

# **JT30/JT30 All Terrain**

**Tier 4**

## **Operator's Manual**



**Issue 1.0**  
Original Instruction

**053-2837**

# Overview



## Chapter Contents

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**Equipment Modification . . . . . 3**

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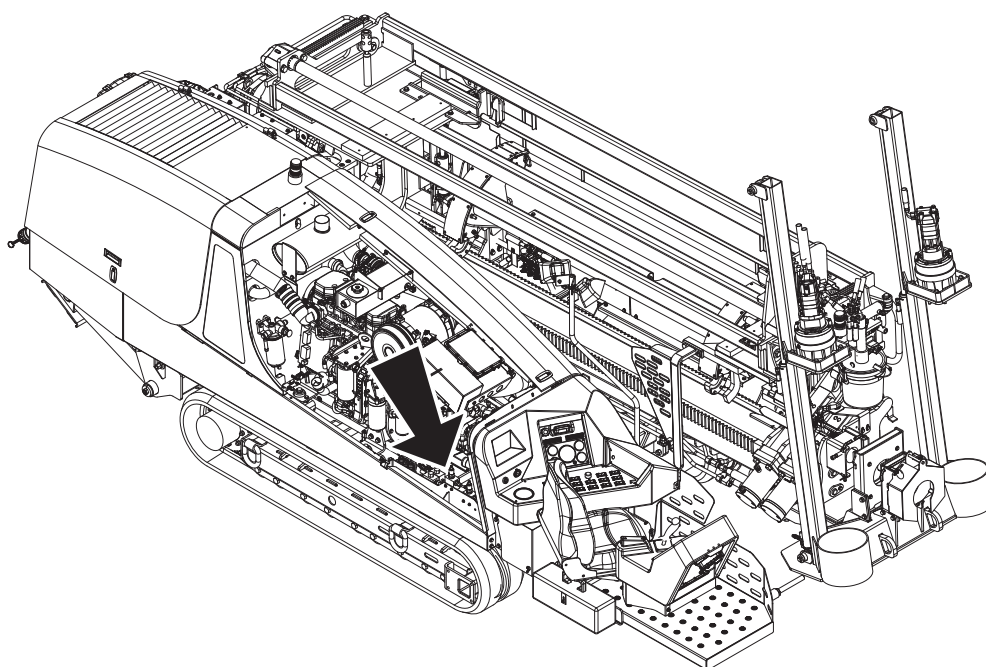
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## Serial Number Location

Record serial numbers and date of purchase in spaces provided. Drilling unit serial number is located as shown.



j34om006h.eps

Item	
date of manufacture	
date of purchase	
drilling unit serial number	
engine serial number	

## Intended Use



The JT30 is a self-contained horizontal directional drilling unit designed to install buried cable and pipe to distances of 650' (200 m) depending on soil conditions. Its All Terrain version is designed to drill through rock, cobblestone, broken rock, gravel, and caliche.

The unit is designed for operation in temperatures typically experienced in earth moving and construction work environments. Provisions may be required to operate in extreme temperatures. Contact your Ditch Witch® dealer. Use in any other way is considered contrary to the intended use.

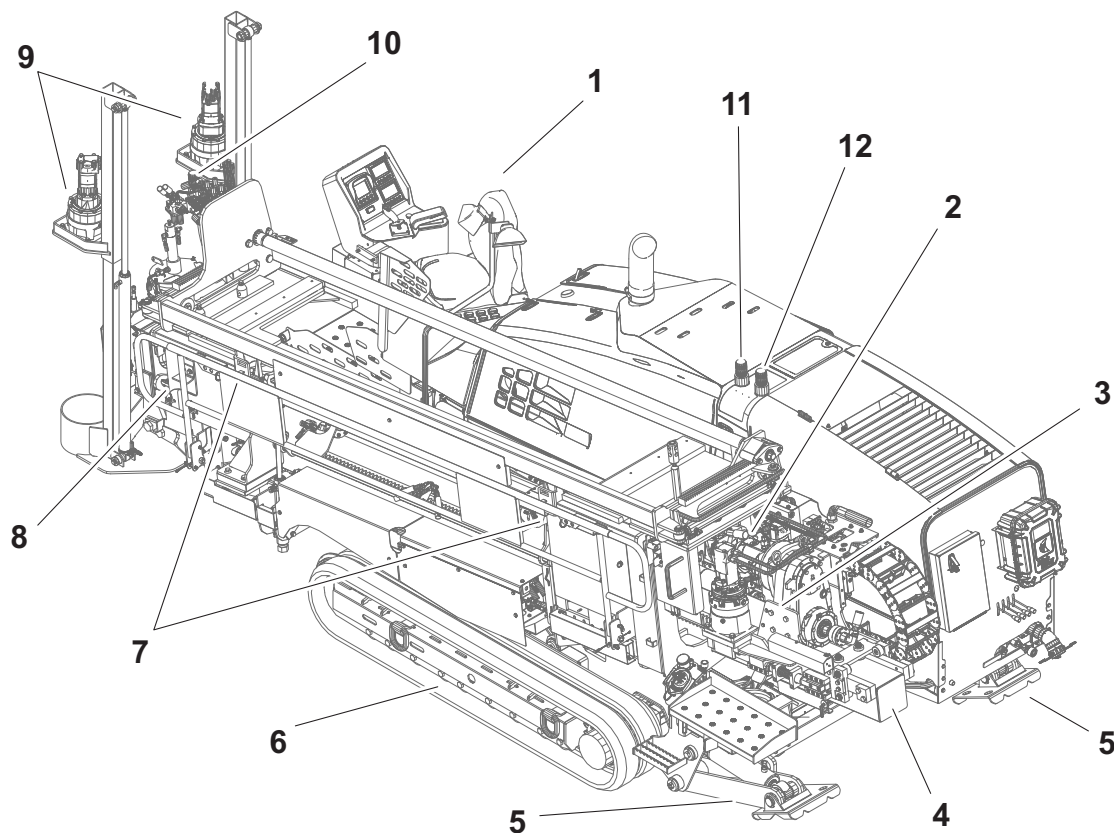
The JT30/JT30 All Terrain should be used with genuine Ditch Witch drilling fluid units and Subsite Electronics® tracking equipment. It should be operated, serviced, and repaired only by persons familiar with its particular characteristics and acquainted with the relevant safety procedures.

## 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 testing.



## Unit Components



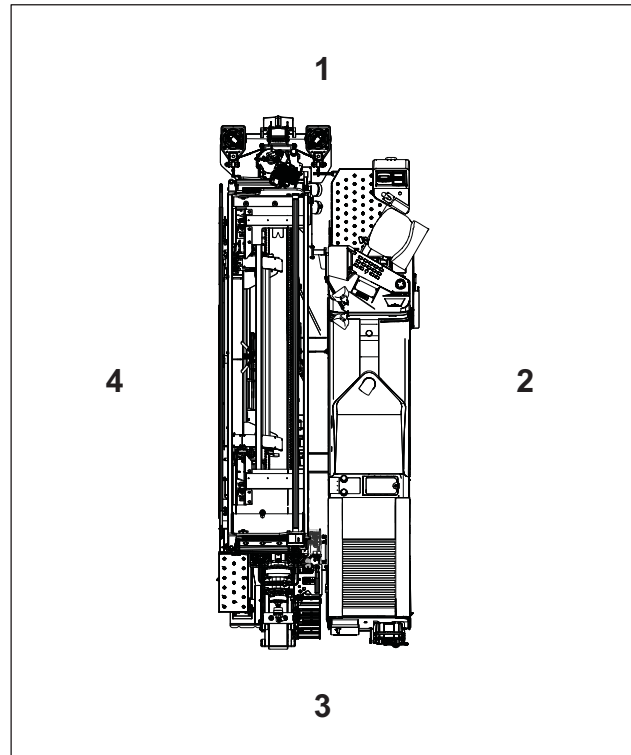
j50om002w.eps

- |                       |   |
|-----------------------|---|
| 1. Operator's station | 7. Pipeloader                             |
| 2. Spindle            | 8. Vise wrenches                          |
| 3. Carriage           | 9. Anchoring system                       |
| 4. Drill frame        | 10. DrillLok™ light (green)               |
| 5. Stabilizer         | 11. Wireless remote control light (clear) |
| 6. Tracks             | 12. ESID strobe light (amber)             |

## Operator Orientation

**IMPORTANT:** Top view of unit is shown.

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



j50om003w.eps

## About This Manual

This manual contains information for the proper use of this machine. See the beige **Operation Overview** pages for basic operating procedures. Cross references such as "See page 50" will direct you to detailed procedures.

### Bulleted Lists

Bulleted lists provide helpful or important information or contain procedures that do not have to be performed in a specific order.

### Numbered Lists

Numbered lists contain illustration callouts or list steps that must be performed in order.



# Foreword



This manual is an important part of your equipment. It provides safety information and operation instructions to help you use and maintain your Ditch Witch® equipment.

Read this manual before using your equipment. Keep it with the equipment at all times for future reference. If you sell your equipment, be sure to give this manual to the new owner.

If you need a replacement copy, contact your Ditch Witch dealer. If you need assistance in locating a dealer, visit our website at **[www.ditchwitch.com](http://www.ditchwitch.com)** or write to the following address:

The Charles Machine Works, Inc.  
Attn: Marketing Department  
PO Box 66  
Perry, OK 73077-0066  
USA

The descriptions and specifications in this manual are subject to change without notice. The Charles Machine Works, Inc. reserves the right to improve equipment. Some product improvements may have taken place after this manual was published. For the latest information on Ditch Witch equipment, see your Ditch Witch dealer.

Thank you for buying and using Ditch Witch equipment.

**JT30/JT30 All Terrain  
Tier 4  
Operator's Manual**

**Issue number 1.0/OM-07/15**

**Part number 053-2837**

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, Subsite, Jet Trac, Fluid Miser, Power Pipe, SaverLok, SaverLok System and The Underground Authority are registered trademarks of The Charles Machine Works, Inc.

This product is covered by one or more of the following patents:

**U.S.** 5684466; 5794719; 5880680; 6085852; 6109371; 6179065; 6250403; 6250404; 6311790; 6411094; 6543551; 6550547; 6672409; 6739413; 6761231; 6776246; 6808210; 6827158; 6848506; 6871712; 7011166; 7038454; 7759824; 7025152; 7347283; 7413031; 7392858; 7600584; 7628226; 7987924; 8201644; 8534388; RE37,450; RE37,975; RE38,418; **AU** 689,533; 706,544; 718,034; 755,862; **CA** 2,156,398; 2,217,899; **DE** 694 17 019; 695 29 634; 697 28 716; 69829107.7-08, 19712641; 66942993.5; **EP** 0683845; **FR** 674093; **GB** 2312006; 817901; 146608; EP 927892; EP674,093; EP846,841; UK 0984132; **JP** 3,458,247; other U.S. and foreign patents pending.

# Contents



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	<b>Controls</b> machine controls, gauges, and indicators and how to use them	<b>21</b>
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machine specifications including weights, measurements, power ratings, and fluid capacities

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additional information about Ditch Witch<sup>®</sup> equipment

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# Safety

## Chapter Contents



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## Guidelines

Follow these guidelines before operating any jobsite equipment:

- Complete proper training and read operator's manual before using equipment.
- Contact your local One-Call (811 in USA) or the One-Call referral number (888-258-0808 in USA and Canada) to have underground utilities located before digging. Also contact any utilities that do not participate in the One-Call service. Mark proposed path with white paint prior to contacting One-Call or utilities.
- Classify jobsite based on its hazards and use correct tools and machinery, safety equipment, and work methods for jobsite.
- Mark jobsite clearly and keep spectators away.
- Wear personal protective equipment.
- 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/safe](http://www.ditchwitch.com/safe).
- Fully inspect equipment before operating. Repair or replace any worn or damaged parts. Replace missing or damaged safety shields and safety signs. Contact your Ditch Witch dealer for assistance.
- Use equipment carefully. Stop operation and investigate anything that does not look or feel right.
- Do not operate unit where flammable gas may be present.
- Only operate equipment in well-ventilated areas.
- Contact your Ditch Witch dealer if you have any question about operation, maintenance, or equipment use.
- Complete the equipment checklist located at [www.ditchwitch.com/safe](http://www.ditchwitch.com/safe).

## California Proposition 65 Warning

This product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

- battery posts, terminals and related accessories
- engine exhaust
- ethylene glycol

## Emergency Procedures



**⚠ WARNING**

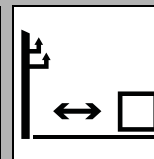
Jobsite hazards could cause death or serious injury. Use correct equipment and work methods. Use and maintain proper safety equipment.



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

**EMERGENCY SHUTDOWN** - Turn ignition switch to stop position or push remote engine stop button (if equipped).

## Electric Strike Description



**⚠ DANGER**

Electric shock. Contacting electric lines will cause death or serious injury. Know location of lines and stay away.

When working near electric cables, remember the following:

- Electricity follows all paths to ground, not just 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, or if strike alarm sounds or flashes, assume an electric strike has occurred.**

## **If an Electric Line is Damaged**

If you suspect an electric line has been damaged and you are **on drilling unit or bonded equipment**, DO NOT MOVE. Remain on drilling machine and take the following actions. The order and degree of action will depend on the situation.

- Warn people nearby that an electric strike has occurred.
- Have someone contact electric company.
- Reverse drilling direction and try to break contact. Do not touch drill pipe with hands or hand-held tools.
- Press electric strike system self test button.
  - If alarm sounds again, stay where you are and wait for electric company to shut off power.
  - If alarm does not sound and there is no other indication of a strike, wait at least one full minute before moving away from equipment. Utility might use automatic reclosers which will restart current flow. If alarm sounds again while waiting, stay where you are until electric company shuts off power.
  - If alarm does not sound but all lights in strike indicator are on, assume strike is continuing and stay where you are until electric company shuts off power.
- Do not resume drilling or allow anyone into area until given permission by electric company.

If you suspect an electric line has been damaged and you are **off drilling unit or bonded equipment**, DO NOT TOUCH ANY EQUIPMENT connected to drilling unit. Take the following actions. The order and degree of action will depend on the situation.

- Stay where you are unless you are wearing electric insulating boots. If you leave, do not return to area or allow anyone into area until given permission by electric company.

