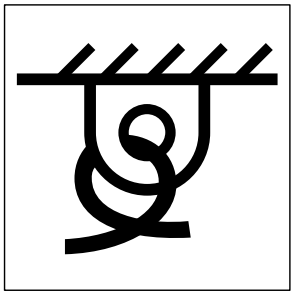
- **Load the unit with the engine in low idle and the attachment as low as possible.**
- **Load the trailer on level ground.**
- **Load the trailer correctly to avoid the trailer swaying.**
- **Attach the trailer to the vehicle before loading or unloading.**
- **If loading the machine onto a tilt-bed trailer, ensure that the tilt latch is secured in the correct position.**
- **10 to 15 percent of the total vehicle weight (equipment plus trailer) must be on the tongue to help prevent the trailer from swaying.**

---

1. Connect the trailer to the towing vehicle and connect the safety chains.
2. If applicable, connect the trailer brakes.
3. Lower the ramp(s).
4. Start the machine.
5. Ensure transport mode is selected.
6. Move the machine to the rear of the trailer and align it with the ramps.
7. Drive forward slowly in slow throttle to move the machine onto the trailer until the tiedown position is reached.
8. Lower the stabilizers to the trailer floor.
9. Lower the drill frame to the trailer floor.
10. Turn off the machine.
11. Tie down the machine at the tie down points.
12. Ensure all covers are properly secured.

Tie Down Points

Tie down points are identified by the tie down decals. Securing the machine to the trailer at other points is unsafe and can damage the machine.



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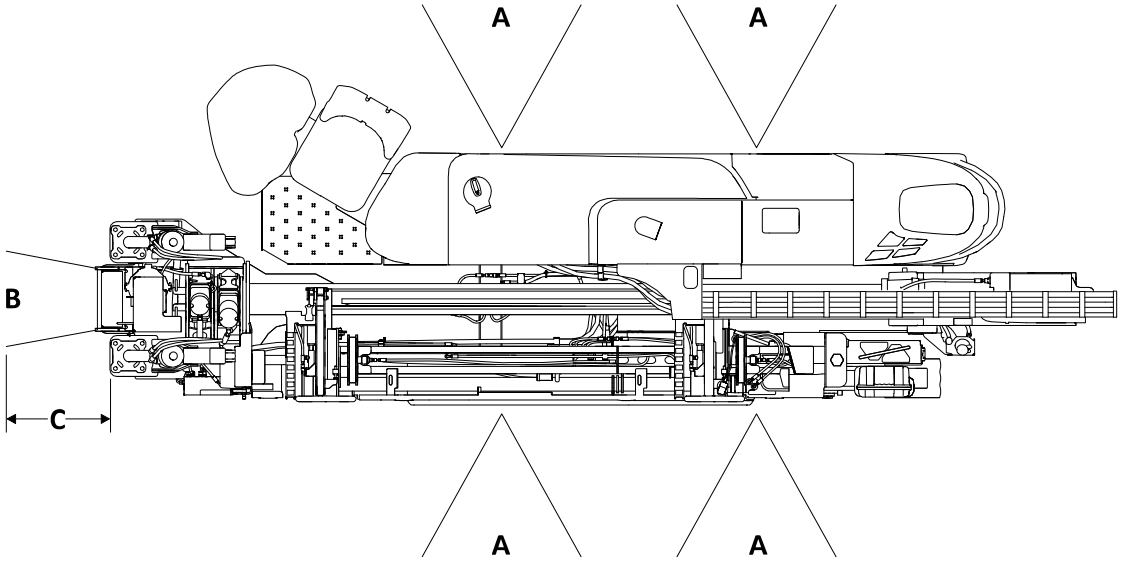
Machine Tie Downs

IMPORTANT

Use minimum Grade 7, 18.7 cm (3/8 inch) transport chain to secure the machine to the trailer.

Loop a transport chain around each tie down point. See the chart below for the correct distances between tie down ends. Ensure that the tie down chains are tight before transporting.



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Distance	Metric	US
A	Greater than 15 cm	Greater than 6 inches
B	Less than 130 cm	Less than 47 inches
C	Greater than 15 cm	Greater than 6 inches

Unloading the Machine

⚠ WARNING ⚠

Crushing weight could cause death or serious injury. Stay away.

To help avoid injury:

- **Unload the unit with the engine in slow idle and the attachment as low as possible.**
- **Unload the trailer on level ground.**
- **Attach the trailer to the vehicle before loading or unloading.**
- **If the trailer tilts, ensure that the tilt latch is secured in the correct position.**

---

1. Lower the trailer ramps.
2. Remove the chains from the tie down points.
3. Start the machine.
4. Ensure transport mode is selected.
5. Raise the stabilizers.
6. Raise the drill frame.
7. Set the throttle to slow.
8. Slowly back the machine down the trailer or ramps.

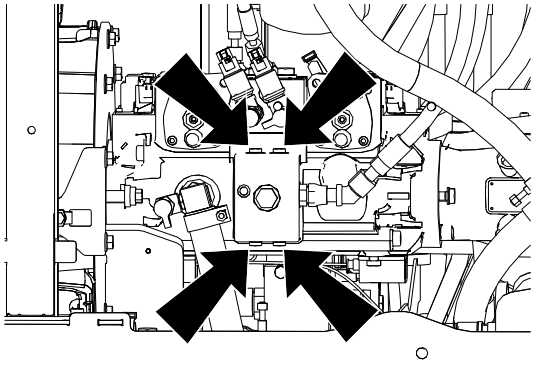
Retrieving the Machine

Under normal conditions, the machine should not be towed. If the machine breaks down and retrieval is necessary:

- Tow for no more than 30 m (100 ft) at less than 1.6 km/h (1 mph).
- Use maximum force of 1.5 times machine weight.
- Use towing chains appropriately rated for maximum towing force.

1. Stop the engine.
2. Block the tracks to prevent the machine from rolling.
3. Attach chains to the tie down points facing the towing vehicle.
4. Locate the 4 plugs on the pump housing (shown).
5. Remove the 4 plugs. Some fluid will escape.
6. Remove the relief/check valves. Set them aside.
7. Install plugs and tighten them until they are snug.

   Note: Keep the relief/check valves clean while towing.



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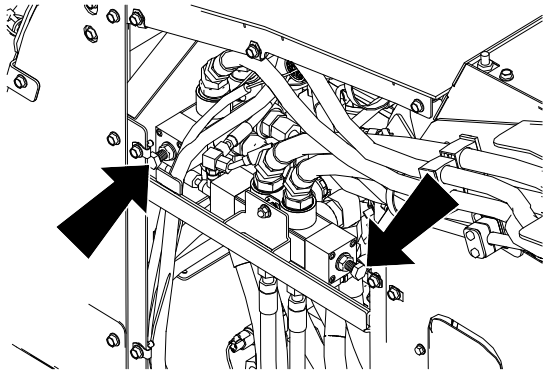
8. Locate the diverter valves, loosen the jam nuts, and tighten the valve screws (shown) until they are fully threaded into the shift selector valves.
9. Remove the blocks.
10. After towing, block the tracks and reinstall the relief/check valves, reset the diverter valves and manual override screws.



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Chapter 7

Systems and Equipment

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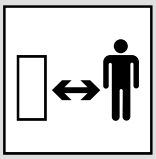
Anchor System

⚠ DANGER ⚠

Contact with the rotating shaft will cause death or serious injury.

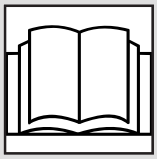
- **Stay away from the shaft.**
- **Never replace the anchor collar bolt with one longer than the original. Clothing could catch on turning shaft.**

⚠ WARNING ⚠


Contact with underground utilities could cause death or serious injury.

- **Locate and verify the location of underground utilities before digging or drilling.**
- **If you are not driving the anchors to full depth, drive optional ground rod into soil away from the machine and connect ground rod to the machine.**

⚠ WARNING ⚠

Horizontal movement could crush operators and bystanders causing death or serious injury.

- **Read and understand the operator's manual and all safety instructions before use.**
- **Set stabilizers prior to driving anchors.**
- **Drive anchors and/or tie off the machine before drilling.**
- **Remain a safe distance away if driving the anchors with the wireless remote control.**

Anchor Bit Selection

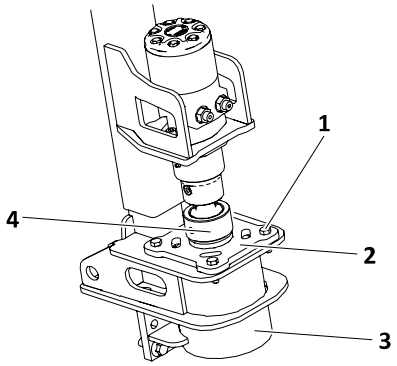
There are 3 anchor options for this machine. Choose the correct anchor type based on job conditions as shown below.

Anchor Type	Jobsite Conditions
Rock bit	Hard/soft rock, asphalt, concrete, cobble
Auger bit	Soft/hard soil, soft rock
Straight bit	Hard soil

Driving Anchors

Note: Do not attempt to operate anchor controls while drilling fluid is on.

1. Install the centering cap.



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IMPORTANT

The centering cap must be properly installed to prevent damage to the anchor.

The centering cap is properly installed when:

- The hardware(1) is secure but not overtightened.
- The centering cap(2) is free to slide back and forth inside the centering tube(3) under normal load.

2. Use high speed rotation and low thrust to drive the anchor into the ground.

   Note: Carefully time anchor rotation with anchor movement. Properly driven anchors should not auger up soil.

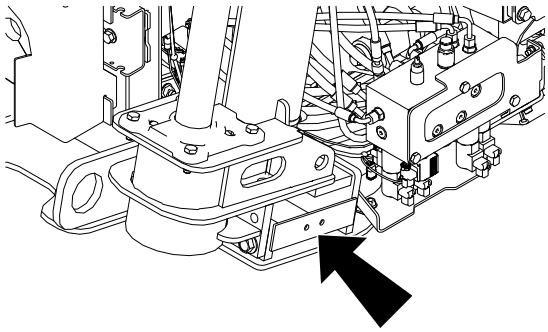
3. The anchor is set when the auger shaft stop collar(4) rests firmly on the centering cap.
4. Repeat the process for the other anchor.

Removing Anchors

1. Use anchor controls to slowly remove the anchor from the ground.
2. Repeat the process for the other anchor.

Setting Up Alternate Grounding

1. If not using anchors, additional grounding will need to be done for the machine using external kit 100–794 Contact your Ditch Witch dealer for more information.
2. Remove paint from all surfaces prior to installing the grounding kit.
3. Connect the ground included in the grounding kit to the anchor valve as shown.



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Cruise Control

During the bore, thrust/pullback and rotation can be set to match ground conditions. Cruise control enables the machine to maintain these settings hands-free. These settings can be engaged, disengaged, overridden, and resumed at any time.

Engaging the Cruise Control

Note: In order for cruise control to function, the front wrench must be unclamped and shuttles must be fully retracted.

1. Position the joystick to the desired thrust or pullback settings.
2. Position the joystick to the desired rotation setting (optional).
3. Press set. The cruise mode indicator will appear on display.
4. If using cruise control for thrust/pullback and rotation, release the joystick. If not using cruise control for rotation, use the joystick to control rotation.

Settings

Note: To make fine adjustments, press and hold the multi-use button while adjusting.

Thrust/Pullback

To increase thrust or pullback speed, move the joystick to the neutral position and press resume.

To decrease thrust or pullback speed, move the joystick to the neutral position and press set.

Rotation

To increase rotation speed, move the joystick to the left and press resume.

To decrease rotation speed, move the joystick to the left and press set.

Override

To override thrust/pullback settings, move the joystick out of neutral and beyond its current setting. The machine will increase to the joystick setting.

To return to the previous setting, release the joystick.

Disengage

To disengage cruise control, move the joystick out of neutral in the opposite direction of carriage travel. Cruise mode indicator on the display will turn off and the carriage will stop moving.

Resume

Move the joystick out of neutral in the direction to be resumed (forward or backward) and press resume. Thrust and rotation will resume at the previous settings and cruise mode indicator will appear on the display. See the Controls chapter for more information.

Diagnostic Codes

This machine is equipped with two diagnostic systems: engine and machine. The engine diagnostic system detects errors within the engine operating system and communicates fault codes on the display. The machine diagnostic system detects errors within the automated machine control system. These error codes are also displayed on the upper display.

Use the display to hide/recall active codes. Note the SPN, FMI, and description of the diagnostic code for future reference.

Note: Do not turn off the engine. Diagnostic codes are cleared each time the ignition is turned off.

Electronic Controlled Engine Overview

This machine is equipped with a self-diagnostic computer-controlled engine management system. An Electronic Control Unit (ECU) monitors engine performance and makes adjustments to optimize that performance.

Indicators, plus diagnostic codes and messages, on the display tell the operator about potential engine problems. Depending on the severity of the problem, the ECU may reduce engine power or speed or may shut the engine down. The ECU also stores all diagnostic codes regardless of severity.

Machine Diagnostic System Overview

Use the display to view condition of the machine automation diagnostic system. Under normal operating conditions, any diagnostic code that is recorded will be shown as a pop-up message on the display.

Reading Engine Diagnostic Codes

Engine diagnostic codes are shown in pop-up messages on the display. Amber or yellow messages indicate problems that should be addressed but do not need immediate attention. Red messages indicate problems that need immediate attention. Failure to address a problem indicated by a red message will generally result in the engine derating or shutting down.

Downhole Tools

The chart below should be used when selecting downhole tools.

Soil	Description
Sandy	Sugar sand, blow sand, or other soils where sand is the predominant component
Soft	Sandy loam
Medium	Loams, loamy clays
Hard	Packed clays, gumbo, all compacted soils
Cobble rock	Chunk rock, glacial till, cobble, gravel
Soft rock	Sandstone, shale, coral, caliche, chaulk
Medium rock	Limestone, caliche, sandstone, shale
Hard rock	Granite, schist, marble, hard limestone

Backreamers

A backreamer enlarges the hole as pipe is pulled back through the bore. No one backreamer works well in all conditions. These charts are meant as a guideline only. Contact your Ditch Witch dealer for soil conditions and backreamer recommendations for your area.

- 1 = best
- 2 = good
- 3 = fair
- 4 = not recommended

Backreamer	Sandy Soil	Soft Soil	Medi-um Soil	Hard Soil	Rocky Soil	Soft Rock	Hard Rock
Beavertail	2	1	1	1	4	4	4
Compact fluted HD	3	3	1	2	2	3	4
EZ	3	1	2	2	3	3	4
Kodiak™ HD	3	3	3	2	1	2	3
Rockmaster™	4	4	4	4	3	1	1
RockMonster™	4	4	4	4	3	1	1
Sandhog HD		1	2	3	3	4	4
Warthog™ HD	4	3	2	1	2	2	3

Backreaming Fluid Requirements

Backreaming is only successful when enough fluid reaches the bore. The amount of fluid needed depends on size of bore and soil condition.

Follow these steps to find the minimum amount of fluid needed in perfect conditions.

Note: Using less than the recommended amount of fluid can cause the bore to be dry and unsuccessful.