## **If a Gas Line is Damaged**



**⚠ WARNING** Fire or explosion possible. Fumes could ignite and cause burns. No smoking, no flame, no spark. 275-419 (2P)



**⚠ WARNING** Explosion possible. Serious injury or equipment damage could occur. Follow directions carefully.

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 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.
- Leave jobsite as quickly as possible.
- Immediately call your local emergency phone number and utility company.
- If jobsite is along street, stop traffic from driving near jobsite.
- Do not return to jobsite until given permission by emergency personnel and utility company.

## **If a Fiber Optic Cable is Damaged**

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

## **If Machine Catches on Fire**

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


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


## **Safety Alert Classifications**


These classifications and the icons defined on the following pages work together to alert you to situations which could be harmful to you, jobsite bystanders or your equipment. When you see these words and icons in the book or on the machine, carefully read and follow all instructions. **YOUR SAFETY IS AT STAKE.**



Watch for the three safety alert levels: **DANGER**, **WARNING** and **CAUTION**. Learn what each level means.

 **DANGER** indicates a hazardous situation that, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.

 **WARNING** indicates a hazardous situation that, if not avoided, could result in death or serious injury.

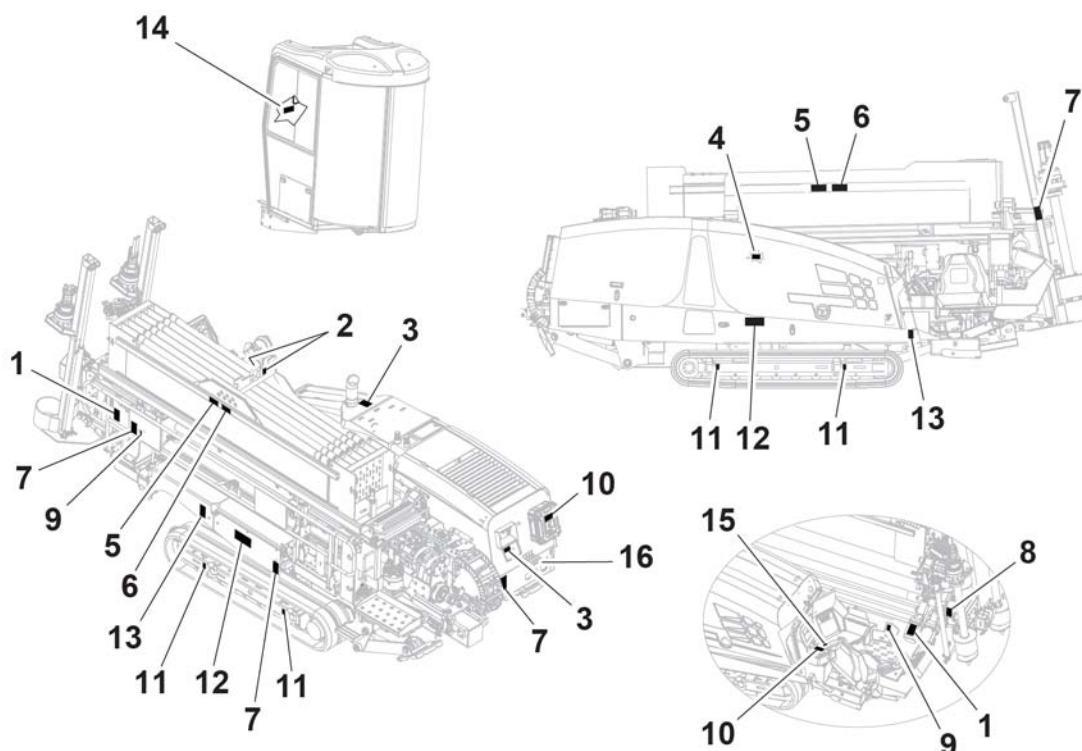
 **CAUTION** indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

Watch for two other words: **NOTICE** and **IMPORTANT**.

**NOTICE** indicates information considered important, but not hazard-related (e.g., messages relating to property damage).

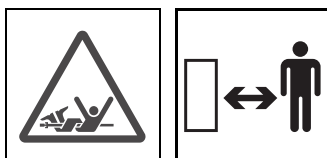
**IMPORTANT** can help you do a better job or make your job easier in some way.

## Machine Safety Alerts



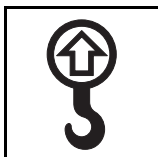
Decal\_ATJT30\_T4.png

1

**⚠ DANGER**

Turning shaft will kill you or crush arm or leg. Stay away. 274-187

2

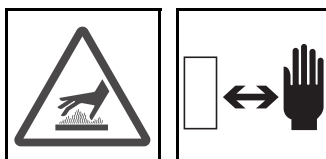


Lift point. See Transport chapter for more information. 274-442

3

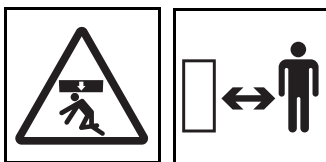
**⚠ WARNING**Fire or explosion possible. Do not use starter fluid.  
273-459 (2P), 274-206 (2P), 700-206 (2P)

4

**⚠ CAUTION**

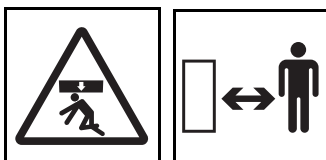
Hot parts may cause burns. Do not touch until cool or wear gloves. 275-355 (2-P), 273-423 (2-P)

5



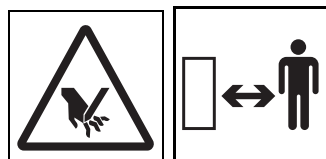
**⚠ WARNING** Crushing weight could cause death or serious injury. Stay away. 275-326, 701-326

6



**⚠ WARNING** Crushing weight could cause death or serious injury. Stay away. 275-326, 701-326

7



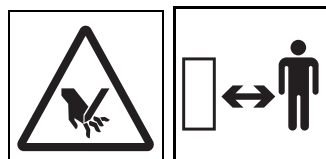
**⚠ WARNING** Moving parts could cut off hand or foot. Stay away. 275-184, 273-546

8



**⚠ DANGER** Moving tools will kill or injure. Never use pipe wrenches on drill string. 273-278

9



**⚠ WARNING** Moving parts could cut off hand or foot. Stay away. 275-184, 273-546

10



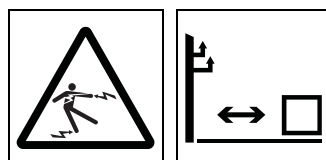
**⚠ WARNING** Read operator's manual. Know how to use all controls. Your safety is at stake. 273-475

11



Tiedown location. See Transport chapter for more information. 274-318

12

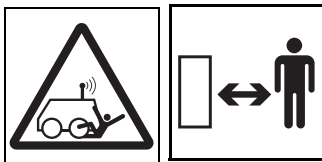


**⚠ DANGER** Electric shock will cause death or serious injury. Stay away. 274-049





13



**CAUTION** Equipment can be operated by remote control. Stay away.

14



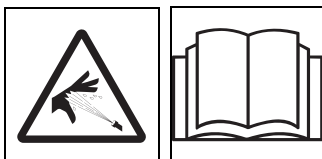
Emergency exit. Break glass to exit cab when door is blocked or inoperable.

15



**WARNING** Jobsite hazards could cause death or serious injury. Use correct equipment and work methods. Use and maintain proper safety equipment.

16



**WARNING** Pressurized fluid or air could pierce skin and cause severe injury. Refer to operator's manual for proper use. 270-6035

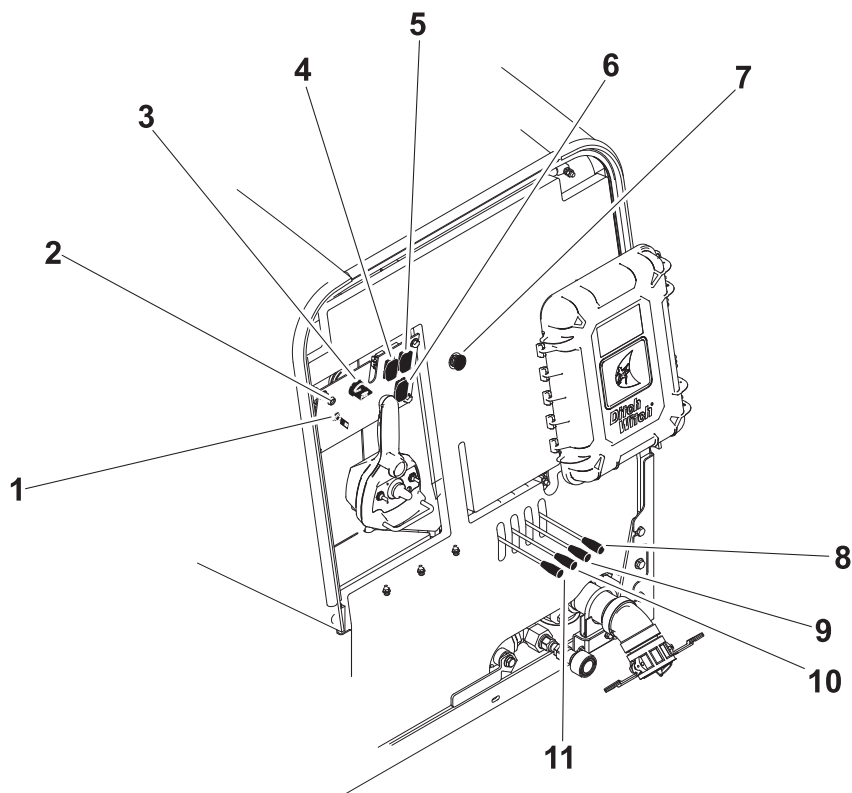
# Controls

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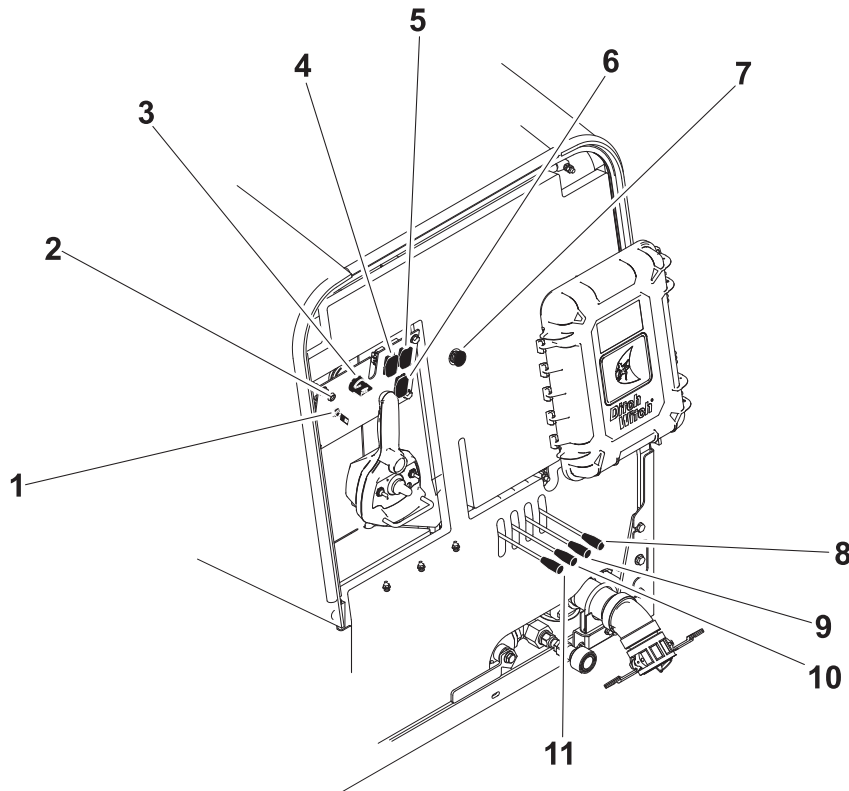
## Set-Up Console



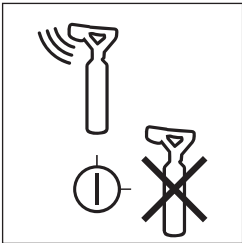
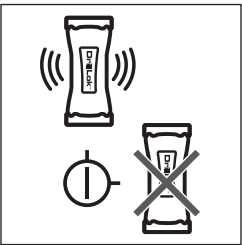
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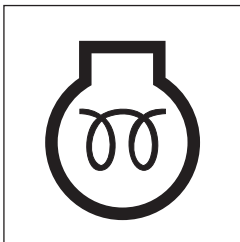
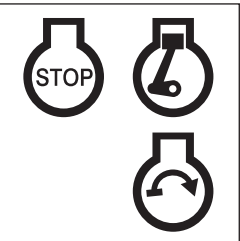
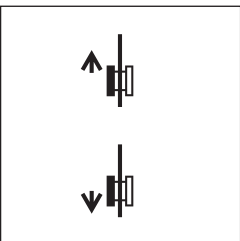
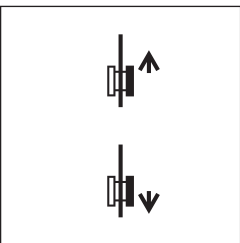

- |                                    |                              |
|------------------------------------|------------------------------|
| 1. DrillLok™ key                   | 7. Remote engine stop switch |
| 2. Cold start wait indicator       | 8. Right stabilizer control  |
| 3. Ignition switch                 | 9. Left stabilizer control   |
| 4. Left track switch               | 10. Back frame tilt control  |
| 5. Right track switch              | 11. Front frame tilt control |
| 6. Engine shutdown override switch |                              |

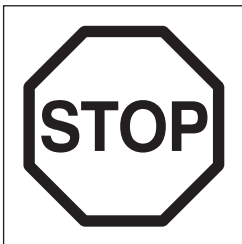
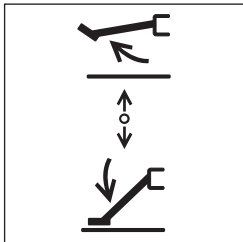
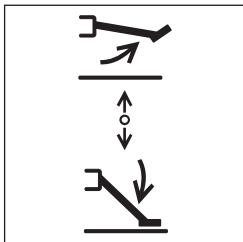
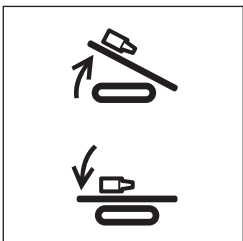
## Set-Up Console