Instructions	Example
1. Find the amount of fluid needed for your size of backreamer. See the following table.	152 mm (6 inch) backreamer requires at least 18.24 L/min (1.47 US gallon/ft)
2. Multiply this number by the distance per minute you plan to backream. The answer is an estimate of the amount of fluid you will need for each minute of backreaming.	18 L (1.5 US gallons) x 0.5 m/min (2 ft/min) = 9 L (3 US gallons) for each minute of backreaming

Backreamer/Product Diameter	L/m	US gallon/ft	Backreamer/Product Diameter	L/m	US gallon/ft
13 mm (0.5 inch)	0.13	0.01	343 mm (13.5 inches)	92.35	7.44
25 mm (1 inch)	0.51	0.04	356 mm (14 inches)	99.31	8.00
38 mm (1.5 inches)	1.14	0.09	368 mm (14.5 inches)	106.54	8.58
51 mm (2 inches)	2.03	0.16	381 mm (15 inches)	114.01	9.18
64 mm (2.5 inches)	3.17	0.25	394 mm (15.5 inches)	121.74	9.80
76 mm (3 inches)	4.56	0.37	406 mm (16 inches)	129.72	10.44
89 mm (3.5 inches)	6.21	0.50	419 mm (16.5 inches)	137.95	11.11
102 mm (4 inches)	8.11	0.65	432 mm (17 inches)	146.44	11.79
114 mm (4.5 inches)	10.26	0.83	445 mm (17.5 inches)	155.18	12.49
127 mm (5 inches)	12.67	1.02	457 mm (18 inches)	164.17	13.22
140 mm (5.5 inches)	15.33	1.23	470 mm (18.5 inches)	173.42	13.96
152 mm (6 inches)	18.24	1.47	483 mm (19 inches)	182.92	14.73

Backreaming Fluid Requirements (continued)

Backreamer/Product Diameter	L/m	US gallon/ft	Backreamer/Product Diameter	L/m	US gallon/ft
165 mm (6.5 inches)	21.41	1.72	495 mm (19.5 inches)	192.68	15.51
178 mm (7 inches)	24.83	2.00	508 mm (20 inches)	202.68	16.32
191 mm (7.5 inches)	28.50	2.29	521 mm (20.5 inches)	212.94	17.15
203 mm (8 inches)	32.43	2.61	533 mm (21 inches)	223.46	17.99
216 mm (8.5 inches)	36.61	2.95	546 mm (21.5 inches)	234.23	18.86
229 mm (9 inches)	41.04	3.30	559 mm (22 inches)	245.25	19.75
241 mm (9.5 inches)	54.73	3.68	572 mm (22.5 inches)	256.52	20.65
254 mm (10 inches)	50.67	4.08	584 mm (23 inches)	268.05	21.58
267 mm (10.5 inches)	55.86	4.50	597 mm (23.5 inches)	279.83	22.53
279 mm (11 inches)	61.31	4.94	610 mm (24 inches)	291.86	23.50
292 mm (11.5 inches)	67.01	5.40	622 mm (24.5 inches)	304.15	24.49
305 mm (12 inches)	72.97	5.88	635 mm (25 inches)	316.69	25.50
318 mm (12.5 inches)	79.17	6.37	648 mm (25.5 inches)	219.49	26.53
330 mm (13 inches)	85.63	6.90	660 mm (26 inches)	342.53	27.58

Beacon Housings

Installing Dirt Housing Lid

1. Clean all threads, bolt holes, and mating surfaces.
2. Use removable thread locker (Loctite® 242 or equivalent).
3. Place the lid on the trough and install the bolts①.
4. Use punch holder③ to drive the roll pins② from the direction shown.

Bits

Bit Selection

These charts are meant as a guideline only. No one bit works well in all conditions. Contact your Ditch Witch dealer for soil conditions and bit recommendations for your area.

- 1 = best
- 2 = good
- 3 = fair
- 4 = not recommended

Bit	Sandy Soil	Soft Soil	Medium Soil	Hard Soil	Rocky Soil	Soft Rock	Hard Rock
Omni™	1	1	1	1	2	2	4
Steep taper tuff	2	2	1	1	2	1	4
Tuff	3	2	1	1	3	1	4

Installing Bit

Remove all paint and primer from mating surfaces before attaching any bit to housing. Install screws and tighten bolts to 163 N•m (120 ft•lb).

Quick Wrench

DANGER


Moving or thrown tools could strike the operator or bystanders. This will cause death or serious injury.

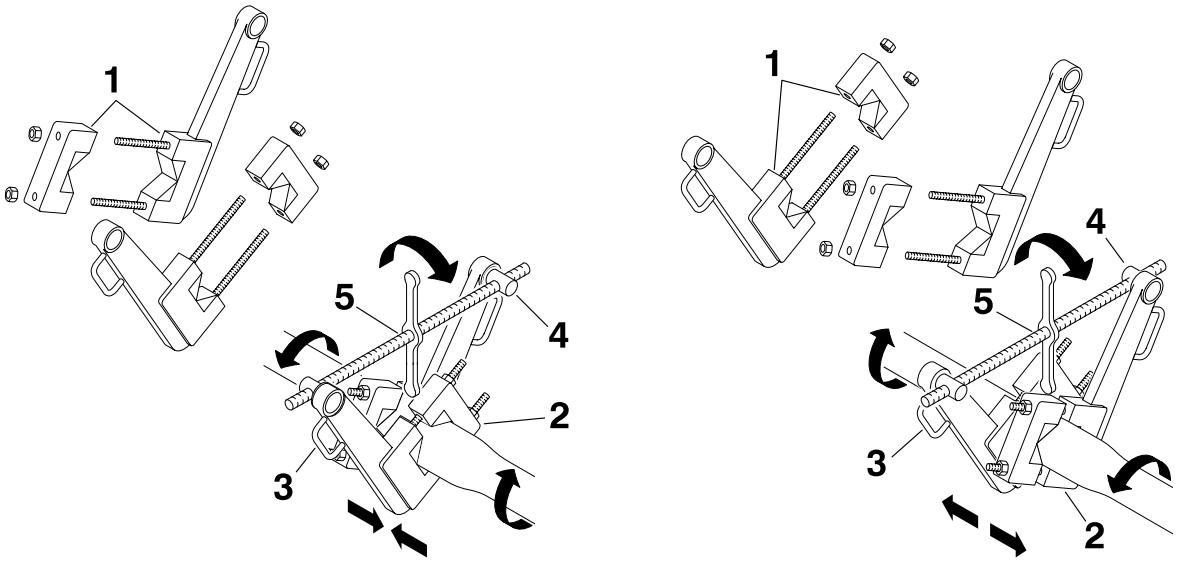
- **Never use pipe wrenches on the drill string.**
- **Follow the instructions in this manual for correct use.**

IMPORTANT

Apply tool joint compound to the threads and hand-tighten the joint before attaching quick wrench components to tighten the joint.

Attaching Quick Wrench

Attach the quick wrench in either the join (left) or break (right) position, as shown.



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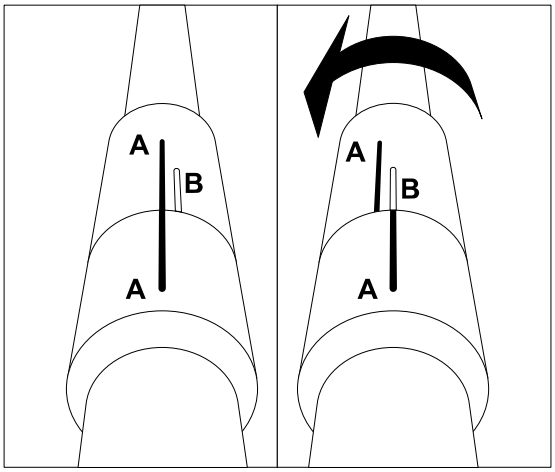
1. Shut off the machine.
2. Unbolt the vise(1) and place the jaws around the pipe.
3. Bolt the jaws of the vise together.
4. Place the jaw(2) around the pipe, transition sub, or downhole tool.
5. Pin the handles(3) to the wrench jaws. Ensure the handles are both up.
6. Attach the pivot nuts(4) to the wrench handles so that the screw drive handle(5) is over the joint.

Quick Wrench (continued)

Joining Pipe

1. Scribe a straight line across the joint on both sides of the separating line Ⓐ.
2. To join, scribe a second line Ⓑ on the movable side of the joint in the opposite direction of the tightening action. Refer to the table for the correct dimension.



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Connection	Dimension
Transition sub to JT21 Power Pipe® HD	6.35 mm (1/4 inch)
Transition sub to beacon housing	15.88 mm (5/8 inch)
Transition sub to #600 HDX pipe	6.35 mm (1/4 inch)

Breaking a Joint

IMPORTANT

Ensure the machine is shut off or the tracker operator has disabled thrust and rotation.

1. Turn the handle until the joint is broken.
2. Turn the handle in the opposite direction 2 turns to relieve pressure.
3. Remove the quick wrench components.

Nozzles

Nozzles control fluid flow from the pipe to the bore. Select nozzles that will supply at least the amount of fluid per minute needed for the flow and pressure you will be using. A nozzle that will supply more fluid per minute is recommended. Contact your Ditch Witch dealer for nozzle recommendations.

Drill Pipe

Regular Drill Pipe Care

Preconditioning New Pipe

IMPORTANT

Failure to follow this procedure could result in damaged or destroyed pipe.

Note: Precondition new SaverLok® body using this procedure.

Repeat this procedure 3 times for each piece of pipe before it is used the first time.

1. Hand lubricate the entire surface of threads and shoulders of both ends of pipe with tool joint compound.
2. Join pipe and tighten the joint.
3. Break the joint.
4. Move pipe back to the box.

Lubricating Joints before Each Use

Lubricate threads and shoulders of male joints with tool joint compound. This prevents rust and reduces wear on shoulders and threads.

Cleaning the Threads

Clean the threads as needed with high-pressure water and detergent.

IMPORTANT

Do not use gasoline or other petroleum-based solvents. This prevents tool joint compound from sticking to the joints and will reduce thread life.

Replacing Worn SaverLok® Body

IMPORTANT

Failure to replace SaverLok body will result in damaged drill pipe.

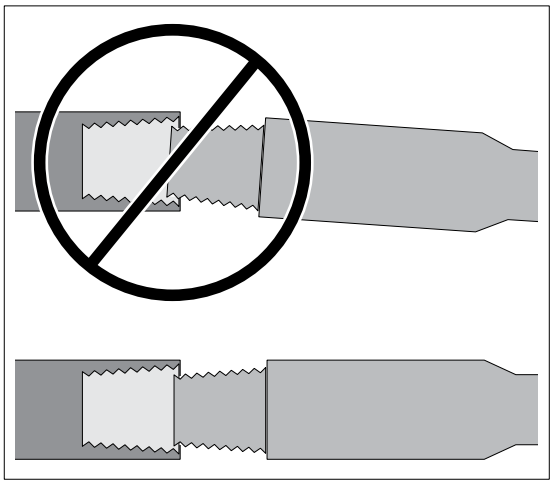
Because each pipe comes in contact with the SaverLok body, check SaverLok body regularly for wear. Compare condition of SaverLok body threads to condition of drill

pipe threads. Replace SaverLok body any time when its thread condition is not better than thread condition of drill pipe.

Correct Drill Pipe Use

Aligning the Joints

Always carefully align the male and female ends of the pipe before threading them together.



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IMPORTANT

- **Poor alignment can damage the threads and destroy the usefulness of the joint..**
- **If joints get out of alignment during a bore, use frame tilt or rear stabilizers to adjust the machine.**

Correct Joint Make Up and Break Out

IMPORTANT

To prevent thread crossing, galling, and shoulder swelling:

- **Make up and break out joints slowly.**
- **Do not ram pipes together during makeup or force them apart during breakout.**
- **Carefully match carriage travel speed to rotation speed, and always connect and disconnect joints slowly and deliberately.**

Regular Drill Pipe Care (continued)

Do Not Overwork Pipe

IMPORTANT

Bending pipe more sharply than recommended will damage pipe and cause failure.

Do not exceed the bend radius for pipe. Always make up drill pipe to the maximum machine rated torque.

Drilling Fluid

⚠ WARNING ⚠

Exposure to chemicals can cause death, serious injury, or illness the operator or bystanders.

Follow the instructions on labels and in the Safety Data Sheets (SDS).

⚠ WARNING ⚠

Exposure to silica dust could cause lung disease.

Use breathing protection.

- **Use water spray or other means to control dust.**
- **Follow US Occupational Safety and Health Administration (OSHA) or other applicable regulating guidelines for appropriate breathing protection or dust control methods.**

Drilling Fluid (continued)

Recommended Products

For productive drilling and equipment protection, use these recommended products, available at your Ditch Witch® dealer.

Product	Description
Bentonite	Forms a thin cake on bore walls, lubricating the bore and keeping it open and holding fluid
Premixed bentonite	Contains premixed bentonite, polymer, and soda ash
Polymer	Provides lubrication, increases viscosity in average soils and heavy clay, and reduces swelling that traps pipe in the bore in swelling clay
Wetting	Water soluble cleaning solution
Soda ash	Used to adjust pH of water and water hardness

Match drilling fluid to soil type. This chart is meant as a guideline only. Contact your Ditch Witch® dealer or drilling fluid representative for drilling fluid recommendations and soil conditions in your area, or use the Fluid Formulator on www.DitchWitch.com.

Soil Type	Drilling Fluid Recommendation
Smooth, flowing sand	Bentonite or premixed bentonite + medium chain polymer
Coarse sand or light soil	Bentonite or premixed bentonite
Heavy or swelling clay	Long chain polymer + wetting agent
Rock	Premixed bentonite

Mixtures

Bentonite does not mix well in water containing polymer. To use both, mix bentonite first, then add polymer. When adding other products follow the order listed below.

Note:

- If chemicals are added in the wrong order, they will not mix properly and will form clumps.
- If tank contains bentonite/polymer mix and more drilling fluid is needed, completely empty tank and start with fresh water before mixing another batch.

1. Soda ash
2. Bentonite
3. Polymer
4. Wetting agent

Drilling Fluid (continued)

Some things to remember when mixing bentonite:

- Use clean water free of salt, calcium, or excessive chlorine.
- Use water with pH level between 9 and 10.
- Use water with hardness of less than 120ppm.
- Do not use bentonite containing sand.
- Mix bentonite thoroughly or it will settle in tank.
- Do not mix bentonite to a funnel viscosity of over 50.

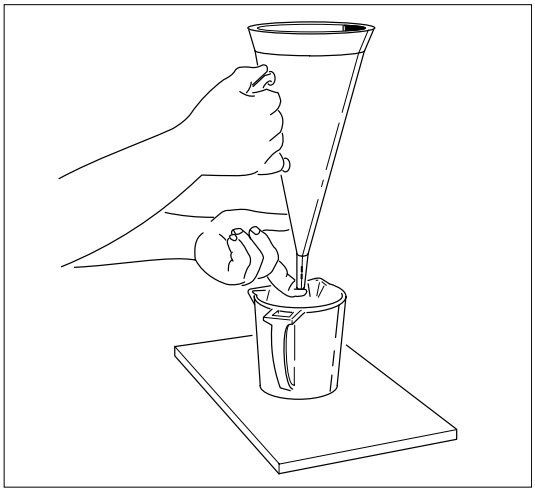
Measuring Funnel Viscosity

Note: Sand content of drilling fluid should be minimal and never exceed 0.25%.

Viscosity is the measure of internal resistance of a fluid to flow; the greater the resistance, the higher the viscosity. Viscosity of drilling fluids must be controlled. Contact your Ditch Witch® dealer or drilling fluid representative for more information.

To determine viscosity, you will need a Marsh funnel (p/n 259-267) and a measuring cup, available from your Ditch Witch® dealer.

Note: Ensure Marsh funnel is clean and free of obstruction and that you have a stopwatch available for timing the viscosity.



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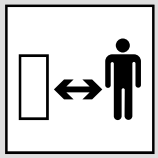
1. Using a clean container, take a fresh sample of drilling fluid. The sample must be at least 1.4 L (1.5 qt).
2. With finger over bottom of funnel, fill with fluid from the container through the screen until fluid reaches the bottom of the screen.
3. Move funnel over 0.95 L (1 qt) container.
4. Remove finger from bottom of funnel and use the stopwatch to count the number of seconds it takes for 0.95 L (1 qt) of fluid to pass through the funnel. The number of seconds is the viscosity.
5. Thoroughly rinse measuring cup and Marsh funnel.

Drilling Fluid (continued)

DrillLok System

⚠ DANGER ⚠



Contact with the rotating shaft will cause death or serious injury.

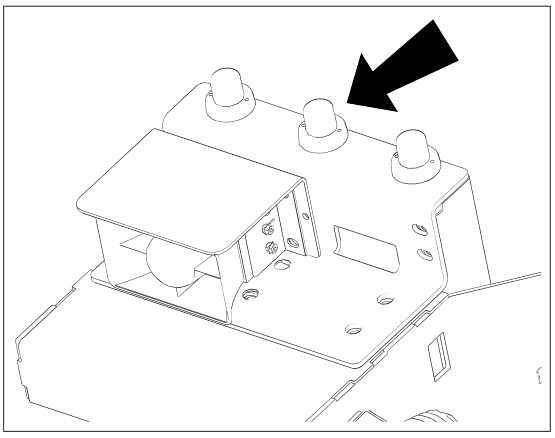
Stay away from the shaft.

- **Use DrillLok system every time downhole tools are changed or during other times when the drill string is exposed.**
- **If you are not using a DrillLok system, turn off machine and keep key in tracker operator's possession before changing downhole tools.**

Note:

- See the DrillLok Key section.
- This mode does not disable thrust and rotation immediately. Functions are disabled within 16 seconds.
- Tracker operator cannot disable thrust and rotation from tracker if DrillLok key is installed in machine and turned to the deactivated position.

This mode allows the tracker operator to disable hydraulic power to machine thrust and rotation. The green DrillLok indicator (shown), located on front of machine, will light when thrust and rotation have been disabled by DrillLok system.



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If operating with Subsite Electronics tracking equipment, DrillLok system will be incorporated into tracker. See tracker operator's manual.

If operating without Subsite Electronics tracking equipment, DrillLok system will be a separate handheld device. See DrillLok operation sheet.

Electric Strike System

WARNING

Contact with underground utilities could cause death or serious injury.

Locate and verify the location of underground utilities before digging or drilling.

IMPORTANT

The strike system does not prevent electric strike or detect strikes before they occur. If alarms are activated, a strike has already occurred and equipment is electrified.

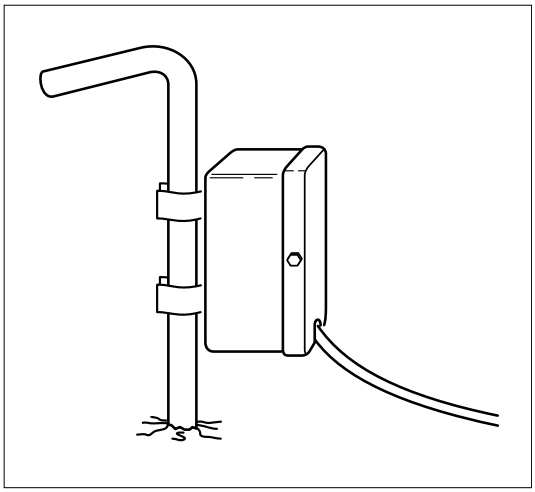
Electric strike system must be properly set up, tested, and used any time jobsite is classified as electric.

See the Apply Precautions. Review safety procedures before each job.

If an electric strike occurs, immediately contact your local Ditch Witch® dealer to have the electric strike system tested.

Assembling Voltage Detector

1. Drive voltage stake into ground at least 2m (6 ft) away from any part of system and behind drill frame.
2. Clip voltage limiter to voltage stake as shown.



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Testing Strike System

If component fails any part of this system test, see Troubleshoot Strike System section. Do not drill until system test is completed successfully.

1. Start engine.

Testing Strike System (continued)

2. Test alarms and strobe.
3. View test results and historical data stored in the display. This data includes:
   - ESID bar graph
   - alphanumeric readout showing volts and amps
   - current diagnostic codes, or diagnostic codes detected during previous tests
4. Use Electric Strike Simulator to test voltage and current sensors.

Strike System Troubleshooting

When strike system detects a problem, a diagnostic code will be displayed. If this happens, press manual-test button to retest. If an error code is still displayed and does not appear in this chart, have control module checked or replaced.

Other problem situations and their possible causes and solutions are listed in the chart below.

Problem	Possible Cause	Possible Solution
No communication with ESID. Red icon shown in upper display.	Problems in startup	Select test function from ESID menu. If problem goes away, retest strike system.
	No power to strike system control module	Check machine electrical system. Ensure harness from machine to control module is connected.
	Defective control module	Have control module checked or replaced.
	Defective CAN bus connection	Ensure CAN cable from machine to ESID control module is connected.
SPN521513 FMI31 DID224 shows on display	Test wire not connected	Ensure test wire is connected to ESID control module. Ensure test wire is connected to display. Have ESID control module checked or replaced.
Strobe light on machine does not work during system test	Improper connections with control module	Check connections and wiring harness.
	Defective strobe light	Disconnect strobe and connect to external 12V power source. If strobe still does not work, replace.

Strike System Troubleshooting (continued)

Problem	Possible Cause	Possible Solution
	Defective control module	Have control module checked or replaced.
Alarm on machine does not work during system test	Improper connections with control module	Check connections and wiring harness.
	Defective alarm	Disconnect alarm and connect to external 12C power source. If alarm still does not work, replace.
	Defective control module	Have control module checked or replaced.
SPN523518 FMI31 DID224 and red ESID current indicator shows on display	Improper connections with control module	Check cable connections on control module and current transformer.
	Defective current transformer	Disconnect current transformer. Check for 20-40ohms from pin 1 to pin 4 and from pin 1 to pin 2, and less than 1ohm from pin 2 to pin 4.
	Defective current transformer cable	Disconnect cable from transformer and control module and check continuity of cable. If continuity is zero or cable is damaged, replace.
	Defective control module	Have control module checked or replaced.
Red ESID voltage indicator shows on display	Improper connection of voltage limiter to ground stake	Check voltage limiter connection to ground stake and verify that ground stake is driven properly.
	Improper connections with control module	Check cable connection on control module.
	Defective voltage limiter	Have voltage limiter checked or replaced.
	Defective control module	Have control module checked or replaced.

Electric Strike Simulator

Use the Electric Strike Simulator (p/n 220-1275) to test voltage and current sensors on ESID. If readings are less than indicated here, replace battery in simulator and retest. If readings are still less than indicated, contact your Ditch Witch dealer to have ESID repaired before drilling.

Current Test

Testing for Current at Normal Levels

1. Thread one lead wire through current transformer.
2. Clip ends of lead wires together to make one loop.
3. Select ESID menu on upper display.
4. Move simulator switch to “current” and press test button.
5. Watch display on upper display.
   - ESID bar graph should show 1/2 scale on display.
   - ESID % and current “AMPS” should show 30% or higher in display.

Testing for Current at Strike Levels

1. Thread two or three loops through current transformer.
2. Follow steps above to test.
3. Display should show the following:

   With 2 loops:

   - Current “AMPS” should be 80% or higher.
   - Strike indication might go on and off.

   With 3 loops:

   - Current “AMPS” should be 130% or higher.
   - Strike indication should be continuous.

Performing Voltage Check

1. Place voltage limiter on something insulated from ground and machine (such as dry board or tire), but near frame of machine.
2. Clip one lead to frame.
3. Clip other lead to one voltage limiter mount.
4. Move simulator switch to “Voltage” and press test button.
5. Display should show the following:
   - ESID % and voltage “VOLTS” should show 90% or higher.
   - Alarm and strobe should turn on.

Electric Strike Simulator (continued)

It is normal for simulator voltage levels to drift below strike level. When this happens, ESID bar should show less than full and alarm and strobe should stop working. If the level drifts above strike level again light, ESID bar, and strobe should be turned on again.

Pipe Loader

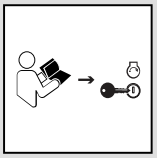
Adding/Removing Single Pipe

⚠ WARNING ⚠


Horizontal movement could crush operators and bystanders causing death or serious injury.

- **Read and understand the operator's manual and all safety instructions before use.**
- **Never attempt to move shuttles until everyone is at least 3 m (10 ft) away from machine.**
- **Ensure switch operator is standing clear of all moving parts while adding pipe.**

⚠ WARNING ⚠

Misuse of the machine could cause death or serious injury.

- **Read and understand the operator's manual and all other safety instructions before use.**
- **Know how to use all the controls.**
- **Use auxiliary pipe loading controls to add/remove single pipe. See the Auxiliary Pipe Loading section.**
- **Open or close both auxiliary pipe loaders.**
- **Carriage must be in full back position to load and unload pipe.**
- **Always use provided pipe guide.**
- **Drill pipe is heavy. Have enough people on hand to manually add or remove single pipe to pipe box.**

⚠ WARNING ⚠


Contact with underground utilities could cause death or serious injury.

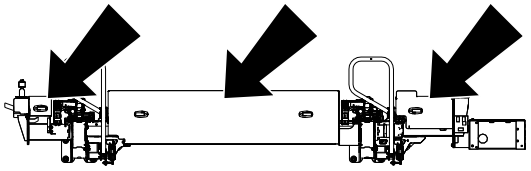
- **Locate and verify the location of underground utilities before digging or drilling.**
- **Never attempt to load and unload pipe while drilling or backreaming.**
- **On electrical jobsite, load and unload pipe only if loader is wearing electrically insulating boots and gloves.**

Load a single pipe or up to a whole row of pipe into last row of pipe box to finish bore without changing pipe boxes. Pipe can be added as soon as last row of pipe has been started and other rows are empty. Unload added drill pipe with auxiliary pipe

Adding/Removing Single Pipe (continued)

loaders once bore is finished. Pipe in last row of pipe box can be unloaded only when other rows are empty.

1. Select last row.
2. Override drill operator control of shuttles and pipe lifters.
3. Lower shuttle covers.
4. Lower pipe lifter covers.
5. Extend shuttles fully.
6. Rotate auxiliary pipe loaders into position as shown.



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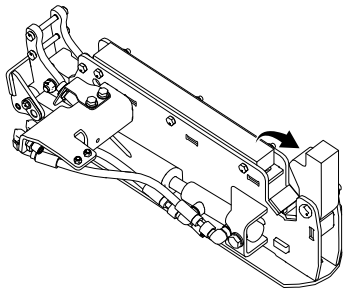

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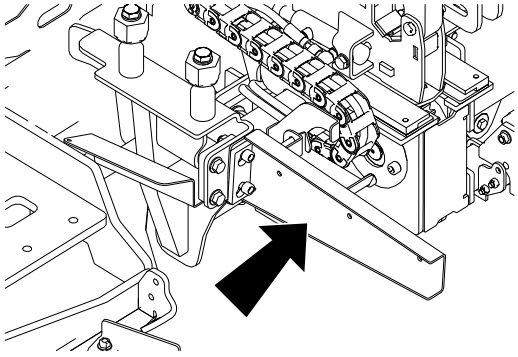
7. Remove pipe guide (stored on shuttle drive cover) and attach to front of pipe loader frame as shown.



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To Add a Pipe:

   A. Load single pipe in auxiliary pipe loader and rest against pipe guide.
   B. Move auxiliary pipe loaders under last row.
   C. Raise pipe lifters.
   D. Extend shuttles.
   E. Repeat if more than one pipe is needed.
   F. Lower pipe lifters.

To Remove a Pipe:

   A. Raise pipe in last row.
   B. Retract shuttles.
   C. Lower pipe lifters.
   D. Extend shuttles.
   E. Remove pipe from auxiliary pipe loaders and store properly.
   F. Repeat if more than one pipe was added.

8. Close both auxiliary pipe loaders.
9. Remove pipe guide and store on shuttle drive cover.
10. Replace covers.

Adding/Removing Single Pipe (continued)

11. Enable drill operator controls of shuttles and pipe lifters.
12. Step away from machine.

Correcting Dropped Pipe

To return a dropped pipe to the drill string, shut off machine and manually retrieve pipe. Return it to pipe box by loading as a single piece of pipe. See the Adding/ Removing Single Pipe section.

Correcting Misaligned or Jammed Pipe

A pop-up message on the display will indicate a misaligned or jammed pipe. Turn engine off and inspect pipe in active row. If drill pipe is bent, remove from pipe box and discard.

IMPORTANT

If misaligned or jammed pipe cannot be corrected by removing bent pipe, contact your Ditch Witch® dealer for assistance.

Pipe Box Removal/Installation

⚠ DANGER ⚠

Contact with overhead electrical lines will cause death or serious injury.

- **Know the location of lines.**
- **Stay away.**
- **Follow US Occupational Safety and Health Administration (OSHA) guidelines for working around overhead electrical lines.**

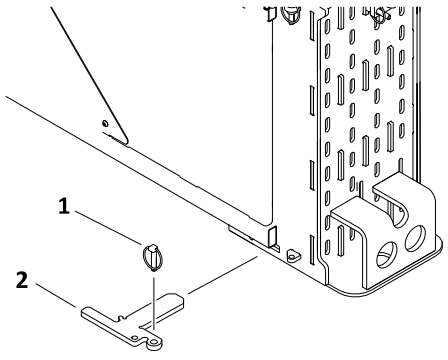
⚠ WARNING ⚠

A lifted load could crush the operator or bystanders, causing death or serious injury.

- **Stay away from the lifted load and its range of movement.**
- **Always walk around machine and check for obstructions before moving load.**
- **Use equipment capable of supporting the equipment's size and weight. See the Specifications section or measure and weigh equipment before lifting.**
- **Never remove pins from ends of pipe box until lifting device is attached. Box may fall if pipe lift switch is pressed without end pins in place.**
- **Lift only one box of pipe at a time.**
- **Never take your eyes off moving load. Always look in the direction load is moving.**
- **Never swing a load over people.**

Preparing

1. Raise pipe and remove pins (1) and support bars (2) from pipe box storage pockets.
2. Insert each support bar into opening and retain with pin through tab.
3. Lower pipe.