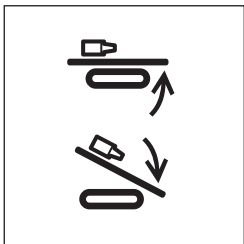
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Item	Description	Notes
<b>1. DrillLok™ key</b>  <small>c00ic063h.eps</small>  <small>c00ic122w.eps</small>	<p>To allow tracker operator to stop thrust and rotation, move key to enable position (up).</p> <p>To override DrillLok mode, move key to override position (right).</p>	<p><b>IMPORTANT:</b> Remove key and keep in tracker operator's possession.</p> <ul style="list-style-type: none"> <li>Top icon is shown when operating with Subsite® Electronics tracker.</li> <li>Bottom icon is shown when operating without Subsite Electronics tracker.</li> </ul>

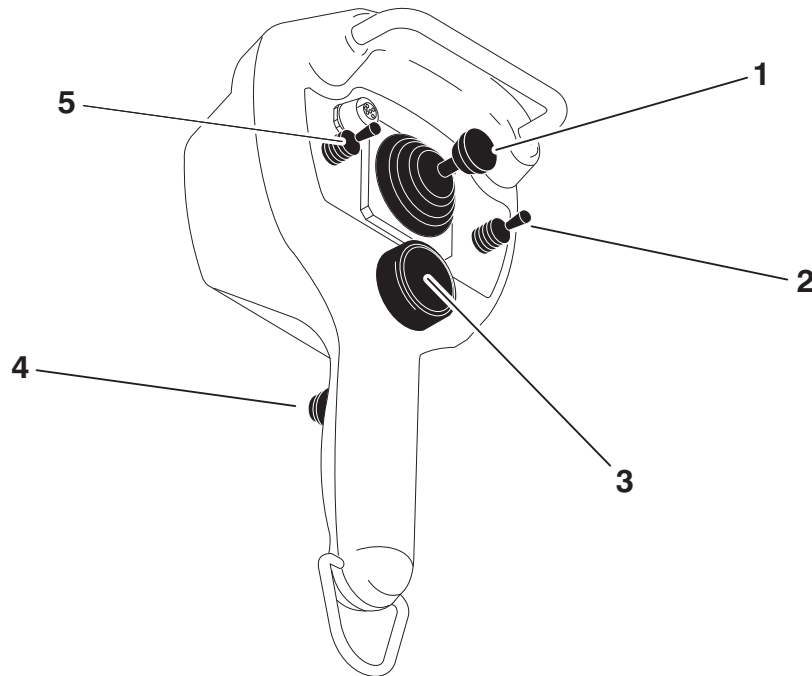
Item	Description	Notes
<b>2. Cold start wait indicator</b>  c00ic180h.eps	Lights when intake air pre-heater is operating.	<b>NOTICE:</b> If indicator is on, wait until it goes out before starting engine.
<b>3. Ignition switch</b>  c00ic065h.eps	<p>To start engine, insert key and turn clockwise.</p> <p>To stop engine, turn key counterclockwise.</p>	<b>IMPORTANT:</b> <ul style="list-style-type: none"> <li>Restart engine with ignition switch after it has been turned off with any remote engine stop switch.</li> <li>If wrenches are engaged when engine is stopped with ignition switch, wrenches will release and then engage when unit is started.</li> </ul>
<b>4. Left track switch</b>  c00ic147h.eps	<p>To move forward, press top.</p> <p>To move backward, press bottom.</p>	<b>IMPORTANT:</b> Use track switches only if tethered or wireless control is inoperable.
<b>5. Right track switch</b>  c00ic148h.eps	<p>To move forward, press top.</p> <p>To move backward, press bottom.</p>	<b>IMPORTANT:</b> Use track switches only if tethered or wireless control is inoperable.
<b>6. Engine shutdown override switch</b>  c00ic178h.eps	If engine shutdown indicator comes on, press to delay engine shutdown for 30 seconds.	<p>This control allows a temporary override of engine shutdown.</p> <p><b>NOTICE:</b> After 30 seconds, engine will again shut down unless fault condition has been corrected.</p> <p><b>IMPORTANT:</b> See "Electronic Controlled Engine Overview" on page 175.</p>

Item	Description	Notes
<b>7. Remote engine stop switch</b>  <small>c00ic062h.eps</small>	<p>To stop engine, press.</p> <p>To restart engine, press remote engine start switch.</p>	<p><b>IMPORTANT:</b></p> <ul style="list-style-type: none"> <li>If this switch is used to stop drilling unit, be sure to turn ignition switch off if machine will be left unattended for long periods of time. Battery discharge can occur.</li> <li>If wrenches are engaged when remote stop is pressed, wrenches will remain engaged but could gradually open.</li> </ul>
<b>8. Left stabilizer control</b>  <small>c00ic030h.eps</small>	<p>To raise, pull up.</p> <p>To lower, push down.</p>	<p><b>IMPORTANT:</b> Lower left and right stabilizers to the ground together, then adjust individually.</p> <p><b>WARNING:</b> Crushing weight could cause death or serious injury. Use proper procedures and equipment or stay away.</p>
<b>9. Right stabilizer control</b>  <small>c00ic029h.eps</small>	<p>To raise, pull up.</p> <p>To lower, push down.</p>	<p><b>IMPORTANT:</b> Lower left and right stabilizers to the ground to stabilize unit and then adjust for side-to-side stability.</p> <p><b>WARNING:</b> Crushing weight could cause death or serious injury. Use proper procedures and equipment or stay away.</p>
<b>10. Back frame tilt control</b>  <small>c00ic027h.eps</small>	<p>To raise, pull up.</p> <p>To lower, push down.</p>	<p><b>IMPORTANT:</b> To ensure a stable platform for drilling, use front and back tilt controls together to set frame at desired pitch without raising tracks off the ground.</p>



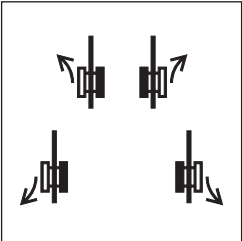
Item	Description	Notes
<b>11. Front frame tilt control</b>  c00ic026h.eps	To raise, pull up.  To lower, push down.	<b>IMPORTANT:</b> To ensure a stable platform for drilling, use front and back tilt controls together to set frame at desired pitch without raising tracks off the ground.

## Tethered Ground Drive Controller

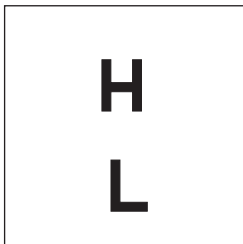
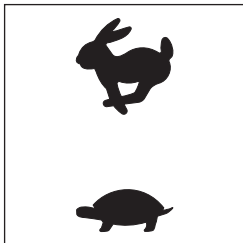


j10om016h.eps

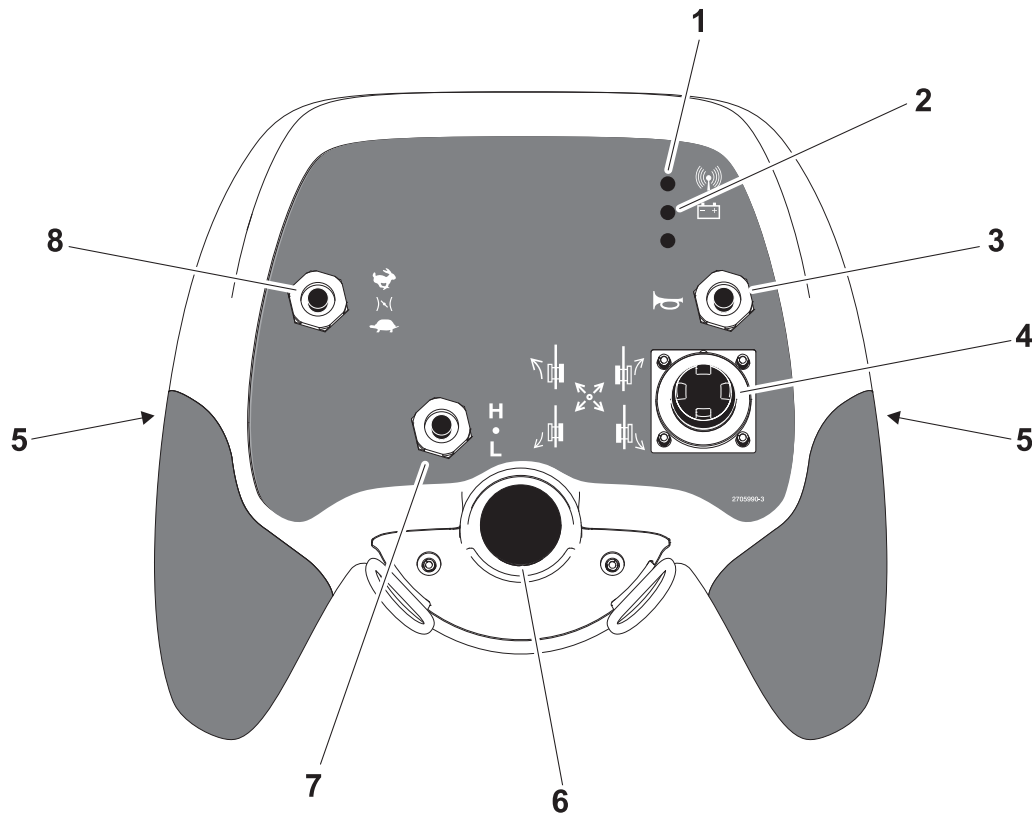
- |                            |                             |
|----------------------------|-----------------------------|
| 1. Speed/direction control | 4. Operator presence switch |
| 2. Drive mode switch       | 5. Throttle switch          |
| 3. Remote engine stop      |                             |

Item	Description	Notes
<b>1. Speed/direction control</b>  <p>c00ic145h.eps</p>	<p>To move forward, push.</p> <p>To move backward, pull.</p> <p>To steer, move left or right while moving forward or backward.</p>	<p><b>IMPORTANT:</b></p> <ul style="list-style-type: none"> <li>Operator presence switch must be pressed and operator seat must be empty for control to work.</li> <li>See "Steer Unit" on page 92 for more information.</li> </ul>




Item	Description	Notes
<b>2. Drive mode switch</b>  <small>c00ic146h.eps</small>	<p>To select normal driving mode (high), push.</p> <p>To select loading and unloading mode (low), pull.</p> <p>To disable controller, return to center.</p>	
<b>3. Remote engine stop</b>	To stop engine, press red button.	<b>IMPORTANT:</b> To restart engine, turn ignition switch off and then back on.
<b>4. Operator presence switch</b>	<p>To operate ground drive with tethered controller, press.</p> <p>To disable controller, release.</p>	
<b>5. Throttle switch</b>  <small>c00ic042h.eps</small>	<p>To increase engine speed, press top.</p> <p>To decrease engine speed, bottom.</p>	

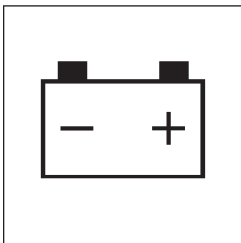
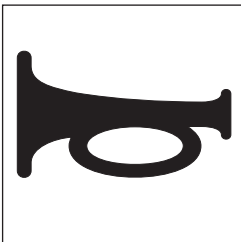
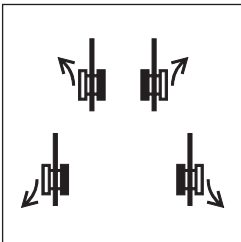
## Wireless Ground Drive Controller

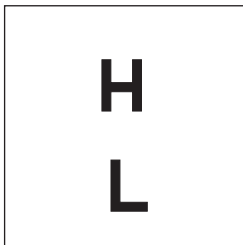
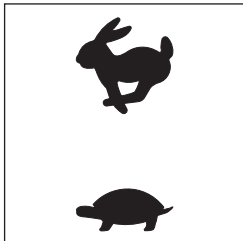


Remote\_GroundDrive\_Control\_2202375.eps

- |                                 |                               |
|---------------------------------|-------------------------------|
| 1. Communication link indicator | 5. Operator presence switches |
| 2. Power status indicator       | 6. Engine stop                |
| 3. Power/start/horn switch      | 7. Drive mode switch          |
| 4. Speed/direction control      | 8. Throttle switch            |

Item	Description	Notes
<b>1. Communication link indicator</b>  <small>c00ic713h.eps</small>	<p>Indicates the status of the transmitter and receiver link.</p> <ul style="list-style-type: none"> <li>Blinking yellow indicates no communication link.</li> <li>Blinking green indicates good communication link.</li> <li>Steady red indicates an internal problem. Contact your Ditch Witch® dealer.</li> </ul>	<p>An active communication link is required for wireless control.</p>

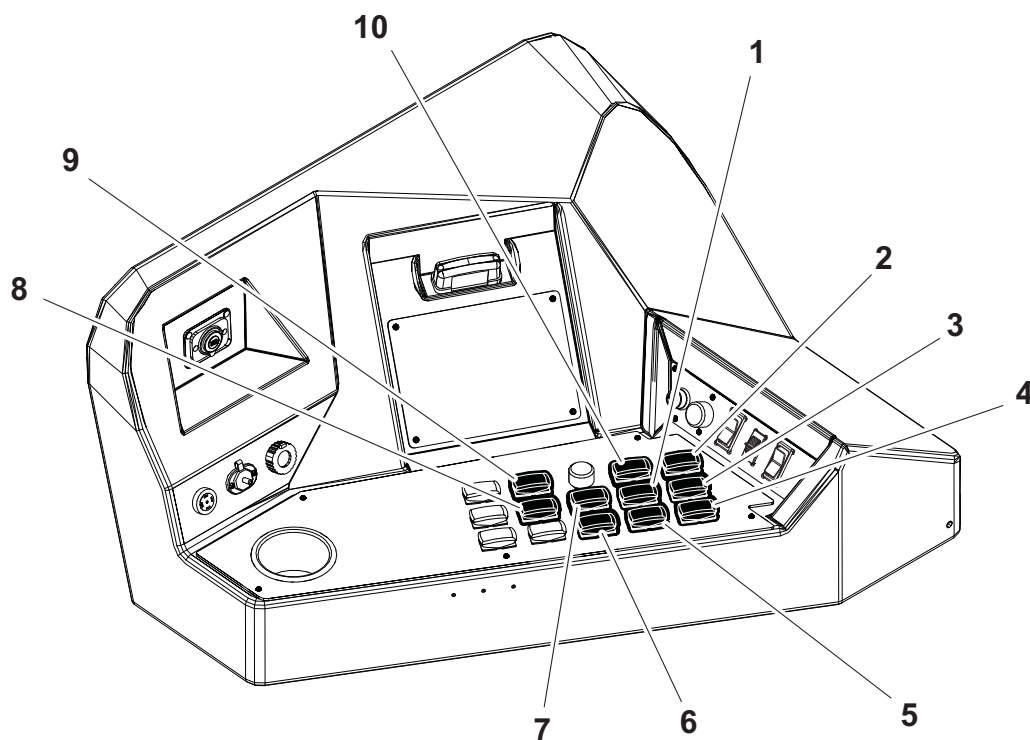
Item	Description	Notes
<b>2. Power status indicator</b>  <small>c00ic008w.eps</small>	<p>Indicates battery status and cable connection.</p> <ul style="list-style-type: none"> <li>Off indicates good battery level.</li> <li>Blinking red indicates low battery level.</li> <li>Solid green indicates transmitter is connected to machine.</li> </ul>	
<b>3. Power/start/horn switch</b>  <small>c00ic044h.eps</small>	<p>To turn power on, hold switch up until yellow LED indicator comes on and then blinks green. Release switch. Wireless remote control light (page 4) will shine.</p> <p>To start operation, hold switch up with speed/direction control in neutral position until horn sounds. Release switch.</p> <p>To use horn, move switch up. Release switch to stop horn.</p> <p>To turn power off, hold switch down until LED indicators go off.</p>	<p><b>IMPORTANT:</b> Transmitter shuts off and yellow LED indicator blinks after 1 minute of inactivity. Hold switch up twice to restart.</p>
<b>4. Speed/direction control</b>  <small>c00ic145h.eps</small>	<p>To move forward, move up.</p> <p>To move backward, move down.</p> <p>To steer, move left or right while moving forward or backward.</p>	<p><b>IMPORTANT:</b></p> <ul style="list-style-type: none"> <li>Operator presence switch must be pressed and operator seat must be empty for control to work.</li> <li>See "Steer Unit" on page 88 for more information.</li> </ul>
<b>5. Operator presence switches</b>	<p>To operate wireless controller, press one or both switches.</p> <p>To disable controller, release.</p>	
<b>6. Engine stop</b>	<p>To stop engine, press red button.</p>	<p><b>IMPORTANT:</b> To restart engine, turn ignition switch off and then back on.</p>

Item	Description	Notes
<b>7. Drive mode switch</b>  <small>c00ic146h.eps</small>	<p>To select normal driving mode (high), move up.</p> <p>To select loading and unloading mode (low), move down.</p>	
<b>8. Throttle switch</b>  <small>c00ic042h.eps</small>	<p>To increase engine speed, move up.</p> <p>To decrease engine speed, move down.</p> <p>Release switch to stop speed adjustment.</p>	<p><b>IMPORTANT:</b> Switch only works when controller is in the ready mode (green LED blinking) and at least one operator presence switch is pressed.</p>



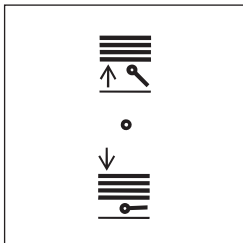
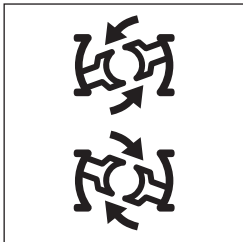
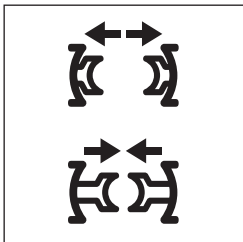
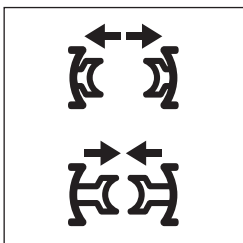
## Left Control Console

### Pipelading Controls

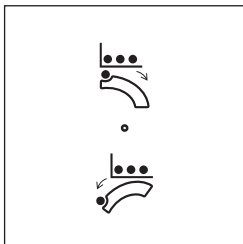
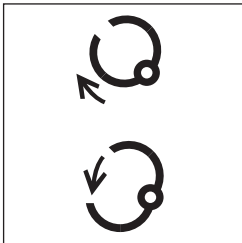
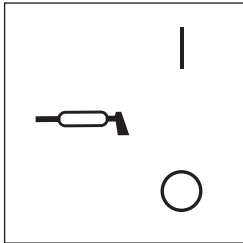
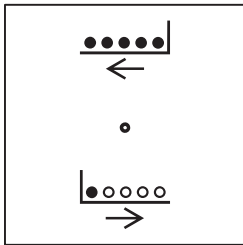
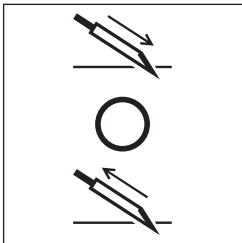


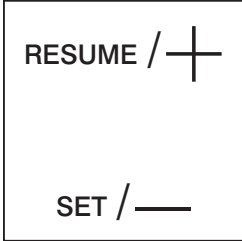
j50om044w.eps

- |                                |                                       |
|--------------------------------|---------------------------------------|
| 1. Pipe lift switch            | 6. Pipe gripper switch                |
| 2. Rear wrench rotation switch | 7. Pipe lubricator switch             |
| 3. Rear wrench clamp switch    | 8. Pipe box position switch           |
| 4. Front wrench clamp switch   | 9. Add pipe/manual/remove pipe switch |
| 5. Pipe shuttle switch         | 10. Set/Resume switch                 |

Item	Description	Notes
<b>1. Pipe lift switch</b>  <small>c00ic171h.eps</small>	<p>To raise, press top.</p> <p>To lower, press bottom.</p> <p>To stop, release.</p>	
<b>2. Rear wrench rotation switch</b>  <small>c00ic038h.eps</small>	<p>To rotate counterclockwise, press top.</p> <p>To rotate clockwise, press bottom.</p> <p>To stop rotation, release.</p>	
<b>3. Rear wrench clamp switch</b>  <small>c00ic033h.eps</small>	<p>To unclamp, press top.</p> <p>To clamp, press bottom.</p>	
<b>4. Front wrench clamp switch</b>  <small>c00ic033h.eps</small>	<p>To unclamp, press top.</p> <p>To clamp, press bottom.</p>	

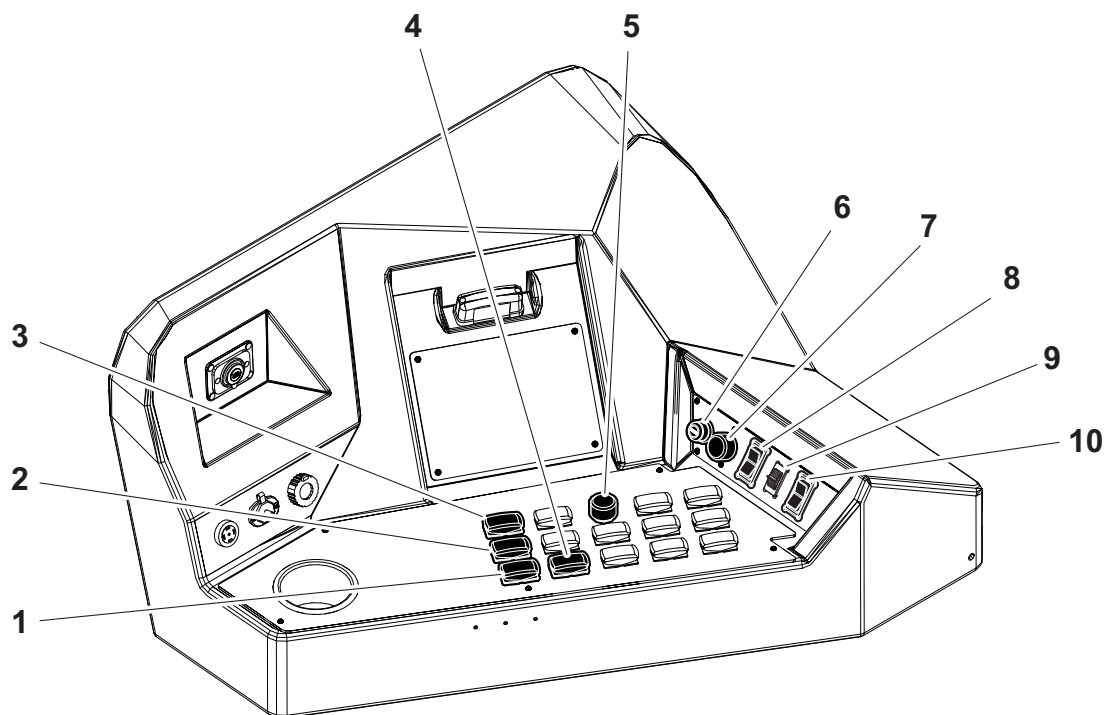


Item	Description	Notes
<b>5. Pipe shuttle switch</b>  c00ic172h.eps	<p>To move toward pipe box, press top.</p> <p>To move toward spindle, press bottom.</p> <p>To stop shuttles, release.</p>	
<b>6. Pipe gripper switch</b>  c00ic035h.eps	<p>To close, press top.</p> <p>To open, press bottom.</p> <p>To stop grippers, release.</p>	
<b>7. Pipe lubricator switch</b>  c00ic472h.eps	<p>To apply joint compound, press top.</p>	<p>Applies joint compound to threads at wrenches.</p>
<b>8. Pipe position switch</b>  c00ic126a.eps	<p>To shift pipe box away from operator, press top.</p> <p>To shift pipe box toward operator, press bottom.</p> <p>To stop pipe box, release.</p>	<p><b>IMPORTANT:</b> See "Shift Pipe Box" on page 161.</p>
<b>9. Add pipe/manual/remove pipe switch</b>  c00ic031h.eps	<p>To select "add pipe" automated pipeloader function, press top.</p> <p>To use manual pipeloader controls, move to center.</p> <p>To select "remove pipe" automated pipeloader function, press bottom.</p>	<p>See "Enable Automated Pipeloader System" on page 113.</p>

Item	Description	Notes
<p><b>10. Set/Resume switch</b></p>  <p>c00ic113h.eps</p>	<p>To resume operation or increase operation levels, press top.</p> <p>To set operating conditions or reduce operation levels, press bottom.</p>	<p>See "Cruise Control" on page 170.</p> <p>See "AutoCarve switch" on page 37 and 118.</p> <p>See "Pipeloder" on page 158.</p>

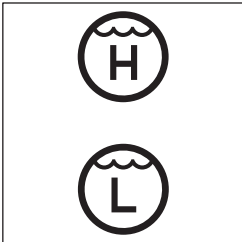
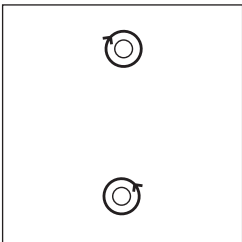
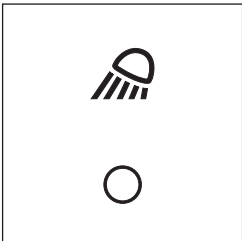
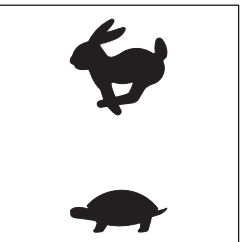




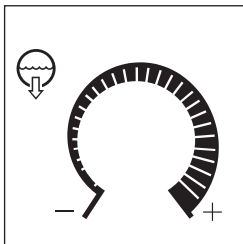
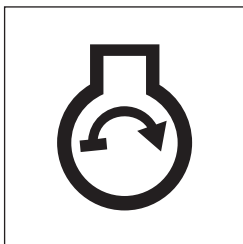
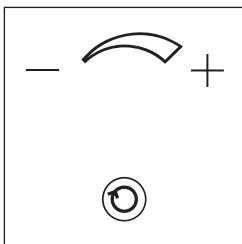
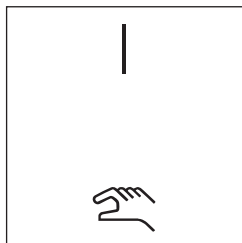
**Drilling/Operation Controls**

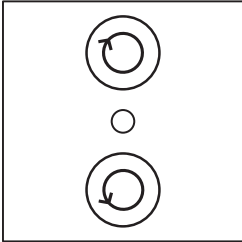
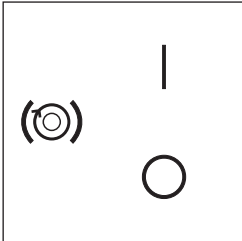
j50om006w.eps

- |                              |  |
|------------------------------|--|
| 1. Fluid pump speed switch   | 6. Remote engine start switch  |
| 2. AutoCarve switch          | 7. AutoCarve speed control (JT, AT Dirt modes)<br>Inner spindle speed control (AT Rock mode) |
| 3. Console/Work light switch | 8. Inner spindle switch (AT only)  |
| 4. Engine throttle switch    | 9. Manual inner spindle control (AT only)  |
| 5. Fluid flow control        | 10. Outer spindle brake switch (AT only)   |

Item	Description	Notes
<b>1. Fluid pump speed switch</b>  <small>c00ic106c.eps</small>	<p>For high speed, press top.</p> <p>For low speed, press bottom.</p>	<p>High speed delivers more flow at lower pressure.</p> <p>Low speed delivers less flow at higher pressure.</p>
<b>2. AutoCarve switch</b>  <small>c00ic460h.eps</small>	<p>To enable autocarve, press top.</p> <p>To deactivate autocarve, press bottom.</p>	<p>Two-speed thrust is not allowed in autocarve mode.</p> <p>Cruise control is not available in autocarve mode.</p> <p>Autocarve is disabled while front wrench is closed.</p>
<b>3. Console/Work light switch</b>  <small>c00ic151h.eps</small>	<p>To turn on, press top.</p> <p>To turn off, press bottom.</p>	
<b>4. Engine throttle switch</b>  <small>c00ic042h.eps</small>	<p>To increase speed, press top.</p> <p>To enable autothrottle mode, leave switch in top position.</p> <p>To disable autothrottle mode, return switch to center after desired speed is reached.</p> <p>To decrease speed, press bottom.</p>	<p>Autothrottle mode slows the engine to low throttle after 15 seconds of inactivity involving thrust, rotation, drilling fluid flow, or pipeloader functions. To return to high speed, activate thrust, rotation, drilling fluid, or an add/remove pipe cycle.</p>