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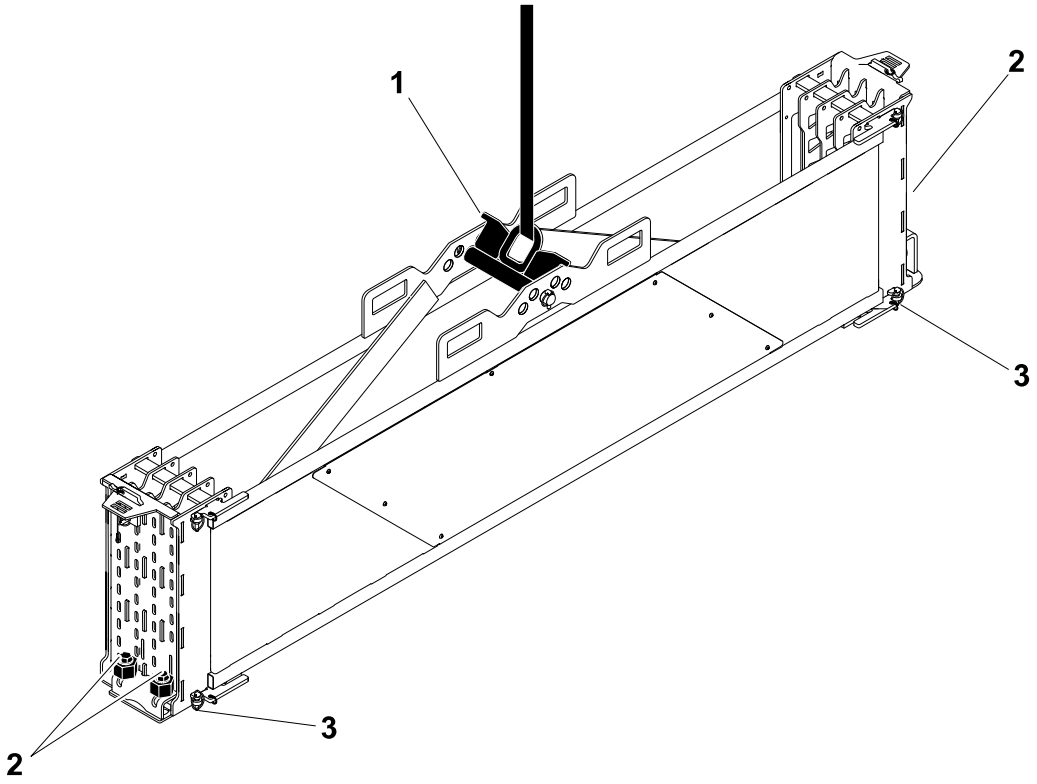
Pipe Box Removal/Installation (continued)

Removing Pipe Box

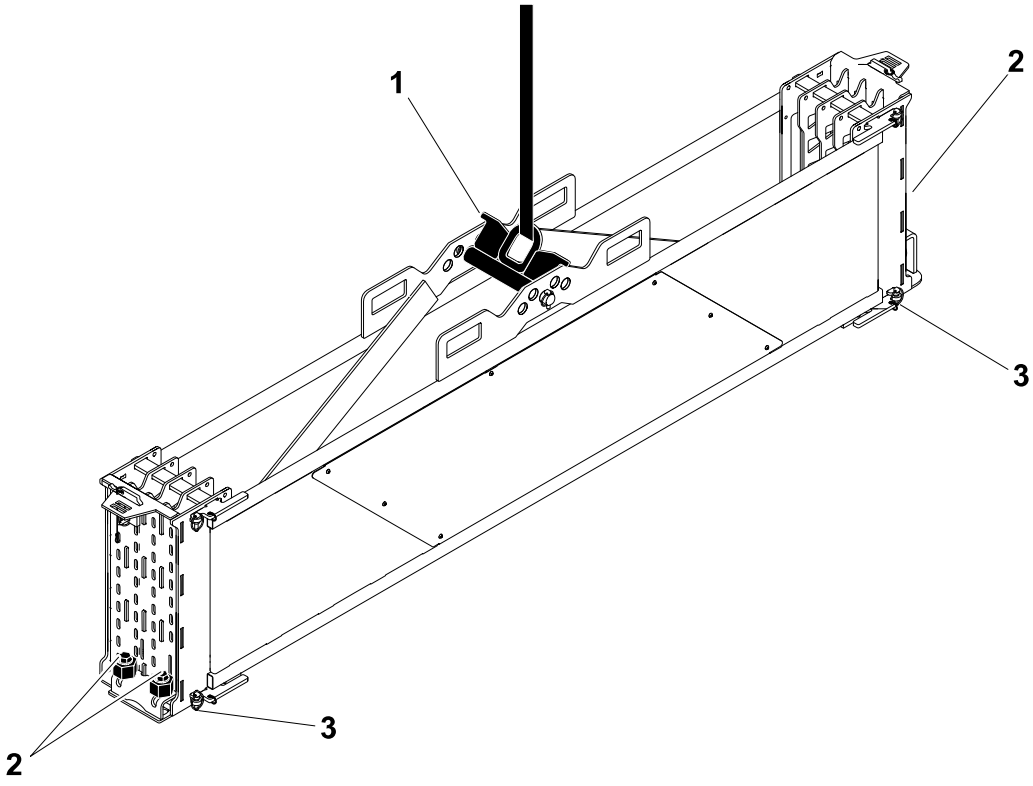


G513607

1. Install the lift block① and secure with the lift block support bar and pins. Adjust to match the drill frame angle.
2. Ensure the bottom support bars③ are in place on both ends of the pipe box.
3. Remove threaded caps② from the pins.
4. Move the pipe box off of the drill frame.

Pipe Box Removal/Installation (continued)

Installing Pipe Box



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IMPORTANT

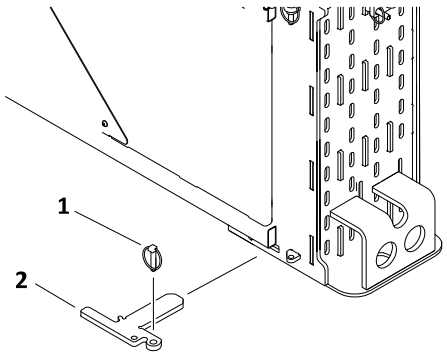
The pipe box should only be installed onto the pipe loader when the shuttle is in the first row position.

1. Move the pipe box over front and rear locating pins and lower into position. Ensure the pipe box is moved all the way to the front.
2. Install threaded caps(2) onto the pins.
3. Raise the pipe lifters.
4. Remove the bottom support bars(3) from both ends of the pipe box. Store the support pins in pipe box storage pockets.

Rotating Drill Pipe Order

Rotating the drill pipe is a manual process. Rotate drill pipes in the drill string weekly. Rotate only as many rows as used on the longest bore of the week. For example, if the longest bore was 61 m (200 ft), then only rotate two rows used.

1. Remove pipe retainers (2) from the stowed position.
2. Raise pipe lifters until the pipe retainer slot is free of obstruction.
3. Insert pipe retainers into slot on front and rear of pipe box on the first row of pipe.
4. Secure the pipe retainer with pin (1).
5. Adjust the row stop to the second row of pipe.



G513608

6. Operate drill until the desired row(s) of pipe remain.
7. Set the row stop to the first row.
8. Raise the pipe lifters to take weight off of the pipe retainers.
9. Remove the pipe retainers and secure in the stowed position.
10. Operate drill until the pipe box is empty.
11. Fill the box using normal operating procedures.

Row Select

IMPORTANT

- **Do not raise the pipe lifters with too many pipes in a row.**
- **The shuttle must be extended from under the pipe box when row is selected.**

Drilling

Change the row when the row is empty. If the automated pipe loader is being used, the display will indicate that it is time to select a new row. Use the row select buttons to select a new row.

Backreaming

Select the next row when the active row is full.

Sensor Override

Automated functions of this machine are made possible by information collected from many sensors on the machine. Sensor override mode permits limited operation without automated functions and standard equipment protections when an issue is detected with one or more of the sensors. In sensor override mode, an operator can complete a bore and move the machine away from the jobsite so that proper repairs can be made at a Ditch Witch dealership.

IMPORTANT

Some automated functions that can protect components from damage are NOT available in sensor override mode. Use extreme caution when operating in sensor override mode.

Note: Only qualified Ditch Witch service technicians can return machine to normal operation.

If a sensor affected by the sensor override mode has an error and needs attention, a pop-up message will appear on display. Each pop-up message will give the operator the option to override the error. The table below details how automated functions are affected in sensor override mode.

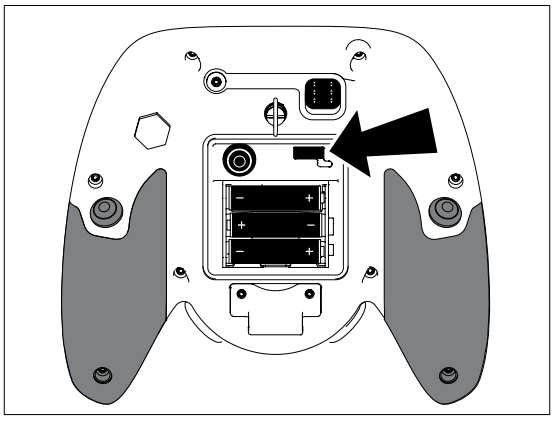
Pop-Up Message	With Override	Without Override	Cause
Automatic row stop	Pipe loader automation and automatic row change disabled Row stop will stay in current position Row must be changed by manually repositioning row stop	Shuttle will not move Row stop will stay in current position	Row select sensor reads out of range Row select motor pulling too much or too little current Row select sensor not detecting movement when row select should be moving
Carriage sensor	Two-speed carriage control, pipe loader automation, and distance drilled disabled	Carriage unable to move and shuttles unable to extend from under pipe box	No CAN communications Sensor shows carriage is beyond front or rear stop Sensor does not detect movements when carriage should be moving
Rotation pressure sensor	Rotation, SaverLok attach pressure limiting not active	Rotation unable to move	One or both rotation pressure sensors disconnected or reading out of range

Pop-Up Message	With Override	Without Override	Cause
	Excessive torque could damage components Rotation pressure reading on display not available Pressure in counterclockwise direction not limited during carve		Rotation pressure sensor reading pressure when no pressure should be present
Rotation pump control sensor	Rotation operates without rotation pump control sensor Rotation control will be less precise Rotation speed varies with pressure more than normal	Rotation unable to move	One or both rotation pump control sensors disconnected or reading out of range Rotation pump control sensor not reading centered when pump not in operation
Thrust pressure sensor	Thrust pressure limiting not active Excessive thrust could damage components Thrust pressure reading on display not available	Carriage unable to move	One or both thrust pressure sensors disconnected or reading out of range Thrust pressure sensor reading pressure when no pressure should be present
Thrust pump control sensor	Thrust operates without thrust pump control sensor Thrust control less precise Thrust speed varies with pressure more than normal	Carriage unable to move	One or both thrust pump control sensors disconnected or reading out of range Thrust pump control sensor not reading centered when pump not in operation

Wireless Remote Control

Setting Up Wireless Remote Control

1. Check wireless remote control battery status. Replace batteries if needed. See the Battery, Wireless Remote Control section.
2. Ensure USB key (shown) is installed. This key is a lock-out feature to prevent unauthorized use.



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Operating

EMERGENCY SHUTDOWN: Press the emergency stop switch..

⚠ WARNING ⚠

Impact from remote-controlled equipment could cause death or serious injury.

- **Stay away.**
- **Never drive while on machine.**
- **Keep machine in sight at all times when using wireless remote control.**
- **Keep a safe distance away from machine when operating wireless remote control.**
- **Ensure bystanders are not near the area where machine will be driven.**
- **Remove strap from around neck when using wireless remote control near moving parts.**

IMPORTANT

Place wireless remote control in storage box after use. Take care not to store with neck strap on top of switches.

Note: The operator station must be empty to operate wireless ground drive control.

1. Turn on the wireless remote control. The wireless remote control indicator will light.

Note: The wireless remote control will shut down after one minute of inactivity. Move the power/start/horn switch up to restart.

2. Select mode.
3. Operate.
4. Turn the wireless remote control off when the job is complete.

Troubleshooting

IMPORTANT

If the machine does not respond as expected when using wireless ground drive, turn the transmitter off and use alternate ground drive controls.

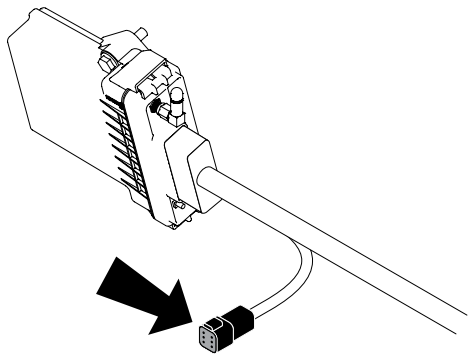
If the communication link indicator is flashing yellow, communication between the wireless remote control and machine has stopped. Move the wireless remote control closer to the machine while maintaining a safe distance. If in an area with interference, try changing the channel (see Changing Channel section).

If communication link indicator is red, communication has been lost. Shut down wireless remote control and restart enable communication. If remote still will not work, contact your Ditch Witch dealer.

If battery and communication link indicators both display red for several seconds and then the wireless control shuts off, USB key is not installed.

Changing Channel

1. Activate accessories.
2. Connect harness to transmitter(2).
3. Ensure the battery indicator is solid green.



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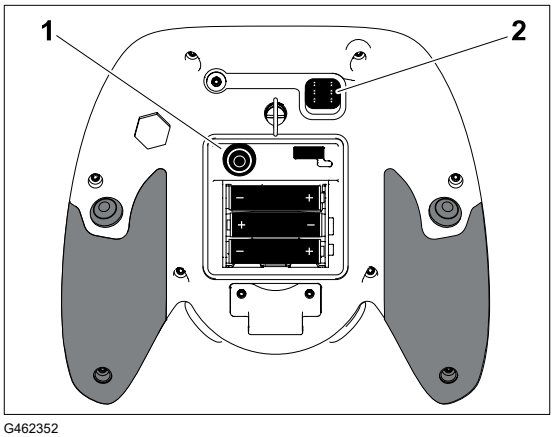
4. Press the channel switch(1) until the communication link indicator begins to flash green/yellow and then release the channel switch.
   - A rapid flashing green indicator signals successful channel connection.
   - A flashing yellow indicator signals unsuccessful channel connection.



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Chapter 8

Maintenance

Table of Contents

Pre-Maintenance Procedures

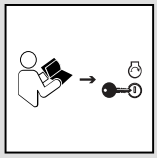
Maintenance Precautions

⚠ WARNING ⚠


Exposure to jobsite hazards could cause death or serious injury.

- **Read and understand the operator's manual and all safety instructions before use.**
- **Wear personal protective equipment including hard hat, safety eye wear, foot protection, hearing protection, and gloves (except when near rotating equipment).**
- **Remove jewelry.**
- **Wear close-fitting, high visibility clothing.**
- **Have other personal protective equipment, such as insulated boots and gloves, breathing protection, face shield, etc. available for use depending on jobsite hazards or requirements.**

⚠ WARNING ⚠

Misuse of the machine could cause death or serious injury.

- **Unless otherwise instructed, all service should be performed with the engine off and cool.**
- **Lower unsecured, raised components before servicing equipment.**
- **Unless otherwise instructed, all service should be performed with the machine parked on a level surface.**
- **Refer to the US Occupational Safety and Health Administration (OSHA) guidelines for appropriate lockout-tagout procedures.**

- Making unauthorized modifications to the machine may result in it no longer meeting safety standards and regulations and/or not functioning properly. Allow only competent and trained personnel to modify the machine according to the applicable standards, regulations, and machine design functionality and requirements.
- Do not allow untrained personnel to service the machine.
- Park the machine on a level surface, lower the stabilizers and drill frame, chock the tracks, shut off the engine, and remove the key. Wait for all movement to stop and allow the machine to cool before adjusting, cleaning, storing, or repairing it.
- Refer to the US Occupational Safety and Health Administration (OSHA) guidelines for appropriate lockout-tagout procedures.
- Keep your hands and feet away from the moving parts. If possible, do not make adjustments with the engine running.

Maintenance Precautions (continued)

- Do not tamper with the safety devices.
- Clean up oil or fuel spills.
- Carefully release pressure from components with stored energy.
- Use jack stands to support raised components when required.
- If welding is required, see your Authorized Service Dealer.

Equipment Modification

This equipment was designed and built in accordance with applicable standards and regulations. Modification of equipment could mean that it will no longer meet regulations and may not function properly or in accordance with the operating instructions. Modification of equipment should only be made by competent personnel possessing knowledge of applicable standards, regulations, equipment design functionality/requirements and any required specialized training.

Welding Precaution

IMPORTANT

Welding can damage electronics.

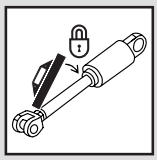
- **Welding currents can damage electronic components. Always disconnect the ECU ground connection from the frame, harness connection to the ECU, and other electronic components prior to welding on machine or attachments.**
- **Connect the welder ground close to the welding point and make sure no electronic components are in the ground path.**
- **Disconnect the battery at the battery disconnect switch before welding to prevent damage to the battery. See the Battery Service section for more information.**
- **Never turn off battery disconnect switch with engine running or alternator and other electronic equipment devices may be damaged.**

Recommended Lubricants

Proper lubrication and maintenance protects equipment from damage and failure. Maintenance intervals listed are for minimum requirements. In extreme conditions, service machine more frequently. Use only genuine Ditch Witch parts, filters, approved lubricants, TJC, and approved coolants to maintain warranty. Fill to capacities listed in the respective maintenance sections.

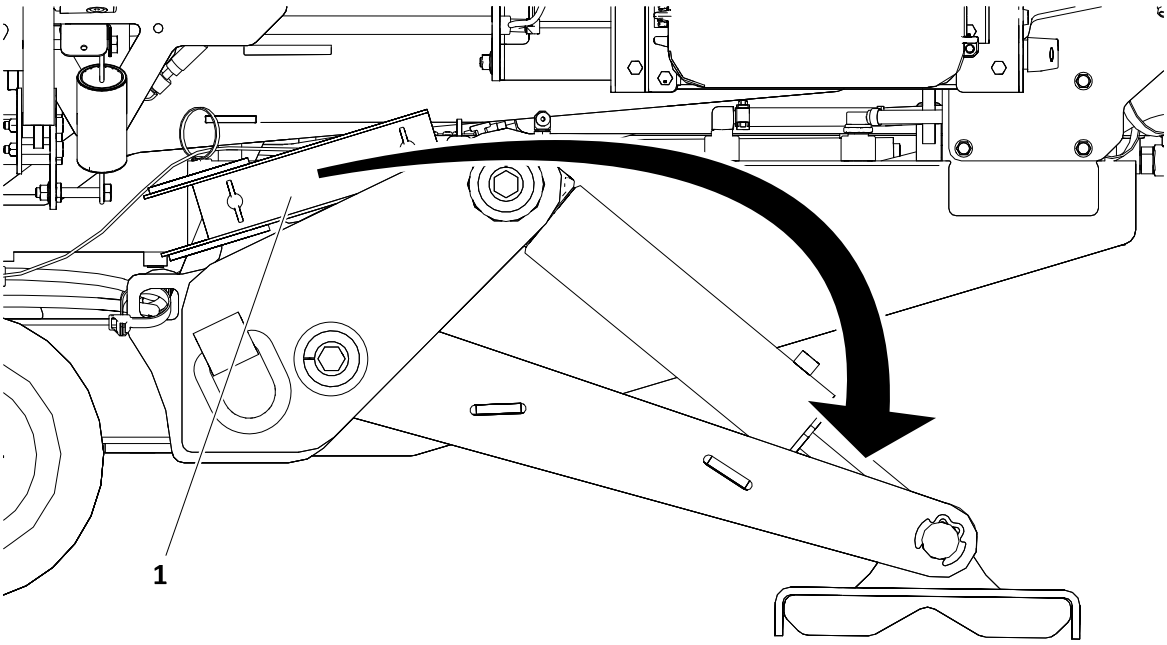
Working Under the Machine

⚠ WARNING ⚠



A raised component could crush the operator or bystanders, causing death or serious injury.

- **Stay away or secure the raised component with a locking device.**
- **Use the correct equipment and procedures.**



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Before working under the area the machine supported by the stabilizer or frame tilt cylinder, ensure the machine is parked on a hard surface.

1. Lower stabilizers fully.
2. Remove stabilizer locks (1) from storage and place the slots on the stabilizers.
3. Install spring pins.
4. Lower the machine until the load is supported by the stabilizer locks.

Cleaning

Rinsing Equipment

⚠ WARNING ⚠


Contact with pressurized fluid or air could cause death or serious injury.

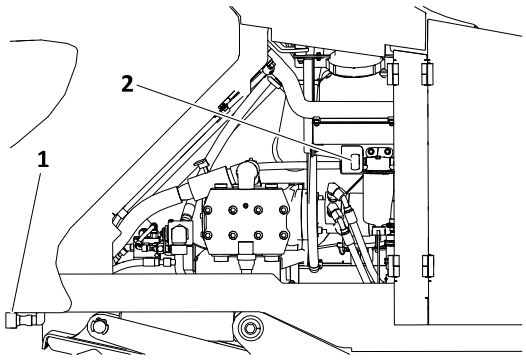
Follow the instructions in this manual for correct use.

- **Never use high flow when using the wash wand.**
- **Never point or aim the wand at yourself or anyone else. Keep the nozzle low to the ground.**
- **Prime the drilling fluid pump before operating the wash wand. Failure to prime the drilling fluid pump will cause flow fluctuations, which will make it difficult to control the wash wand.**

IMPORTANT

- **Do not spray water onto the operator console or electrical center in the engine compartment. Water can damage electrical components. Wipe them down instead.**
- **Ensure all mud and debris is rinsed from the tracks before parking the machine overnight.**

1. Turn the fluid flow to low.
2. Turn off the fluid pump.
3. Connect the wash wand at the quick connect① at the rear of the machine.
4. Press the wash wand switch② to close the discharge valve.
5. Turn on the fluid pump.
6. Check surroundings before pressing the handle to start pressurized fluid flow.



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7. Spray water onto equipment to remove dirt and mud. Some pressure might be needed to remove dried mud from the wrench area. Thoroughly rinse the operator station and step.

   Note: If the front wrench is clamped, fluid will not flow to the wash wand.
8. Release the handle to stop the flow.

Maintenance Symbols

	DEO — Engine Oil		DEAC — Coolant		Tractor Hydraulic Fluid — THF
	TJC — Tool Joint Compound		MPG — Multipurpose Grease		PF — Phillips 66® PowerDrive® Fluid
	Fuel		MPL — Multipurpose Gear Oil		Filter
					Check

Maintenance Interval Chart

▽	Adjust, service, or test	□	Change, initial	○	Lube, initial
▲	Check	■	Change	●	Lube

Service	Before startup	10 Hours	50 Hours	100 Hours	250 Hours	500 Hours	1000 Hours	2000 Hours	As Needed
Battery		▲							▽
Battery, wireless remote control									■
Belt, engine drive			▲						■
Coolant	▲	▲						■	
Drilling Fluid Y-Strainer	▲	▲							
Dust ejector valve	▲	▲							
Engine compartment			▲						
Filter, air	▲								■
Filter, engine oil (see Oil, engine)									
Filter, fuel							■		
Filter, hydraulic			□			■			
Fluid, hydraulic	▲	▲					■		
Fluid pump	▲	▲							

Hydraulic lines	▲	▲							
Hydraulic tank			▽						
Oil, engine	▲	▲			■				
Oil, fluid pump	▲	▲	□					■	
Oil, ground drive gearbox			▲				■		
Pipe auto-lubricator	▲	▲							
Pipe guide inserts	▲								■
Pipe loader inserts	▲								
Radiator	▲								▽
Radiator cap						▲			
SaverLok system			▲						■
Slide blocks			▲						
Tool joint compound	▲	▲							■
Track tension	▲	▲							▽
Water separator	▲	▲							
Wrench jaw inserts	▲								■

Cooling System Maintenance

Cooling System Specifications

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

	DEAC	Diesel engine antifreeze/ coolant meeting Deutz® DQC CB-14 See Approved Coolant section.
	Capacity	18.9 L (5 US gallons)

Approved Coolant

IMPORTANT

- **Use only pre-diluted coolant or concentrated coolant mixed with distilled water. Do not use tap water.**
- **Using water or high-silicate automotive-type coolant will lead to engine damage or premature engine failure.**
- **Mixing heavy-duty diesel engine coolant and automotive-type coolants will lead to coolant breakdown and engine damage.**

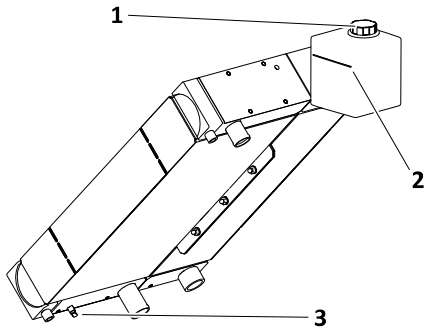
This machine was filled with coolant meeting Deutz® DQC CB-14 (red in color) before shipment from factory. Add or replace only with coolant meeting this specification. This coolant is available, pre-diluted, from your Ditch Witch dealer as part number 255-1053. Contact your Deutz service partner for a full list of approved coolants meeting DQC CB-14. In an emergency, non-Deutz approved, heavy duty diesel engine coolant meeting ASTM D6210 may be used. Change to DQC CB-14 coolant as soon as practical.

Checking Coolant

1. Check the coolant level of the expansion tank.
2. Add DEAC at the fill point as needed to keep the level at the fill line.

Changing Coolant

1. Remove the fill cap①.
2. Open the drain② to drain fluid.
3. Close the drain③.
4. Add DEAC at the fill point to the fill line.
5. Start the engine.
6. Run the engine at 90° C (195° F) for several minutes.
7. Stop the engine and let it cool.
8. Check the coolant level.
9. Add DEAC at the fill point as needed to keep the level at the fill line.



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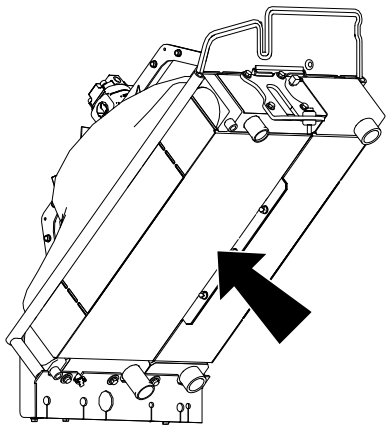
Cleaning Radiator

IMPORTANT

Radiator may need to be cleaned more frequently in dusty or grassy conditions.

1. Check the radiator (shown) for dirt, grass and other debris.
2. Clean the fins with compressed air or spray wash.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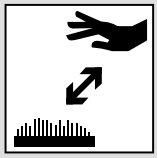
IMPORTANT

Cleaning with high pressure air or water can damage fins.

3. Open the rear hood and spray through the radiator toward the engine.
4. If grease and oil are present on the radiator, spray it with solvent and allow it to soak overnight.

Checking Radiator Cap

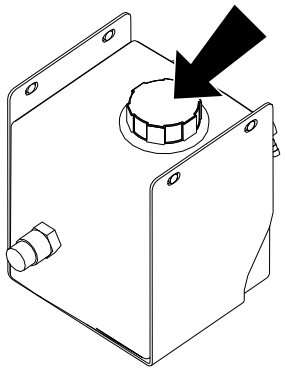
⚠ CAUTION ⚠



Contact with hot parts can cause burns. Only touch parts when they are cool or wear gloves.

Wait for the machine to cool before inspecting the radiator cap.

Inspect the radiator cap (shown). Ensure the rubber seal is not damaged. Replace as needed.



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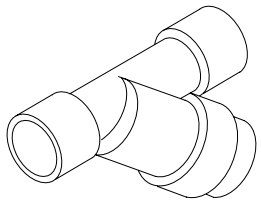
Drilling System Maintenance

Checking Drilling Fluid Y-Strainer

Ensure the y-strainer is free of obstructions and operates properly. Clean as needed.



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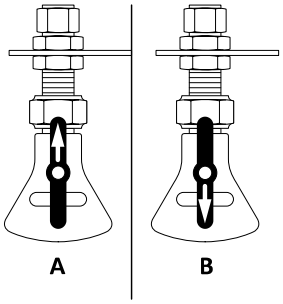
Cleaning Pipe Auto-Lubricator

1. Check that the nozzle is free of obstructions and operates properly.
2. To clean, rotate the handle upward to the clean position Ⓐ.
3. Operate the pump until any obstruction is flushed.



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IMPORTANT

If the neoprene washer is dislodged while cleaning, the entire nozzle must be replaced.

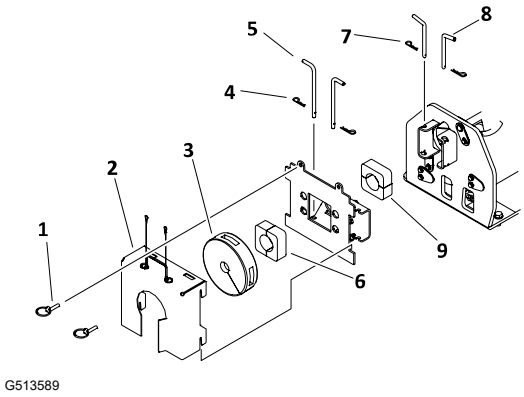
4. Rotate the handle down to the spray position Ⓑ.
5. Clean the nozzle guard. If necessary, pull the handle/nozzle insert out of the housing to clean it with a fine wire or solvent.

Pipe Guide Inserts

Changing Pipe Guide Inserts

Note: Inserts can be rotated for longer wear.

Check inserts for wear.



Replacing Front Inserts

1. Remove lynch pins(1).
2. Remove the wiper catch(2).
3. Remove split rod wiper(3), if equipped.
4. Remove cotter pins(4) to remove pins(5).
5. Replace guide inserts(6).
6. Reassemble.

Replacing Rear Inserts

1. Remove cotter pins(7).
2. Remove guide inserts(8).
3. Replace guide inserts(9).

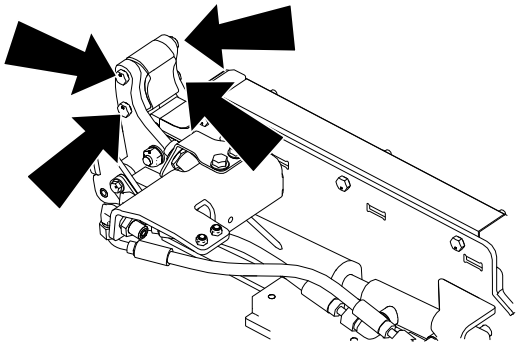
Checking Pipe Loader Wear Pads

Note:

- Ensure four bolts (shown) are loose enough to enable pad to move freely and wear evenly.

Checking Pipe Loader Wear Pads (continued)

Check locations shown for wear. Change as needed.



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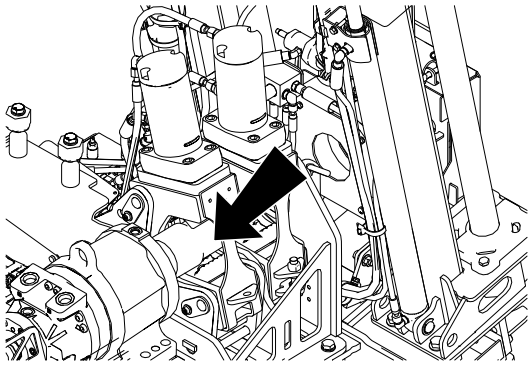
Checking the SaverLok® System

1. Start the engine.
2. Position the carriage so the collar can be clamped in the rear wrenches.
3. Clamp wrenches on the collar and tighten the SaverLok assembly until the rotation pressure gauge reads 310–345 bar (4500–5000 psi) in low speed setting.



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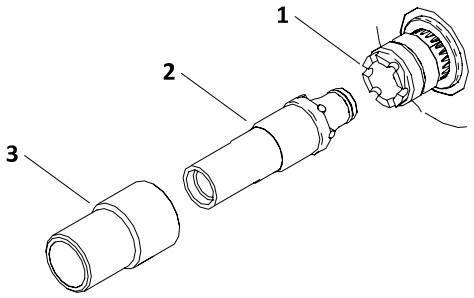
Changing the SaverLok® System

Removing SaverLok System

1. Start the engine.
2. Ensure the front wrench is clear of all pipe and tooling.
3. Position the carriage so collar 3 can be clamped into the rear wrench.
4. Clamp the rear wrench on the collar. The wrench will rotate counterclockwise.



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Changing the SaverLok® System (continued)

IMPORTANT

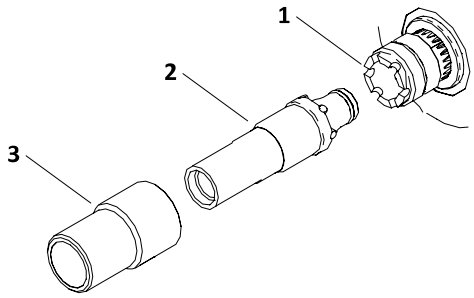
Clamping the wrench on the large diameter of the collar or the nose of the SaverLok will damage the threads.

5. Rotate the spindle counterclockwise to unthread the collar.
6. Remove the collar and set it aside.
7. Remove the body(2) from the connection(1).

   Note: The machine may not build enough torque to break out the collar unless the engine is at high throttle.
8. Shut off the machine.