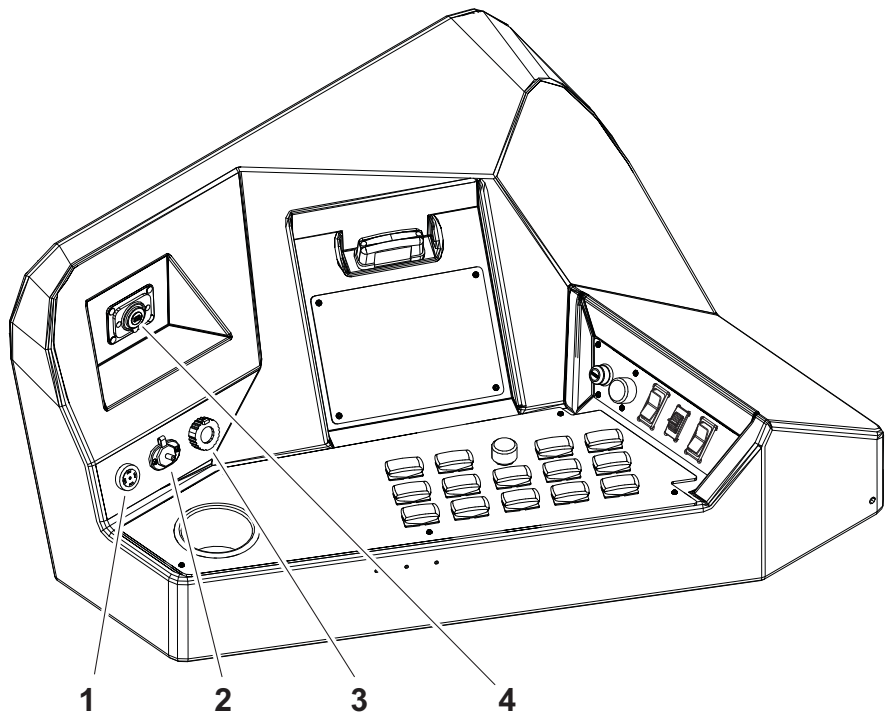


Item	Description	Notes
<b>5. Fluid flow control</b>  <small>c00ic473h.eps</small>	<p>To increase flow, turn clockwise.</p> <p>To decrease flow, turn counterclockwise.</p> <p>To stop flow, turn all the way counterclockwise.</p>	<p><b>Note:</b> Drilling fluid pump must be switched on. See "Right Control Console" on page 41.</p>
<b>6. Remote engine start switch</b>  <small>c00ic152h.eps</small>	<p>To start engine from operator's station, push button.</p> <p>Release when engine starts.</p>	<p><b>IMPORTANT:</b> This button works only when key in set-up console is on, operator is in seat, and battery disconnect switch is closed.</p>
<b>7. Carve window control (JT and AT Dirt mode)</b> <b>or</b> <b>Inner spindle speed control (AT Rock mode)</b>  <small>c00ic040h.eps</small>	<p>To increase carve window range, turn clockwise.</p> <p>To decrease carve window range, turn counterclockwise.</p> <p>To increase rotation speed, turn clockwise.</p> <p>To decrease rotation speed, turn counterclockwise.</p>	<p>See "Use AutoCarve" on page 121.</p> <p>For AT units:</p> <p>To set carve window, autocarve mode must be enabled and drilling mode switch in <b>AT Dirt</b> position. See "Engine Compartment Controls" on page 60.</p> <p>To control inner spindle speed, Inner Spindle switch must be on and drilling mode switch in AT position. See "Engine Compartment Controls" on page 60.</p>
<b>8. Inner spindle switch</b>  <small>c00ic016h.eps</small>	<p>To turn on, press top.</p> <p>To turn off, move to center.</p> <p>To manually control inner rotation speed and direction, press bottom. Then use manual inner spindle control as needed.</p>	<p><b>IMPORTANT:</b></p> <ul style="list-style-type: none"> <li>To restart inner rotation after operator has left seat, turn inner rotation off and then on.</li> <li>Normal dither works in manual control mode unless the manual inner spindle control is moved from its normal position.</li> </ul>

Item	Description	Notes
<p><b>9. Manual inner spindle control</b></p>  <p>c00ic127a.eps</p>	<p>To rotate clockwise, move to top.</p> <p>To rotate counterclockwise, move to bottom.</p> <p>To stop inner rotation, release.</p>	<p><b>IMPORTANT:</b></p> <ul style="list-style-type: none"> <li>Inner spindle switch must be in manual position for this control to work.</li> <li>Range of speed is reduced to allow easier manual control.</li> <li>Up/down paddle is spring centered. Moving it above center rotates inner rod clockwise. Moving it further rotates the rod faster. Moving it below center does the same for counter clockwise rotation.</li> </ul>
<p><b>10. Outer spindle brake switch</b></p>  <p>c00ic255h.eps</p>	<p>To engage, press top.</p> <p>To disengage, press bottom.</p>	<p>Prevents outer spindle from rotating when inner spindle or mud motor are in use.</p> <p>Brake is temporarily released when front wrench is closed to allow pipe change.</p>



Miscellaneous Controls



j50om005w.eps

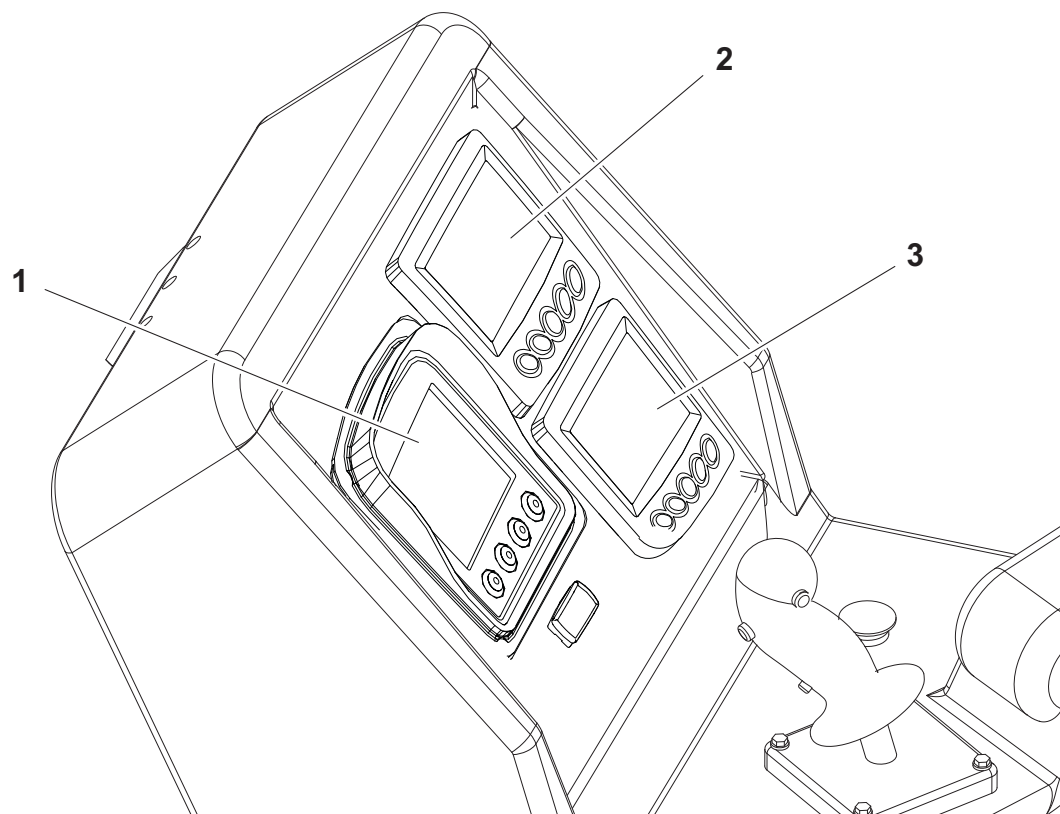
1. Horn

2. Auxiliary outlet
3. Diagnostic port

4. USB port

Item	Description	Notes
1. Horn	Provides audible alarm for strike system and DrillLok™.	
2. Auxiliary outlet	Provides power for other equipment.	Power output is 12VDC, 5A.
3. Diagnostic port	For use by only by qualified Ditch Witch® technicians.	
4. USB port	Provides power for mobile devices	DC5V, 1A (5W)

## Right Control Console



j50om008w.eps

- 1. Remote display\*
- 2. Machine display

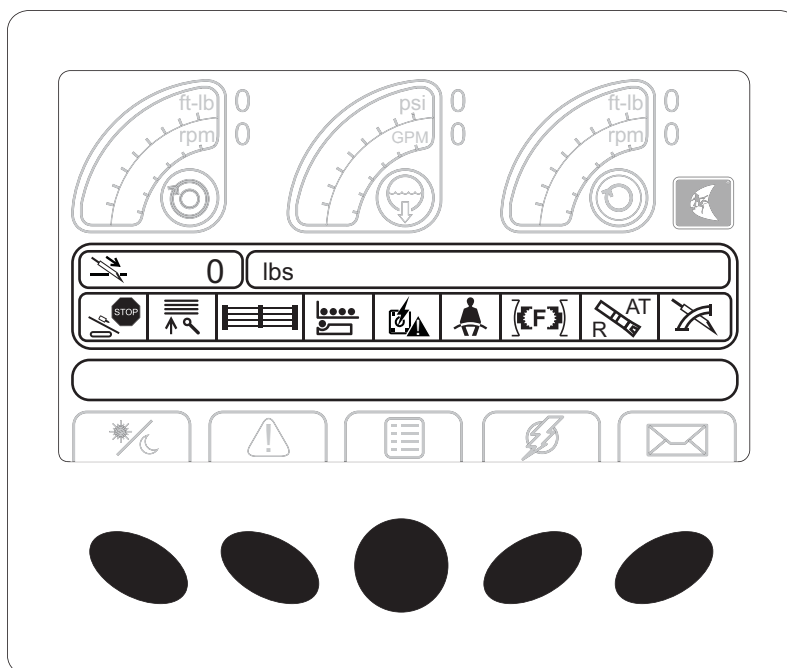
- 3. Engine display

\*See tracker manual


























## Machine Display

### Status Indicators

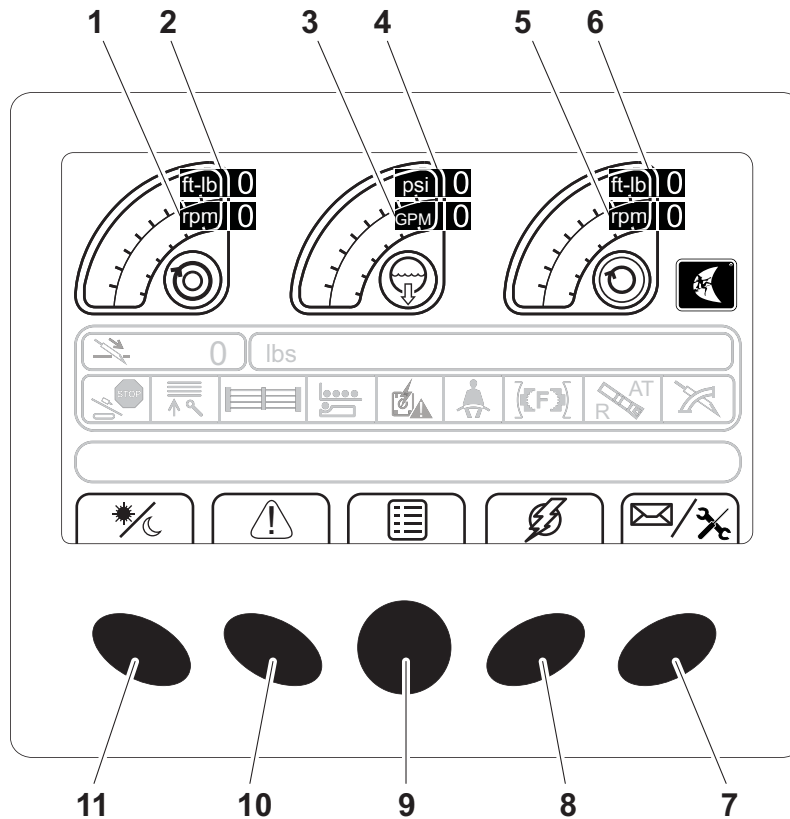


j50om029w.eps

### Indicators

	Front home indicator		All pipe good		AT rock drill mode
	Rear home indicator		Both pipe missing		JT drill mode
	Carriage indicator		Rear pipe missing		AT dirt drill mode
	Rear stop indicator		Front pipe missing		Drive mode
	ESID message indicator		Shuttle home indicator (shuttles retracted)		Front wrench indicator
	ESID OK		Pipe lifter indicator		Carve mode
	ESID voltage		Operator presence indicator		
	ESID detected, not OK				
	ESID current indicator		*Yellow icon will flash in place of status indicators when machine display has lost connection with CAN from machine controller.		

## Gauges and Buttons



j50om048w.eps

- |  |                                    |
|--|------------------------------------|
| 1. Outer rotation speed gauge                    | 7. Hide/Recall iCenter message key |
| 2. Outer rotation pressure gauge                 | 8. Acknowledge ESID errors key     |
| 3. Mud rotation speed gauge                      | 9. Main menu key                   |
| 4. Mud rotation pressure gauge                   | 10. ESID application key           |
| 5. Inner rotation speed gauge (AT units only)    | 11. Day/Night mode key             |
| 6. Inner rotation pressure gauge (AT units only) |                                    |

Item	Description	Notes
1. <b>Outer rotation speed gauge</b>	Displays outer rotation speed graphically and numerically.	
2. <b>Outer rotation pressure gauge</b>	Displays outer rotation pressure graphically and numerically.	
3. <b>Mud rotation speed gauge</b>	Displays mud rotation speed graphically and numerically.	