Installing SaverLok System

1. Inspect the connection for damage.
2. Apply TJC to threads and all surfaces in contact with the body and the collar.
3. Insert the body into the connection.
4. Insert the body into the connection until the o-ring is fully engaged using one of the following methods:
   - Slide the collar over the body and engage the threads by hand.
   - Tap the nose with a rubber mallet until the o-ring is fully engaged.



G513573

5. Position the body by hand for proper engagement of pins and grooves.
6. Slide the collar over the body and hand-tighten (typically 3 to 4 turns).
7. Start the engine.
8. Position the carriage so the collar can be clamped in the rear wrenches.
9. Set the rotation speed to low.
10. Clamp the wrench on the collar and tighten the assembly until rotation pressure gauge reads 310–345 bar (4500–5000 psi).

    Note: The machine may not build enough torque to tighten the collar unless the engine is at high throttle.
11. Immediately loosen the collar and repeat the process 5 times to break in the contact surfaces.
12. Tighten the assembly until the rotation pressure gauge reads between 310–345 bar (4500–5000 psi).

Changing the SaverLok® System (continued)

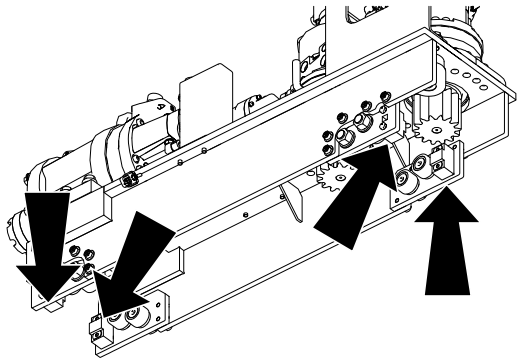
IMPORTANT

Clamping the wrench on the large diameter of the collar or nose of the SaverLok will damage the threads.

13. Shut off the machine.

Changing Slide Blocks

Check the blocks (shown) for wear. Change as needed.



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Tool Joint Compound Specifications

	TJC	Ditch Witch standard or environmental

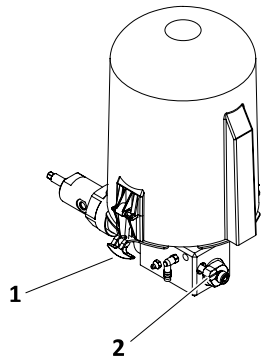
Changing Tool Joint Compound

IMPORTANT

Use only genuine Ditch Witch TJC to maintain warranty.

Change TJC when the bellows is near the base of the canister.

1. Unlatch the rubber latches①.
2. Turn the canister 1/8 turn counterclockwise and lift it off the base.
3. Position the new canister over the base and turn it 1/8 turn clockwise to align with the latches.
4. Fasten the rubber latches. If the TJC does not spray out, turn the priming knob②.



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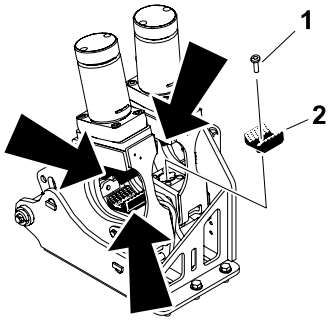
Changing Wrench Jaw Inserts

1. Check for wear.
2. With wrenches open, remove the shoulder bolt①.
3. Remove insert②.
4. Install new insert and new shoulder bolt.



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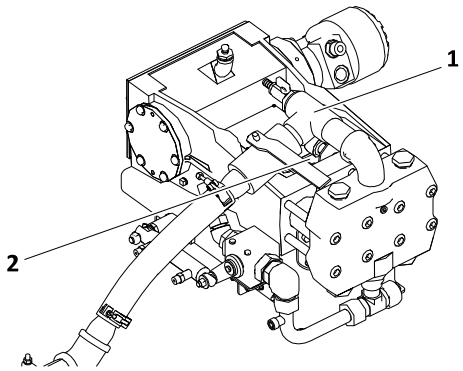
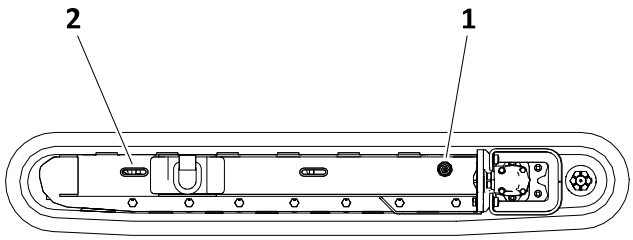
Drive System Maintenance

Checking Fluid Pump

1. Check the ball valve[1] for leaks. Tighten the stem packaging as needed.
2. Check the piston seals[2] for signs of excessive leaking. Replace if needed.



Track Tension



Checking Track Tension

Measure the length of the compressed spring[2]. The distance should be 55.56 cm (21.875 inches).

Adjusting Track Tension

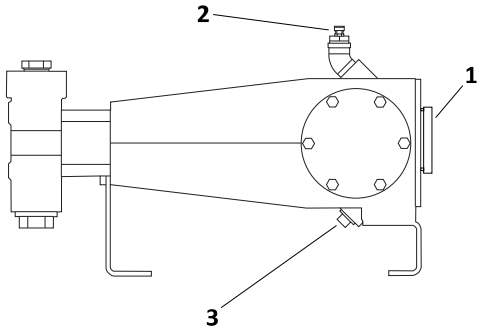
1. To tighten, pump MPG into the fitting[1] until the compressed spring[2] measures 55.56 cm (21.875 inches).
2. To loosen, use a socket wrench to remove the zerk and plug and drain all grease. Follow tightening procedure above.
3. Drive straight forward one machine length and check the tension.

Transmission Fluid Specifications

	PF	Phillips 66® PowerDrive® Fluid 30

Checking Oil, Fluid Pump

1. Check the level at the sight glass①.
2. Add **PF** at the fill point② as needed to keep the level at the halfway point on the sight glass.



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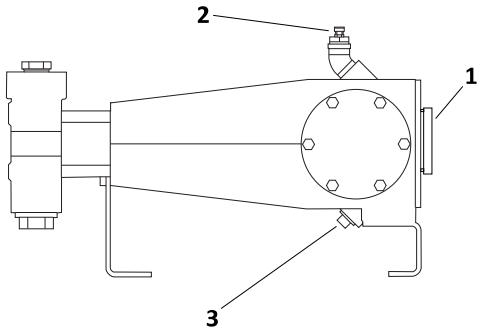
Changing Oil, Fluid Pump

1. Remove the plug③ to drain.
2. Ensure the plug is free of dirt and debris.
3. Install plug.
4. Add **PF** at the fill point to keep the level at the halfway point on the sight glass.



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Multipurpose Gear Oil Specifications

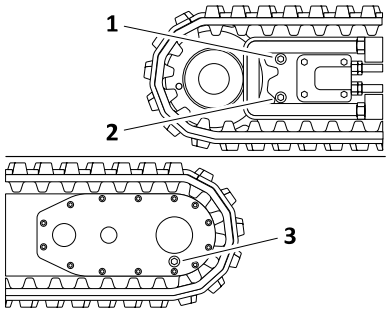
	MPL	Multipurpose gear oil meeting API GL-5 (SAE80W90)

Checking Oil, Ground Drive Gearbox

Note:

- Use a helper to assist in positioning gearbox plugs for checking and adding oil.
- Do not fill more than halfway.

1. Remove the check plug②.
2. Add **MPL** at the fill point① as needed to keep the level visible.
3. Repeat for each gearbox.



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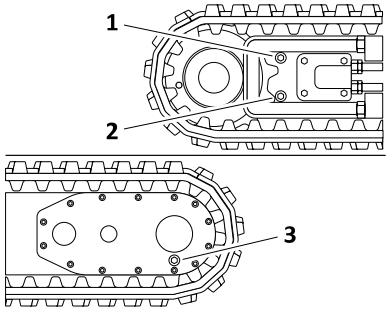
Changing Oil, Ground Drive Gearbox

1. Rotate the gearbox until the plug is in the drain position②.
2. Remove the plug to drain.
3. Rotate the gearbox until the plug is in the fill position①.
4. Add **MPL** at the fill point to keep the level visible.
5. Install the plug.
6. Repeat for each gearbox.



G513585

Electrical System Maintenance

Electrical System Specifications

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

SAE reserve capacity rating	195 minutes
SAE cold crank rating at -18° C (0° F)	950 amps

Electrical System Safety

- Disconnect the battery before repairing the machine. Disconnect the negative terminal first and the positive last. Connect the positive terminal first and the negative last.
- Charge the battery in an open, well-ventilated area, away from sparks and flames. Unplug the charger before connecting or disconnecting the battery. Wear protective clothing and use insulated tools.

⚠ WARNING ⚠

Battery acid is corrosive; contacting it can cause death or serious injury.
- **Avoid contact with skin, eyes, and clothing. Wear appropriate gloves and eye protection.**
- **Never attempt to charge a battery that is leaking, bulging, heavily corroded, frozen, or otherwise damaged.**
- **Refer to the safety data sheet (SDS) for additional battery information.**

⚠ WARNING ⚠

Fire or explosion from explosive hydrogen gas can cause death or serious injury. Keep heat, flames, sparks, and other sources of ignition away.
- **Use a single 12 V maximum source for charging. Never connect the battery to rapid chargers or dual batteries.**
- **Never lean over the battery when making connections.**
- **Never allow the vehicles to touch each other when charging.**
- **Never short-circuit the battery terminals or strike the battery posts or cable terminals.**
- **Refer to the safety data sheet (SDS) for additional battery information.**

Battery Service

Battery Safety

⚠ WARNING ⚠


Contact with corrosive battery acid could cause burns.
- **Avoid contact.**
- **Wear appropriate gloves.**
- **See the Safety Data Sheet (SDS) for more information.**

⚠ WARNING ⚠


A fire or explosion from explosive hydrogen gas can cause death or serious injury.

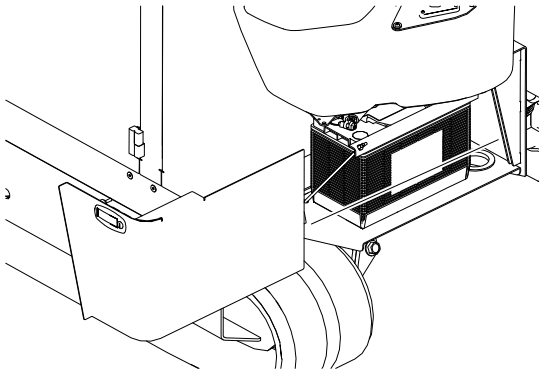
Keep heat, flames, sparks, and other sources of ignition away.

IMPORTANT

- **Electronic components can be easily damaged by electrical surges. Jump starting can damage electronics and electrical systems, and is not recommended. Try to charge the battery instead. Use quality large diameter jumper cables capable of carrying high currents (400 amps or more). Low quality cables may not allow enough current flow to charge a dead/ discharged battery.**
- **Read all steps thoroughly and review illustrations before performing procedure.**

Checking Battery

1. Disconnect the battery at the battery disconnect switch, if equipped.
2. Ensure that no ignition sources are near the battery.
3. Loosen and remove the battery cable clamps carefully, negative (-) cable first.
4. Clean the cable clamps and the terminals to remove dull glaze.
5. Check for signs of internal corrosion in the cables.



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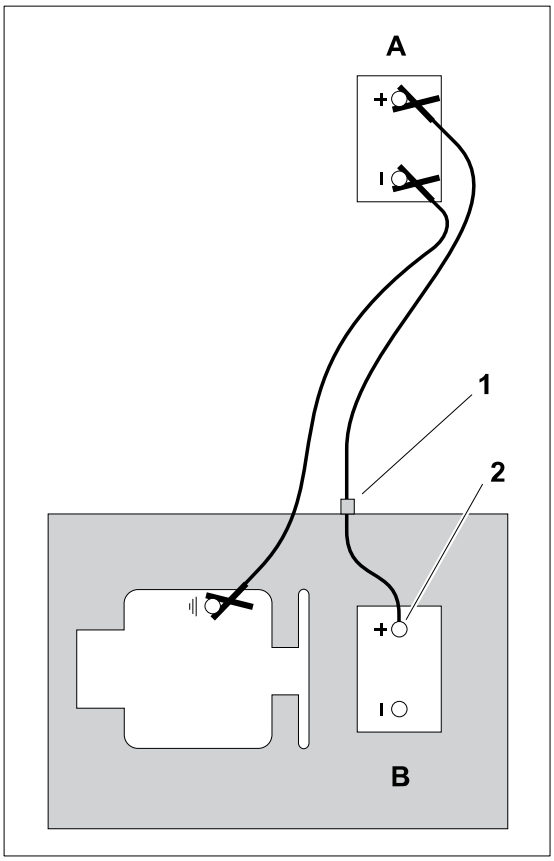
Battery Service (continued)

6. Connect the battery cable clamps, positive (+) cable first.
7. Tighten any loose connections.
8. Ensure that the battery tie downs are secure.
9. Turn the battery disconnect on, if equipped.

Charging Battery

1. Park the service vehicle close to the disabled equipment but do not allow the vehicles to touch.
2. Engage the parking brake (if equipped) in both vehicles, or chock tires/tracks.
3. Turn off the ignition switch in both vehicles and turn off all other electrical loads.
4. Disconnect the machine controller, if equipped.
5. Inspect the battery in the disabled machine (B) for signs of cracking, bulging, leaking, or other damage.
6. Connect the red positive (+) jumper cable clamp to the positive (+) post of battery (2) in the disabled machine. Some equipment may have a positive jumper cable terminal (1) located externally. If so equipped, connect the red positive (+) jumper cable clamp to terminal.
7. Connect the other red positive (+) jumper cable clamp to the positive (+) post of battery in the service vehicle (A).



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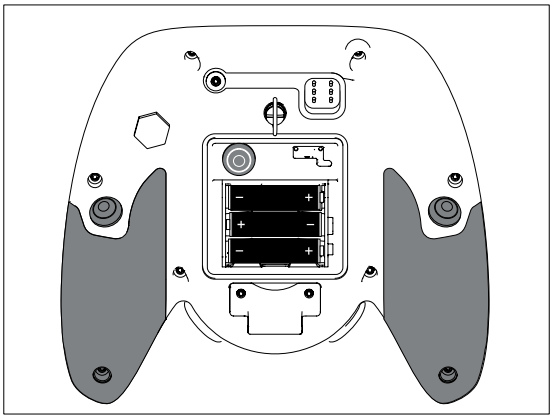
8. Connect the black negative (-) cable clamp to the negative (-) post of battery in the service vehicle.
9. Connect the other black negative (-) cable clamp to the engine or frame ground on the disabled machine, at least 12” (305mm) from the failed battery, as shown.
10. Operate the service vehicle engine at 1500–2000 rpm for a few minutes to build an electrical charge in the failed battery.
11. Stop the engine in service vehicle.
12. Remove the jumper cables from the service vehicle, black negative (-) clamp first. Do not allow the clamps to touch.
13. Remove the black negative (-) cable clamp from the disabled engine or frame ground.
14. Remove the red positive (+) cable clamp from the disable machine.

Battery Service (continued)

15. Reconnect the machine controller, if equipped.
16. Start the disabled machine.

Changing Wireless Remote Control Battery

Change batteries when the low battery indicator is displayed. Install 6 AA batteries as shown.



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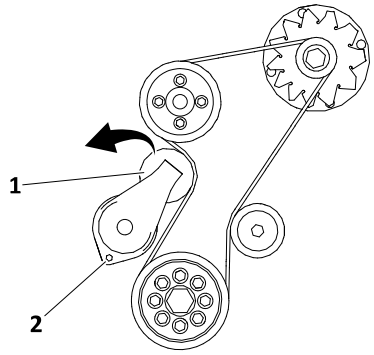
Engine Maintenance

Changing Belt, Engine Drive

1. Check the belt for excessive slack, damage, or wear.
2. Remove tension at the pulley(1).
3. Insert the retaining pin into the assembly bore(2).
4. Remove the belt.
5. Install the new belt.
6. Holding the tensioner pulley in place, remove the retaining pin.



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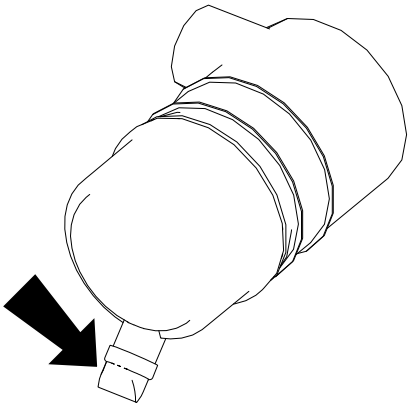
Checking Dust Ejector Valve

Ensure the valve (shown) is not inverted, damaged, plugged, or cracked.



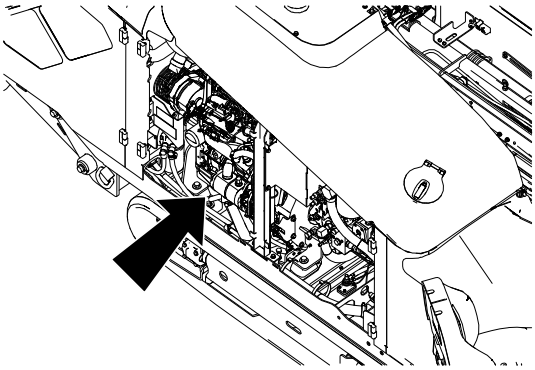
G513578

Cleaning Engine Compartment

IMPORTANT

- **Check more often if operating in large brush or grassy conditions.**
- **Do not use water or compressed air to remove debris.**

Check the compartment (shown) for debris. Manually clean out debris as needed.



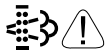
G513579

Exhaust Cleaning

This engine has a Diesel Particulate Filter (DPF) that separates soot caused by the combustion of diesel fuel from the exhaust gases exiting the engine. The DPF must be cleaned as the soot level increases.

Sensors in the engine monitor the exhaust status. When a cleaning cycle is needed, the system will create a pop-up message indicating cleaning is needed and power loss may occur. The exhaust cleaning icon will flash. Follow on-screen prompts to initiate exhaust cleaning. An operator may choose to hide and ignore this message. If so, the icon will continue to flash and the message will reappear after fifteen minutes.

If the operator continues to ignore the cleaning request, the system will create a pop-up message indicating cleaning is needed and power loss will occur. Engine power reduced by 25%. The exhaust cleaning icon will flash and the engine caution icon will appear. Follow onscreen prompts to initiate exhaust cleaning. An operator may choose to hide and ignore this message. If so, the icons will continue to display and the message will reappear after five minutes.



If the operator continues to ignore the cleaning request, the system will create a pop-up message indicating exhaust service is required. Engine derating has been activated. Contact Deutz® service. The exhaust cleaning and the engine stop icons will flash. An operator may choose to hide and ignore this message. If so, the icons will continue to display and the message will reappear after one minute.

Exhaust Cleaning (continued)

Once the operator starts the exhaust cleaning cycle, adjusting the throttle or releasing the parking brake will terminate the cycle. A typical cycle will take approximately 35 minutes. A pop-up message will display the remaining time in the cycle. The high exhaust temperature icon may also light.

The frequency of exhaust cleaning is dependent upon working conditions. In general, operating in hotter conditions and higher loads will lengthen the time between cleaning cycles.

Performing Exhaust Cleaning

A pop-up message will appear when an exhaust cleaning is needed.

IMPORTANT

Failure to complete an exhaust cleaning when required can cause engine damage.

When a pop-up message appears:

1. Ensure the machine is away from combustible material.
2. Set the throttle to slow.
3. Follow on-screen prompts to initiate exhaust cleaning.

After exhaust cleaning is initiated, another pop-up message will be displayed with the estimated time remaining until the process is complete. A typical exhaust cleaning cycle will take approximately 35 minutes.

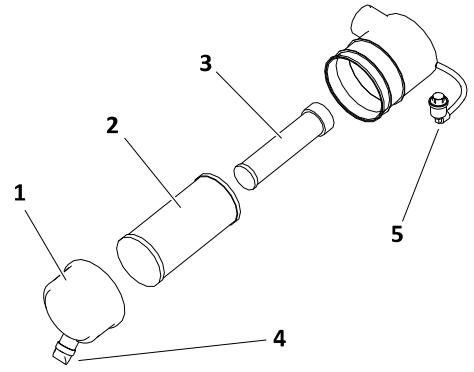
Note: If exhaust cleaning cannot be initiated when the pop-up message occurs, follow on-screen prompts to return to the main screen. A pop-up message will return to prompt exhaust cleaning at a later time.

Changing Filter, Air

IMPORTANT

- **Only open the air filter canister when air restriction is indicated.**
- **Change the elements. Do not attempt to clean them.**
- **Compressed air or water may damage elements.**
- **Tapping to loosen dirt may damage elements.**

1. Check the air filter service indicator(5). Change the filter when the red band is visible.
2. Remove the cover(1).
3. Remove the primary element(2) and secondary element(3).
4. Wipe the inside of the housing and wash the cover.
5. Insert a new secondary element and ensure it is seated correctly.
6. Insert a new primary element.
7. Install the cover with the dust ejector(4) facing down.
8. Reset the air filter restriction indicator.



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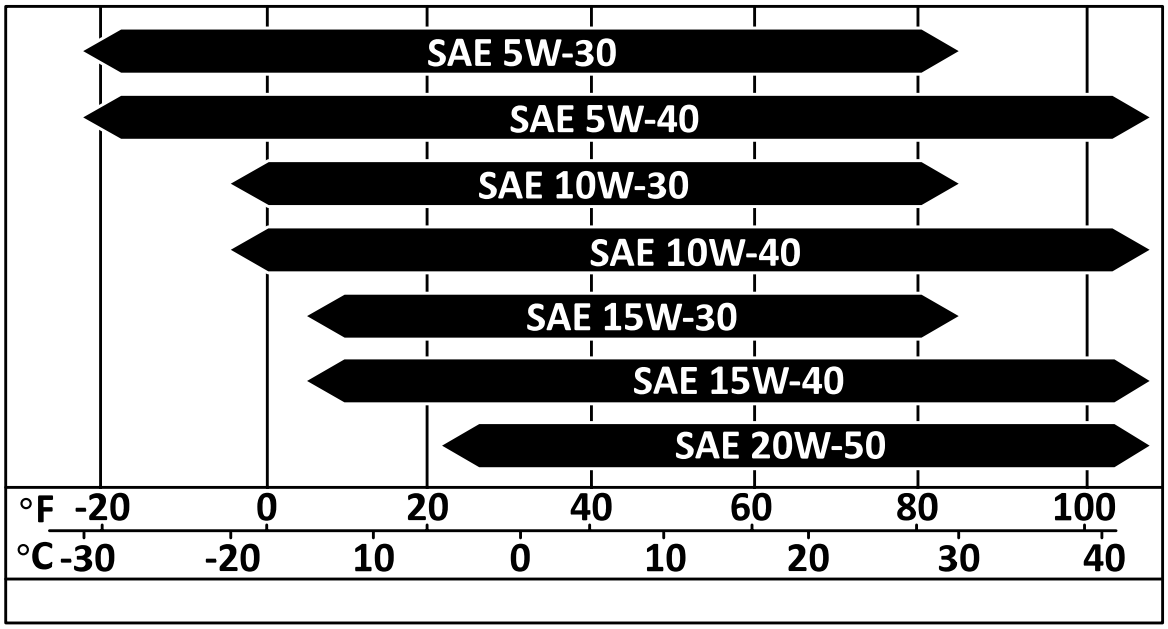
Engine Oil Specifications

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

	Capacity, including filter	9 L (9.5 qt)
	DEO	Diesel engine oil meeting or exceeding Deutz® DQC III-LA or DQC IV-LA or API CK-4. API American Petroleum Institute, ACEA European Automobile Manufacturer's Association
	Viscosity	See viscosity chart



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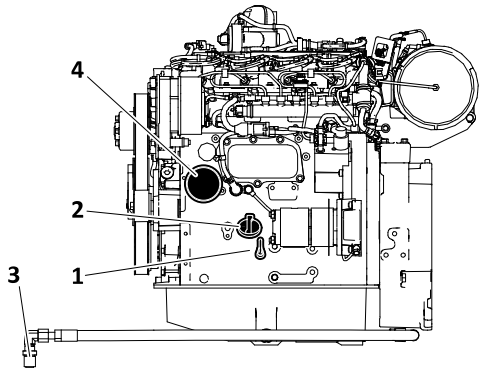
Checking Oil, Engine

1. Check the level at the dipstick①.
2. Add DEO at the fill point② as needed to keep the level at the highest line on the dipstick.



G513581

Changing Oil, Engine

1. Remove plug(3).
2. Install the plug.
3. Remove the filter(4) and replace it with a new filter.
4. Add DEO at the fill point to keep the level at the highest line on the dipstick.
5. Start the engine.
6. Run the engine until operating temperature is reached.
7. Turn off the machine.
8. Check the level.
9. Add DEO at the fill point as needed to keep the level at the highest line on the dipstick.

Fuel System Maintenance

Fuel System Specifications

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

	Capacity	106.7 L (28.2 US gallons)

Approved Fuel

⚠ WARNING ⚠

Ultra Low Sulfur Diesel (ULSD) poses a greater static ignition hazard than earlier diesel formulations with higher sulfur content. Avoid death or serious injury from fire or explosion; consult with your fuel or fuel system supplier to ensure the delivery system is in compliance with fueling standards for proper grounding and bonding practices.

This engine is designed to run on diesel fuel. Use only high quality fuel meeting ASTM D975 No. 2D, EN590, or equivalent. At temperatures below 0°C (32°F) winter fuel blends are acceptable. See the engine manual for more information.

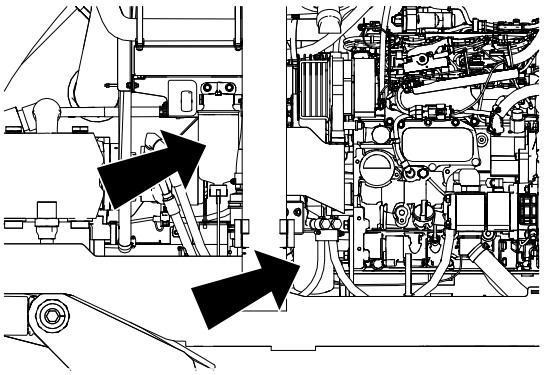
IMPORTANT

Use only Ultra Low Sulfur Diesel (less than 15ppm sulfur content in the US and Canada or 10mg/kg in EU and Japan) in this unit. Operating with higher sulfur content will damage the engine and aftertreatment device.

Biodiesel blends up to 5% (B5) are approved for use in this unit. The fuel must meet the specifications for diesel fuel shown above. In certain markets, higher blends may be used if certain steps are taken. Extra attention is needed when using biodiesel, especially when operating in cold weather or storing fuel. Contact your Ditch Witch dealer or the engine manufacturer for more information.

Changing Filter, Fuel

Change filters (shown).



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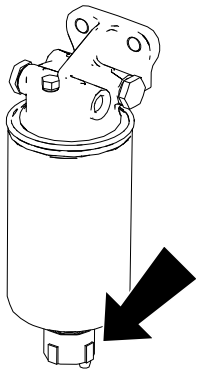
Checking Water Separator

Check the water separator (shown) located on fuel filter. Drain water as needed until fuel runs from the drain.



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Hydraulic System Maintenance

Hydraulic System Safety

WARNING

Contact with pressurized fluid or air could cause death or serious injury.

- **Follow the instructions in this manual for correct use.**
- **Use a piece of cardboard or wood, rather than your hands, to check for leaks.**
- **Contact your Ditch Witch dealer for assistance with relieving trapped pressure.**
- **Before disconnecting a hydraulic line, turn the engine off and operate all controls to relieve pressure.**
- **Lower, block, or support any raised component with a hoist.**
- **Cover the connection with a heavy cloth and loosen the connector nut slightly to relieve residual pressure. Catch all fluid in a container.**
- **Before using the system, check that all connections are tight and all lines are undamaged.**
- **If you are injured, seek immediate medical attention from a doctor familiar with this type of injury.**

Checking the Hydraulic Lines

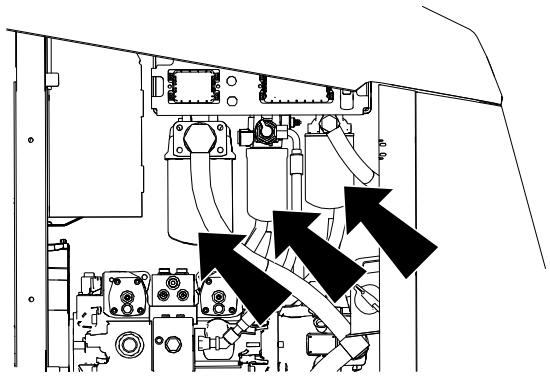
Check the hydraulic lines for leaks, loose fittings, kinked lines, loose mounting supports, wear, and deterioration. Make necessary repairs before operating.

Changing Hydraulic Filters

IMPORTANT

- **Change the filter more often as indicated by the filter indicator.**
- **If the hydraulic system must be opened for repair, install a new hydraulic filter. If the new filter becomes plugged in fewer than 20 hours, replace.**

Change the filters (shown).



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Hydraulic System Specifications

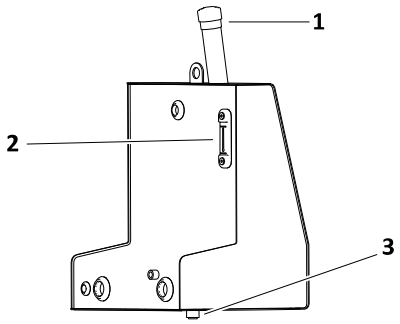
Note: Specifications and design are subject to change without notice.

	THF	Phillips 66® PowerTran XP Fluid or equivalent
	Hydraulic reservoir capacity	62.1 L (16.4 US gallons)

Checking Hydraulic Fluid

Note: Replace the hydraulic filter each time the hydraulic system is opened.

1. Check the level at the sight glass (2)
2. Add **THF** at the fill point (1) as needed to keep the level at the halfway point on the sightglass.



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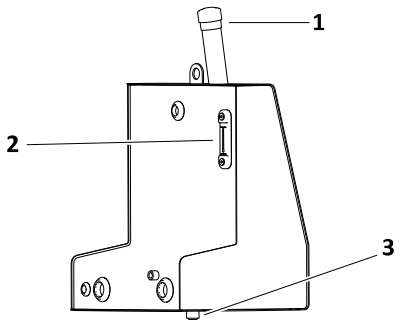
Changing Hydraulic Fluid

1. Remove the plug (3) to drain.
2. Install the plug.
3. Add **THF** at the fill point as needed to keep the level at the halfway point on the sight glass.



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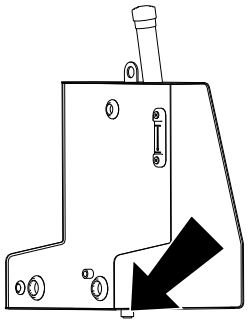
Draining the Hydraulic Tank

1. Turn plug (shown) slightly until water comes out.
2. Tighten the plug.



G513598

Chapter 9

Storage

Table of Contents

Storing Machine

Before storing, ensure the machine is rinsed, the equipment is stowed, and all the fluids are filled.

Note: For more information on filling the fluids, see the Maintenance chapter or contact your Ditch Witch dealer.

Storing Machine

Before storing, ensure the machine is rinsed, the equipment is stowed, and all the fluids are filled.

Note: For more information on filling the fluids, see the Maintenance chapter or contact your Ditch Witch dealer.