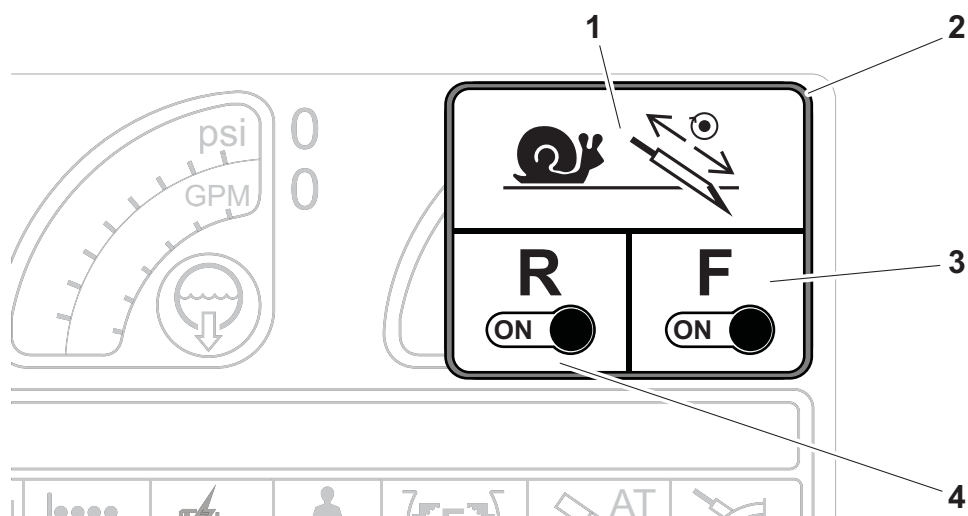
Item	Description	Notes
4. Mud rotation pressure gauge	Displays mud rotation pressure graphically and numerically.	
5. Inner rotation speed gauge (AT units only)	Displays inner rotation speed graphically and numerically.	
6. Inner rotation pressure gauge (AT units only)	Displays inner rotation pressure graphically and numerically.	
7. Hide/Recall iCenter message key	When message appears, press button twice to hide second line of text.  Press button twice to recall message.	
8. Acknowledge ESID errors key	Displays when unit detects an error with ESID system.	Press to view code. Press again to clear code. Pressing button clears codes one at a time.
9. Main menu key	Press from main screen (gauges) to select main menu.	
10. ESID application key	Press to select the ESID menu.	
11. Day/Night mode key	Press from main screen to toggle between day and night modes.	

## Main Menu

**IMPORTANT:** Soft key commands change with each menu screen and are displayed next to the key.







Item	Description	Notes
1. System settings key	Press to select system settings menu.	
2. User settings key	Press to select user settings menu.	User settings menu allows user to change the language and unit settings, and to set the time and date.
3. Main screen key	Press to return to main screen.	
4. ESID menu key	Press to select the ESID menu.	
5. Not used.		

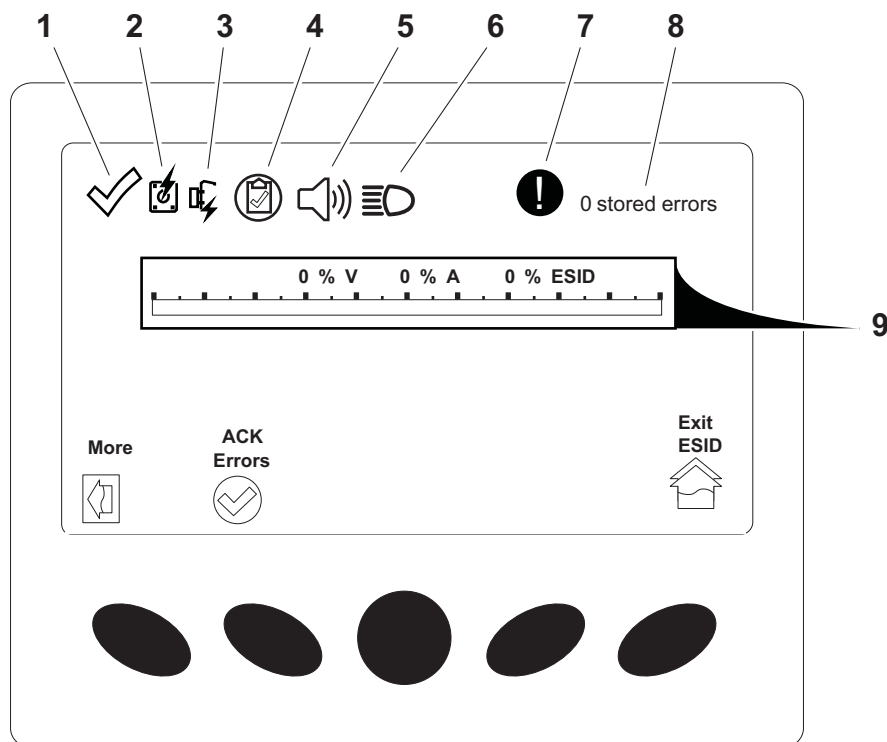
## Wireline Restricted Operating Mode (ROM)



j50om053w.eps

- |                         |                                  |
|-------------------------|----------------------------------|
| 1. ROM status indicator | 3. Front wrench status indicator |
| 2. ROM message boundary | 4. Rear wrench status indicator  |

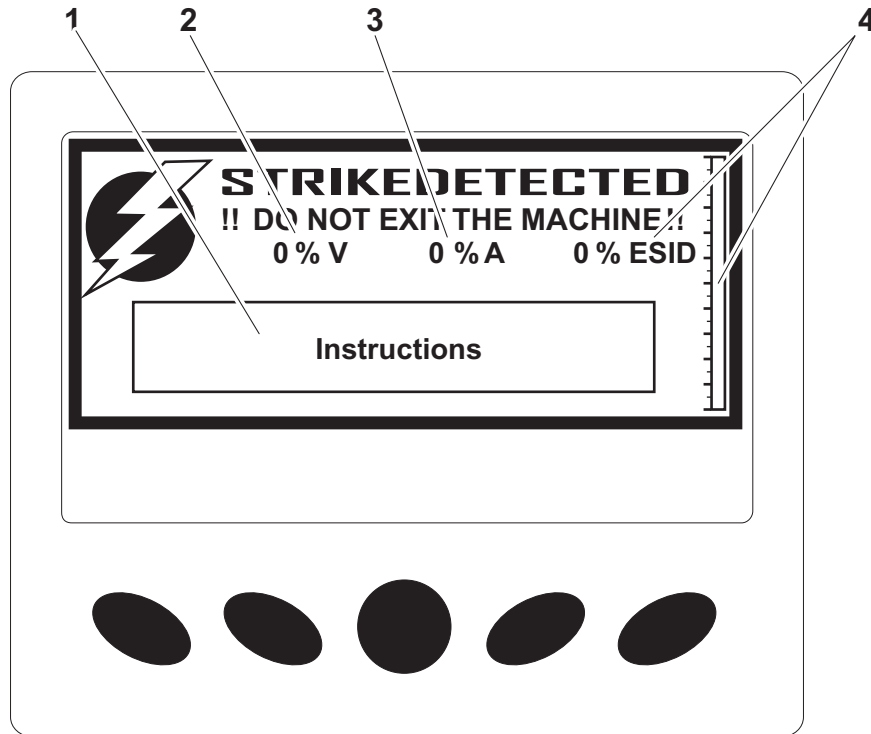
Item	Description	Notes
1. ROM status indicator	 Indicates ROM is on.  Indicates ROM error. See your Ditch Witch® dealer.	
2. ROM message boundary	Green boundary indicates ROM mode is on.  Yellow and red boundary indicate error conditions. See your Ditch Witch dealer.	Turn off wireline ROM switch (page 63). Do not use ROM until error is fixed.
3. Front wrench status indicator	 Indicates switch is on.  Indicates an error.	
4. Rear wrench status indicator	 Indicates switch is on.  Indicates an error.	

**ESID Application Display**


j50om028w.eps

Item Description	Notes
1. ESID okay (check) indicator	ESID self test reports no problems.
2. ESID amperage indicator	ESID has detected a non-specific problem with current coil circuit.
3. ESID voltage indicator	ESID has detected a non-specific problem with voltage limiter circuit.
4. ESID test indicator	Self test is being conducted.
5. ESID horn active indicator	
6. ESID strobe active indicator	
7. ESID error code indicator	
8. ESID stored error count	
9. ESID strike percentages	See next page for information.

**ESID Strike Display**



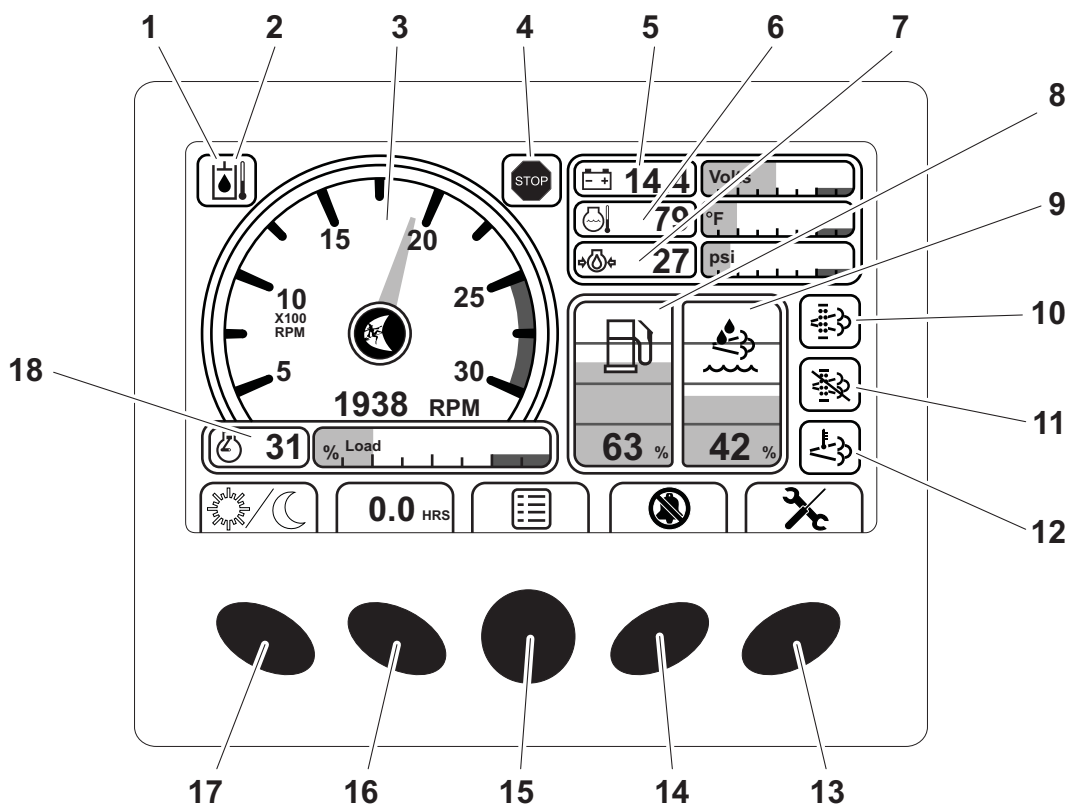
j50om031w.eps

Item Description	Notes
<b>1. Instruction display</b>	Follow the instructions on the screen when a strike is detected.
<b>2. Voltage indicator</b>	Indicates percentage of voltage difference detected between voltage limiter and unit. 30 volts will display as 100%.
<b>3. Current indicator</b>	Indicates percentage of current being detected at the current transformer. 300 milliamps will display as 100%.
<b>4. Strike condition indicator</b>	Indicates the total combined percentage of detected voltage and current and displays it graphically. An alarm condition occurs when the total combined percentage is equal to or greater than 100%.

The above screen is displayed when an electrical strike is detected. For more information, See "Electric Strike System" on page 135.

**IMPORTANT:** The ESID does not indicate proximity to electric lines. System will activate only when voltage and/or amperage detected at the drilling unit are above threshold minimum limits.

## Engine Display



j50om039w.eps

- |   |  |
|---|--|
| 1. Hydraulic fluid filter indicator                     | 10. Exhaust cleaning indicator           |
| 2. Hydraulic fluid temperature indicator                | 11. Exhaust cleaning inhibited indicator |
| 3. Tachometer   | 12. High exhaust temperature indicator   |
| 4. Engine stop indicator                                | 13. Engine diagnostics key               |
| 5. Voltmeter display                                    | 14. Audible alarm key                    |
| 6. Engine coolant temperature indicator/numeric display | 15. Main menu key                        |
| 7. Engine oil pressure indicator/numeric display        | 16. Hourmeter/fuel economy/clock key     |
| 8. Fuel gauge   | 17. Day/Night mode key                   |
| 9. DEF indicator/tank level percentage                  | 18. Engine load display                  |

Item	Description	Notes
1. <b>Hydraulic fluid filter indicator</b>	Lights when hydraulic filter is restricted.	
2. <b>Hydraulic fluid temperature indicator</b>	Lights when hydraulic fluid temperature is too high.	

Item	Description	Notes
3. Tachometer	Displays engine speed.	
4. Engine stop indicator	Lights when operator needs to stop engine.	
5. Voltmeter display	Shows system voltage.	Normal voltage is 13-14V with engine running.
6. Engine coolant temperature indicator/ numeric display	Displays engine coolant temperature.	Normal coolant temperature is 160°-225° F (71°-107° C).
7. Engine oil pressure gauge	Displays engine oil pressure.	Full load reading should be 60-80 psi (4.1-5.5 bar).
8. Fuel gauge	Displays amount of fuel remaining in tank.	See "Approved Fuel" on page 198.
9. DEF indicator/tank level percentage	Displays amount of diesel exhaust fluid (DEF) remaining in tank.	<b>IMPORTANT:</b>  <b>DEF level:</b> <ul style="list-style-type: none"> <li>Icon turns yellow and level turns red when DEF reaches 10%.</li> <li>Icon flashes yellow and level flashes red when DEF reaches 5%.</li> <li>Icon and level continue to flash when DEF drops below 2.5% and engine derates.</li> <li>Icon continues to flash when DEF reaches 0%. Engine begins secondary derate and locks machine to low throttle after 30 minutes.</li> </ul> <p>See "Diesel Exhaust Fluid (DEF)" on page 199.</p>
10. Exhaust cleaning indicator	Lights when a system cleaning is needed.	See "Diesel Exhaust Fluid (DEF)" on page 199.
11. Exhaust cleaning inhibited indicator	Lights when operator has disabled exhaust cleaning.	
12. High exhaust temperature indicator	Lights when exhaust temperatures are high.	<b>NOTICE:</b> May light when exhaust cleaning is occurring.



Item	Description	Notes
<b>13. Hide/Recall engine diagnostics key</b>	When diagnostic message appears, press button twice to hide.  Press button twice to recall message.	
<b>14. Audible alarm key</b>	Press from main screen to toggle audible alarm on and off.	Icon is only visible when alarm is audible.
<b>15. Main menu key</b>	Press from main screen (gauges) to select main menu.	
<b>16. Hourmeter/fuel economy/clock key</b>	Toggles between hourmeter, fuel economy and clock.	Hourmeter displays number of hours engine has been running.
<b>17. Day/Night mode key</b>	Press from main screen to toggle between day and night modes.	
<b>18. Engine load display</b>	Displays engine load.	