Decommissioning Machine

Before decommissioning the machine, follow all local regulations for disposing of hazardous substances.

Note: For more information on draining the fluids, see the Maintenance chapter or contact your Ditch Witch dealer.

Chapter 10

Support

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Registration

If your equipment was purchased through a Ditch Witch dealer, it is already registered. If you purchased from any other source, please email productsupportwarrantyadmin@ditchwitch.com or fill out the registration card located in the back of the *parts manual*. Registration enables you to receive updates on this equipment as well as information on new products of interest.

Procedure

Notify your dealer immediately of any malfunction or failure of Ditch Witch equipment.

Always give model, serial number, and approximate date of your equipment purchase. This information should be recorded and placed on file by the owner at the time of purchase.

Return damaged parts to dealer for inspection and warranty consideration if in warranty time frame.

Order genuine Ditch Witch replacement or repair parts from your authorized Ditch Witch dealer.

Resources

Publications

Contact your Ditch Witch dealer for publications and videos covering safety, operation, maintenance, and repair of your equipment.

Training

For information about on-site individualized training, contact your Ditch Witch dealer.

Chapter 11

Declaration of Conformity

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EU Declaration of Conformity

The Charles Machine Works Inc., PO Box 66, 1959 West Fir Avenue, Perry, Oklahoma, USA declares that the following unit(s):

Model	Serial Number	Description
XXXXX	XXXXXXXXXXXXXXXX	Horizontal Directional Drill

Conforms to the following directives:
2006/42/EC (Machinery Directive), 2014/30/EU (EMC), and 2000/14/EC (Noise)

Each model listed has been evaluated with the following standards and/or other normative documents:
EN 16228-1:2014
EN 16228-3:2014
EN ISO 13766-1:2018

Data for 2000/14/EC Noise Emission Directive:

Model	Classification	Measured Sound Power (dBA)	Guaranteed Sound Power (dBA)	Engine Speed (rpm)	Engine Power (kWH)
XXXXX	Horizontal Directional Drill	XXX	XXX	XXXX	XXX

Determined in accordance with ISO EN 16228–3:2014+A1:2021.
Conformity Assessment: Annex V

Data for Regulation (EU) No 2024/573 on Fluorinated Greenhouse Gases (if equipped with cab):

Model	HFC	kg	GWP	CO2 Equivalent (metric tonnes)
XXXXX	134A	XXX	1430	XXXX

The Technical Construction File is maintained at the manufacturer's location. The Authorized representative designated below is authorized to make the technical file available to the competent authorities of the Member States in response to a duly reasoned request.

This declaration has been issued under the sole responsibility of the manufacturer. The object of the declaration is in conformity with relevant Union harmonization legislation.

Certified:

Engineering Director
1959 West Fir Avenue
Perry, OK 73077, USA

Date _____

Authorized Representative:

Marcel Dutrieux
Manager European Product Integrity
Toro Europe NV
Nijverheidsstraat 5
2260 Oevel
Belgium

UK Declaration of Conformity Information

The Charles Machine Works Inc., PO Box 66, 1959 West Fir Avenue, Perry, Oklahoma, USA declares that the following unit(s):

Model	Serial Number	Description
XXXXX	XXXXXXXXXXXXXXXX	Horizontal Directional Drill

Conform(s) to the following UK national laws:
S.I. 2001 No.1701 (Noise), S.I. 2008 No.1597 (Machinery Safety), and S.I. 2016 No.1091 (EMC)

Each model listed has been evaluated with the following standards and/or other normative documents:
EN 16228-1:2014
EN 16228-3:2014
EN ISO 13766-1:2018

Data for Noise Regulation (S.I. 2001 No. 1701)

Model	Classification	Measured Sound Power (dBA)	Guaranteed Sound Power (dBA)	Engine Speed (rpm)	Engine Power (kWH)
XXXXX	Horizontal Directional Drill	XXX	XXX	XXXX	XXX

Determined in accordance with ISO 16228–3:2014+A1:2021.
Conformity Assessment: Schedule 8

Data for S.I. 2019 No. 583 (Fluorinated Greenhouse Gases) (if equipped with cab):

Model	HFC	kg	GWP	CO2 Equivalent (metric tonnes)
XXXXX	134A	XXX	1430	XXXX

The Technical Construction File is maintained at the manufacturer's location. The Authorized representative designated below is authorized to make the technical file available to the competent authorities of the Member States in response to a duly reasoned request.

This declaration has been issued under the sole responsibility of the manufacturer. The object of the declaration is in conformity with relevant UK legislation.

Certified:

Engineering Director
1959 West Fir Avenue
Perry, OK 73077, USA

Date _____

Authorized Representative:

Marcel Dutrieux
Manager European Product Integrity
Toro U.K. Limited
Spellbrook Lane West
Bishop's Stortford
CM23 4BU
United Kingdom

California Proposition 65 Warning Information

What is this warning?

You may see a product for sale that has a warning label like the following:

 **WARNING:** Cancer and Reproductive Harm—www.p65Warnings.ca.gov.

What is Prop 65?

Prop 65 applies to any company operating in California, selling products in California, or manufacturing products that may be sold in or brought into California. It mandates that the Governor of California maintain and publish a list of chemicals known to cause cancer, birth defects, and/or other reproductive harm. The list, which is updated annually, includes hundreds of chemicals found in many everyday items. The purpose of Prop 65 is to inform the public about exposure to these chemicals.

Prop 65 does not ban the sale of products containing these chemicals but instead requires warnings on any product, product packaging, or literature with the product. Moreover, a Prop 65 warning does not mean that a product is in violation of any product safety standards or requirements. In fact, the California government has clarified that a Prop 65 warning "is not the same as a regulatory decision that a product is 'safe' or 'unsafe.'" Many of these chemicals have been used in everyday products for years without documented harm. For more information, go to https://oag.ca.gov/prop65/faqs-view-all.

A Prop 65 warning means that a company has either (1) evaluated the exposure and has concluded that it exceeds the "no significant risk level"; or (2) has chosen to provide a warning based on its understanding about the presence of a listed chemical without attempting to evaluate the exposure.

Does this law apply everywhere?

Prop 65 warnings are required under California law only. These warnings are seen throughout California in a wide range of settings, including but not limited to restaurants, grocery stores, hotels, schools, and hospitals, and on a wide variety of products. Additionally, some online and mail order retailers provide Prop 65 warnings on their websites or in catalogs.

How do the California warnings compare to federal limits?

Prop 65 standards are often more stringent than federal and international standards. There are various substances that require a Prop 65 warning at levels that are far lower than federal action limits. For example, the Prop 65 standard for warnings for lead is 0.5 µg/day, which is well below the federal and international standards.

Why don't all similar products carry the warning?

- Products sold in California require Prop 65 labelling while similar products sold elsewhere do not.
- A company involved in a Prop 65 lawsuit reaching a settlement may be required to use Prop 65 warnings for its products, but other companies making similar products may have no such requirement.
- The enforcement of Prop 65 is inconsistent.
- Companies may elect not to provide warnings because they conclude that they are not required to do so under Prop 65; a lack of warnings for a product does not mean that the product is free of listed chemicals at similar levels.

Why does Toro include this warning?

Toro has chosen to provide consumers with as much information as possible so that they can make informed decisions about the products they buy and use. Toro provides warnings in certain cases based on its knowledge of the presence of one or more listed chemicals without evaluating the level of exposure, as not all the listed chemicals provide exposure limit requirements. While the exposure from Toro products may be negligible or well within the "no significant risk" range, out of an abundance of caution, Toro has elected to provide the Prop 65 warnings. Moreover, if Toro does not provide these warnings, it could be sued by the State of California or by private parties seeking to enforce Prop 65 and subject to substantial penalties.

Warranty

Ditch Witch Equipment and Replacement Parts

Limited Warranty Policy

Subject to the limitation and exclusions herein, free replacement parts will be provided at any authorized Ditch Witch dealership for any Ditch Witch equipment or parts manufactured by the Ditch Witch factory that fail due to a defect in material or workmanship within one (1) year of first commercial use. Free labor will be provided at any authorized Ditch Witch dealership for installation of parts under this warranty during the first year following “initial commercial” use of the serial-numbered Ditch Witch equipment on which it is installed. The customer is responsible for transporting their equipment to an authorized Ditch Witch dealership for all warranty work.

Exclusions from Product Warranty

- All incidental or consequential damages.
- All defects, damages, or injuries caused by misuse (including, but not limited to, rollover), abuse, improper installation, alteration, neglect, or uses other than those for which products were intended.
- All defects, damages, or injuries caused by improper training, operation, or servicing of products in a manner inconsistent with manufacturer’s recommendations.
- All engines and engine accessories (these are covered by original manufacturer’s warranty).
- Tires, belts, and other parts which may be subject to another manufacturer’s warranty (such warranty will be available to purchaser).
- ALL IMPLIED WARRANTIES NOT EXPRESSLY STATED HEREIN, INCLUDING ANY WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE AND MERCHANTABILITY.

IF THE PRODUCTS ARE PURCHASED FOR COMMERCIAL PURPOSES, AS DEFINED BY THE UNIFORM COMMERCIAL CODE, THEN THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE FACE HEREOF AND THERE ARE NO IMPLIED WARRANTIES OF ANY KIND WHICH EXTEND TO A COMMERCIAL BUYER. ALL OTHER PROVISIONS OF THIS LIMITED WARRANTY APPLY INCLUDING THE DUTIES IMPOSED.

Ditch Witch products have been tested to deliver acceptable performance in most conditions. This does not imply they will deliver acceptable performance in all conditions. Therefore, to assure suitability, products should be operated under anticipated working conditions prior to purchase.

Defects will be determined by an inspection within thirty (30) days of the date of failure of the product or part by Ditch Witch Product Support (DWPS) or its authorized dealer. DWPS will provide the location of its inspection facilities or its nearest authorized dealer upon inquiry. DWPS reserves the right to supply remanufactured replacements parts under this warranty as it deems appropriate.

Extended warranties are available upon request from your local Ditch Witch dealer or the Ditch Witch factory.

Some states do not allow exclusion or limitation of incidental or consequential damages, so above limitation of exclusion may not apply. Further, some states do not allow exclusion of or limitation of how long an implied warranty lasts, so the above limitation may not apply. This limited warranty gives product owner specific legal rights and the product owner may also have other rights which vary from state to state.

For information regarding this limited warranty, contact the DWPS department, P.O. Box 66, Perry, OK 73077-0066, or contact your local dealer.

First version: 1/91; Latest version 7/19

Evaporative Emission Control Warranty Statement

Federal Evaporative Emission Control Warranty Statement
Your Warranty Rights and Obligations

Introduction

The United States Environmental Protection Agency (EPA) and The Charles Machine Works, Inc. are pleased to explain the evaporative emission control system's warranty on your Ditch Witch® equipment. New equipment that use small/large off-road spark ignition engines must be designed, built, and equipped to meet the stringent anti-smog standards. The Charles Machine Works, Inc. must warrant the evaporative emission control system on your equipment for the period listed below provided there has been no abuse, neglect, or improper maintenance of your equipment leading to the failure of the evaporative emission control system.

Your evaporative emission control system may include parts such as: carburetors, fuel tanks, fuel lines (for liquid fuel and fuel vapors), fuel caps, valves, canisters, filters, clamps, connectors, and other associated emission-related components.

Manufacturer's Warranty Coverage

This evaporative emission control system is warranted for two years. If any evaporative emission-related part on your equipment is defective, the part will be repaired or replaced by The Charles Machine Works, Inc.

Owner's Warranty Responsibilities

As the equipment owner, you are responsible for performance of the required maintenance listed in your *Operator's Manual*. The Charles Machine Works, Inc. recommends that you retain all receipts covering maintenance on your equipment, but The Charles Machine Works, Inc. cannot deny warranty solely for the lack of receipts.

As the equipment owner, you should be aware that The Charles Machine Works, Inc. may deny you warranty coverage if your equipment or a part has failed due to abuse, neglect, improper maintenance, or unapproved modifications.

You are responsible for presenting your equipment to a Ditch Witch® service center as soon as the problem exists. The warranty repairs should be completed in a reasonable amount of time, not to exceed 30 days. If you have a question regarding your warranty coverage, you should contact The Charles Machine Works at 1-800-433-6652.

General Evaporative Emissions Warranty Coverage

The Charles Machine Works, Inc. warrants to the ultimate purchaser and each subsequent purchaser that the equipment is:

- Designed, built, and certified to conform with all applicable emissions regulations; and
- Identical in all material respects to the parts as described in the application for certification; and
- Free from defects in materials and workmanship that could cause the failure of a warranted part

The warranty period begins on the date the equipment is delivered to an ultimate purchaser. The warranted period is two years.
Subject to certain conditions and exclusions as stated below, the warranty on evaporative emissions-related parts is as follows:

1. Any warranted part that is not scheduled for replacement as required maintenance in the written instructions supplied, is warranted for the warranty period stated above. If the part fails during the period of warranty coverage, the part will be repaired or replaced by The Charles Machine Works, Inc.. Any such part repaired or replaced under warranty will be warranted for the remainder of the warranty period.
2. Any warranted part that is scheduled only for regular inspection in the written instructions supplied is warranted for the warranty period stated above. Any such part repaired or replaced under the warranty will not reduce the period of warranty coverage and will be warranted for the remainder of the warranty period.
3. Any warranted part that is scheduled for replacement as required maintenance in the written instructions supplied is warranted for the period of time prior to the first scheduled replacement date for that part. If the part fails before the first scheduled replacement, the part must be repaired or replaced by The Charles Machine Works, Inc.. Any such part repaired or replaced under warranty will be warranted for the remainder of the period up to the first scheduled replacement point for the part.
4. Repair or replacement of any warranted part under the warranty provisions herein must be performed at an Authorized Service Dealer at no charge to the owner.
5. Warranty services or repairs will be provided at all Service Dealers authorized to service the subject equipment.
6. The equipment owner will not be charged for diagnostic labor that is directly associated with diagnosis of a defective, emission-related warranted part, provided that such diagnostic work is performed at an Authorized Service Dealer.
7. The Charles Machine Works, Inc. is liable for damages to other engine or equipment components proximately caused by a failure under warranty of any warranted part.
8. Throughout the evaporative emission control system's warranty period stated above, The Charles Machine Works, Inc. will maintain a supply of warranted parts sufficient to meet the expected demand for such parts.
9. Manufacturer approved replacement parts may be used in the performance of any warranty maintenance or repairs and must be provided without charge to the owner. Such use will not reduce the warranty obligations of The Charles Machine Works, Inc..
10. Add-on or modified parts that are not approved by The Charles Machine Works, Inc. may not be used. The use of a non-approved, add-on, or modified part by the purchaser will be grounds for disallowing a warranty claim. The Charles Machine Works, Inc. will not be liable to warrant failures of warranted parts caused by the use of non-approved, add-on, or modified parts.

Warranted Parts

The repair or replacement of any warranted part otherwise eligible for warranty coverage may be excluded from such coverage if The Charles Machine Works, Inc. demonstrates that the equipment has been abused, neglected, or improperly maintained, and that such abuse, neglect, or improper maintenance was the direct cause of the need for repair or replacement of the part. That notwithstanding, any adjustment of a component that has a factory installed, and properly operating, adjustment limiting device is still eligible for warranty coverage. The following emission warranty parts list are covered:

- Fuel Tank
- Fuel Cap
- Fuel Lines (for liquid fuel and fuel vapors)
- Fuel Lines Fittings
- Clamps
- Pressure Relief Valves*
- Control Valves*
- Control Solenoids*
- Electronic Controls*
- Vacuum Control Diaphragms*
- Control Cables*
- Control Linkages*
- Purge Valves
- Gaskets
- Liquid/Vapor Separator
- Carbon Canister
- Canister Mounting Brackets
- Carburetor Purge Port Connection

* As they relate to the installed equipment evaporative control system