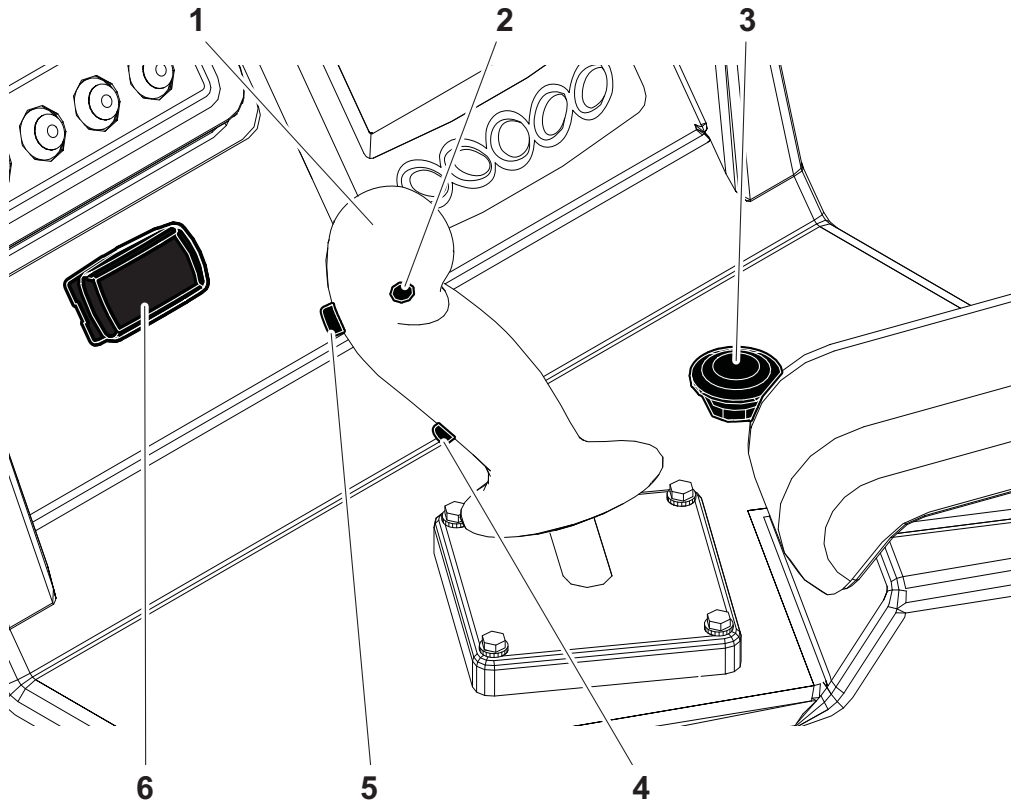
Most engine display functions are self-explanatory. For more information about functions, see the manufacturer's instructions at [www.fwmurphy.com](http://www.fwmurphy.com).

## Main Menu

**IMPORTANT:** Soft key commands change with each menu screen and are displayed next to the key.

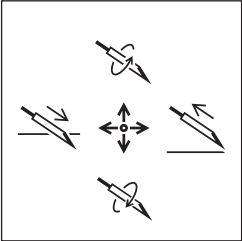
Item	Description	Notes
<b>1. System settings key</b>	Press to select system settings menu.	System settings menu displays information about the system, including exhaust cleaning options (under Tier 4 menu). Diagnostic information is only available to dealer technicians.
<b>2. User settings key</b>	Press to select user settings menu.	User settings menu allows user to change the language and unit settings, and to set the time and date.
<b>3. Main screen key</b>	Press to return to main screen.	
<b>4. Not used</b>		
<b>5. Engine diagnostics key</b>	Press to select engine diagnostics menu.	For dealer technician use only.

## Controls




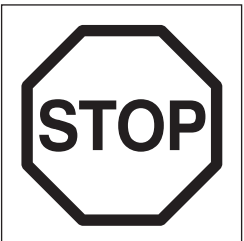
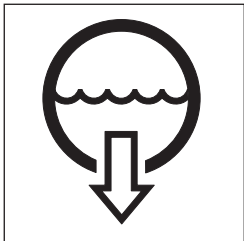
j50om007w.eps

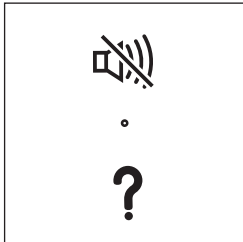
- |                                     |  |
|-------------------------------------|--|
| 1. Carriage control joystick        | 4. Drilling fluid pump switch            |
| 2. Drilling fluid quick fill switch | 5. Multi-use button                      |
| 3. Remote engine stop switch        | 6. ESID alarm interrupt/self-test switch |

Item	Description	Notes
<b>1. Carriage control</b>  <p>c00ic622h.eps</p>	<p>To move carriage forward, push.</p> <p>To move carriage backward, pull.</p> <p>To rotate spindle counterclockwise (breakout), move right.</p> <p>To rotate spindle clockwise (makeup), move left.</p>	<p><b>IMPORTANT:</b> See “Operate Carriage Control” on page 105 for more information.</p>



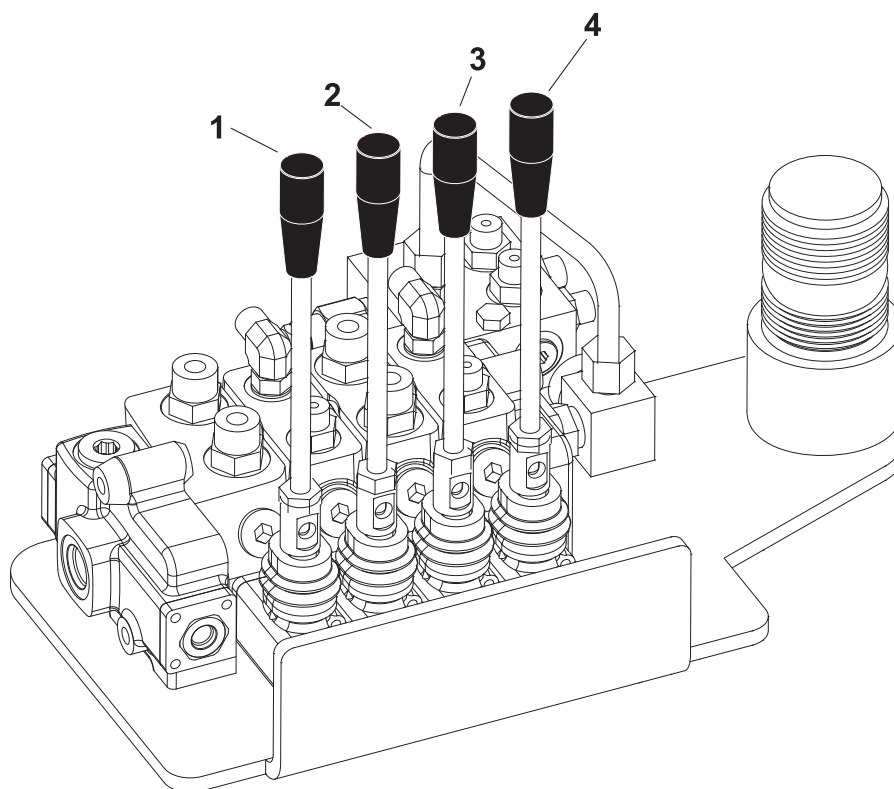


Item	Description	Notes
<b>2. Drilling fluid quick fill switch</b>  <small>c00ic059h.eps</small>	<p>For full pump flow to fill pipe with fluid, press and hold.</p> <p>To return fluid flow to flow control setting, release.</p>	<p><b>IMPORTANT:</b> Overrides fluid control setting for full pump flow. Also overrides temporary fluid shutdown when front wrench is closed.</p>
<b>3. Remote engine stop switch</b>  <small>c00ic062h.eps</small>	<p>To stop engine, press.</p> <p>To restart engine, press remote engine start switch (page 36).</p>	<p><b>IMPORTANT:</b></p> <ul style="list-style-type: none"> <li>If this switch is used to stop drilling unit, be sure to turn ignition switch off if machine will be left unattended for long periods of time. Battery discharge can occur.</li> <li>If wrenches are engaged when remote stop is pressed, wrenches will remain engaged but could gradually open.</li> </ul>
<b>4. Drilling fluid pump switch</b>  <small>c00ic060h.eps</small>	<p>To turn on, press once.</p> <p>To turn off, press once.</p>	

Item	Description	Notes
<b>5. Multi-use button</b>	<p>To engage a function, push and hold.</p> <p>To return to normal operation, release.</p>	<p><b>Operation Options</b></p> <ul style="list-style-type: none"> <li>• Two-speed carriage control</li> <li>• Fine adjustment for cruise and autocarve mode</li> <li>• Autocarve reaming and positioning functions</li> <li>• Automated add pipe for pipes in delivery chute</li> <li>• Jammed collar separation (AT only)</li> <li>• Failed makeup system override</li> <li>• Single pipe loader reset</li> </ul>
<b>6. ESID alarm interrupt / self-test switch</b> <div>  </div> <p>c00ic711h.eps</p>	<p>To turn off strike alarm at drilling unit, press top.</p> <p>To start manual self test, press bottom.</p> <p>To reset system after a strike has been detected, press bottom.</p>	<p>Self test checks all systems and circuits except voltage limiter.</p> <p><b>IMPORTANT:</b> See "If an Electric Line is Damaged" on page 14.</p>



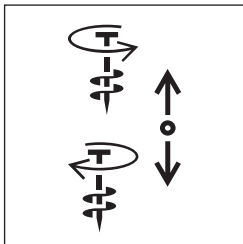
## Anchoring System Console

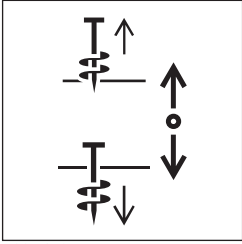
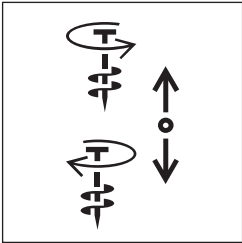
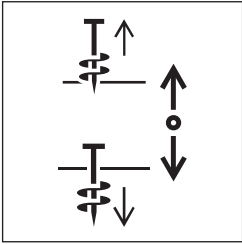


j34om012w.eps

- |                          |                           |
|--------------------------|---------------------------|
| 1. Left rotation control | 3. Right rotation control |
| 2. Left thrust control   | 4. Right thrust control   |

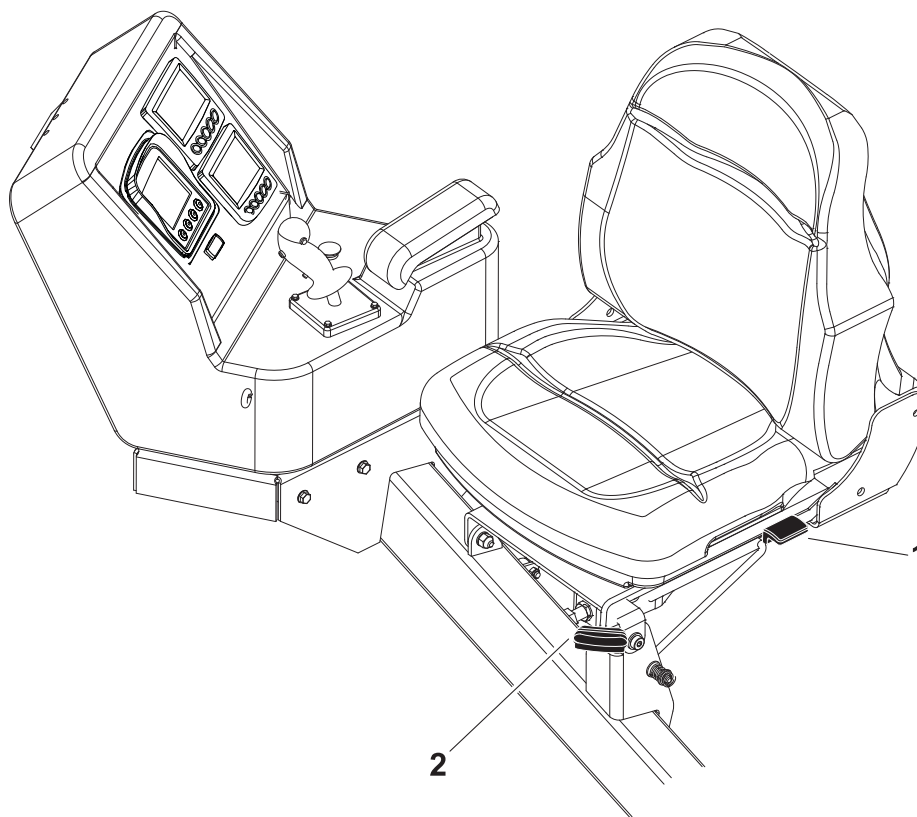
For more information see "Anchor System" on page 133.

Item	Description	Notes
<b>1. Left rotation control</b>  <small>c00ic169h.eps</small>	To remove anchor, push.  To drive anchor, pull.	

Item	Description	Notes
<b>2. Left thrust control</b>  <small>c00ic170h.eps</small>	<p>To move anchor up, push.</p> <p>To move anchor down, pull.</p>	
<b>3. Right rotation control</b>  <small>c00ic169h.eps</small>	<p>To remove anchor, push.</p> <p>To drive anchor, pull.</p>	
<b>4. Right thrust control</b>  <small>c00ic170h.eps</small>	<p>To move anchor up, push.</p> <p>To move anchor down, pull.</p>	

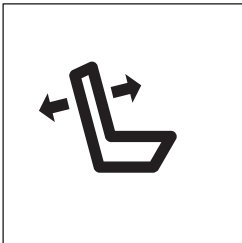



## Seat/Armrest

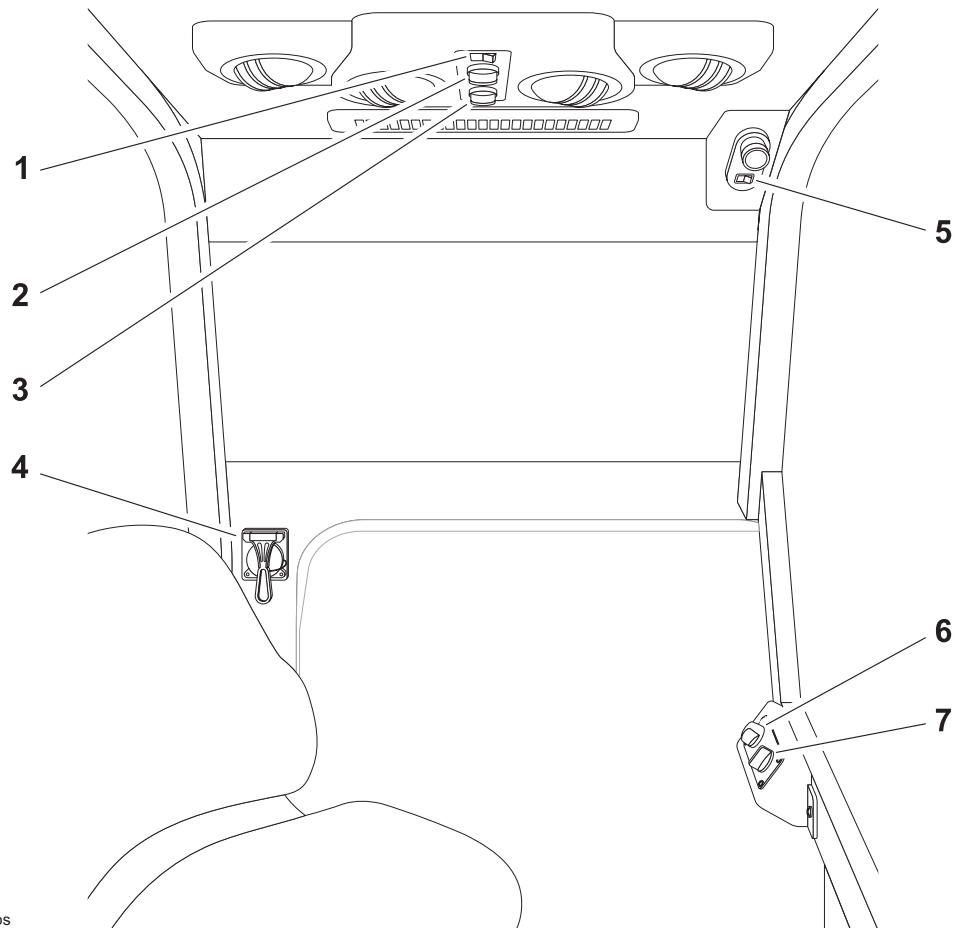


1. Seat recline control

2. Seat slide control

Item	Description	Notes
<b>1. Seat recline control</b>  c00ic096h.eps	To recline or raise seatback, lift.  To lock seatback in position, release.	
<b>2. Seat slide control</b>  c00ic095h.eps	To slide forward or backward, move left.  To lock seat in position, move right.	

## Cab Controls (optional)

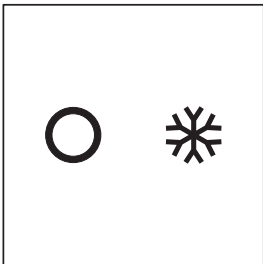
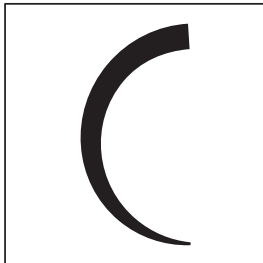
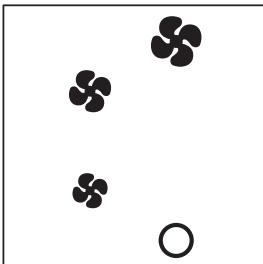
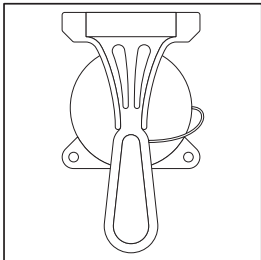


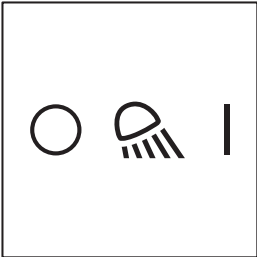
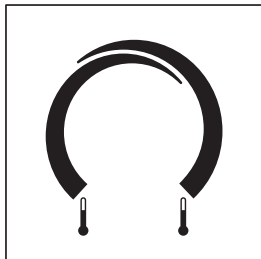
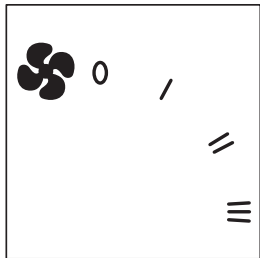
j50om046w.eps



**EMERGENCY EXIT:** Break window to exit cab when door is blocked or inoperable.

- |                                     |                            |
|-------------------------------------|----------------------------|
| 1. Air conditioner on/off switch    | 5. Dome light switch       |
| 2. Air conditioner temperature dial | 6. Heater temperature dial |
| 3. Air conditioner fan speed dial   | 7. Heater fan speed dial   |
| 4. Emergency glass breaker          |                            |

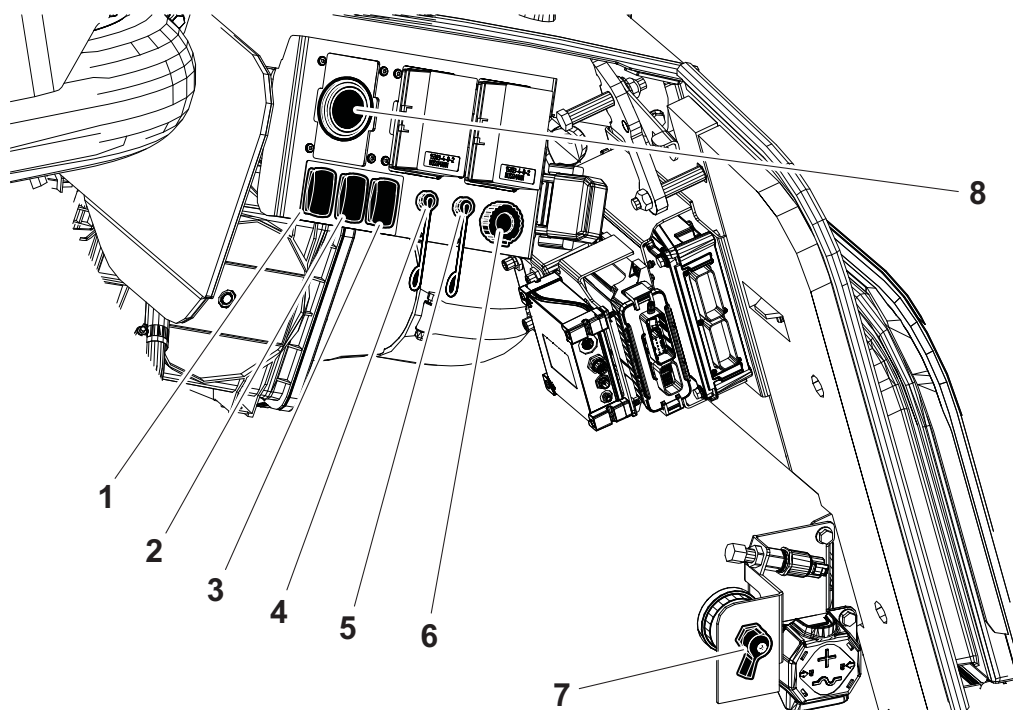
Item	Description	Notes
<b>1. AC on/off switch</b>  <small>c00ic157a.eps</small>	<p>To turn air conditioner on, press right.</p> <p>To turn air conditioner off, press left.</p>	
<b>2. AC temperature dial</b>  <small>c00ic158a.eps</small>	To adjust air temperature, turn dial.	
<b>3. AC fan speed dial</b>  <small>c00ic159a.eps</small>	To adjust fan speed, turn dial.	
<b>4. Glass breaker</b>  <small>c00ic160a.eps</small>	Use breaker to break glass if door becomes inoperable.	<p><b>NOTICE:</b> Only the rear and right windows are fitted with true glass. Hammer may not work on front and left windows, which are acrylic.</p>

Item	Description	Notes
<b>5. Dome light switch</b>  c00ic161a.eps	<p>To turn on dome light, press right.</p> <p>To turn off dome light, press left.</p>	
<b>6. Heater temperature dial</b>  c00ic162a.eps	<p>To adjust heater temperature, turn dial.</p>	
<b>7. Heater fan speed dial</b>  c00ic163a.eps	<p>To adjust heater fan speed, turn dial.</p>	



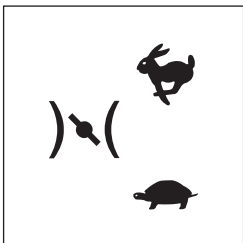


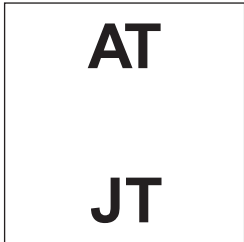
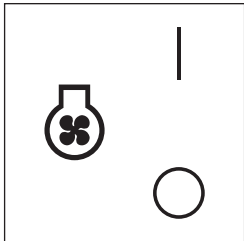
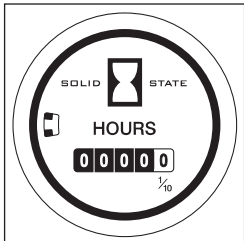
## Engine Compartment Controls



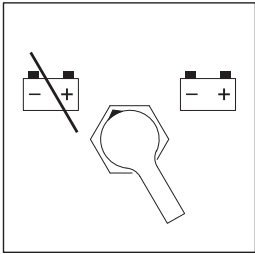
j50om009w.eps

- |   |  |
|---|--|
| 1. Throttle switch                      | 5. J1939 CAN diagnostic port, engine         |
| 2. Drilling mode switch (AT units only) | 6. Inner rotation hour meter (AT units only) |
| 3. Fan speed switch                     | 7. Battery disconnect switch                 |
| 4. EDT diagnostic port, main controller | 8. EDT diagnostic port, tether controller    |

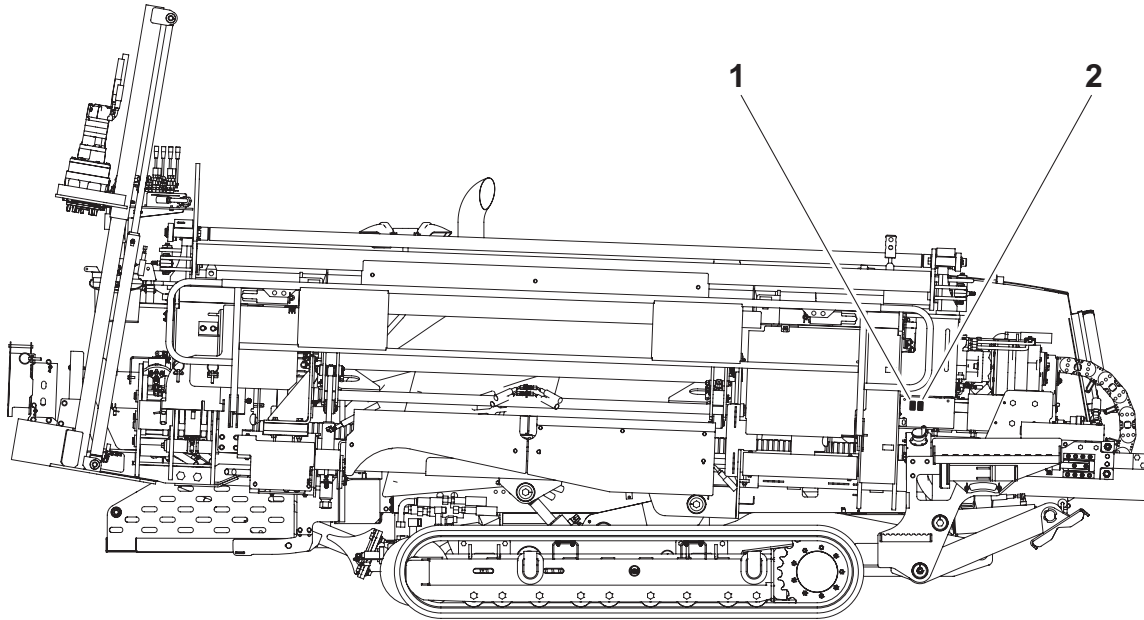
Item	Description	Notes
<b>1. Throttle switch</b>  <small>c00ic243h.eps</small>	<p>To increase engine speed, press top.</p> <p>To decrease engine speed, press bottom.</p> <p>To further increase or decrease speed, press additional times (or hold until desired speed is reached).</p>	Use this switch only if throttle switch on console does not work.

Item	Description	Notes
<p><b>2. Drilling mode switch (AT only)</b></p>  <p>c00ic468h.eps</p>	<p>To select <b>AT Rock</b> mode, press top.</p> <p>To select <b>AT Dirt</b> mode, move to middle.</p> <p>To select <b>JT</b> mode, press bottom.</p>	<p>Use <b>AT Rock</b> mode when using AT pipe with inner rod and rock drilling bits.</p> <p>Use <b>AT Dirt</b> mode when using AT pipe with inner rod and adapter to use dirt tool head.</p> <p>Use <b>JT</b> drilling mode when using JT pipe without inner rod.</p>
<p><b>3. Fan speed switch</b></p>  <p>c00ic378h.eps</p>	<p>For high speed, press top.</p> <p>For automatic speed, press bottom.</p>	<p><b>IMPORTANT:</b> If switch is on high speed, fan will run at full speed all the time. If switch is on auto speed, fan speed will vary in relation to engine temperature.</p>
<p><b>4. EDT diagnostic port, main controller</b></p>	For use only by qualified Ditch Witch® technicians.	
<p><b>5. J1939 CAN diagnostic port, engine</b></p>	For use only by qualified Ditch Witch technicians.	
<p><b>6. Inner rotation hour meter</b></p>  <p>c00ic259h.eps</p>	Displays inner rotation operating time hours.	Use to determine service intervals.



Item	Description	Notes
<b>7. Battery disconnect switch</b>  c00ic097h.eps	To connect, move clockwise.  To disconnect, wait two minutes after turning off engine and move counterclockwise.	<b>IMPORTANT:</b> Use battery disconnect switch when servicing, welding, and during long-term storage.
<b>8. EDT diagnostic port, tether controller</b>	For use only by qualified Ditch Witch® technicians.	

## Miscellaneous Controls



j50om010w.eps

Item	Description	Notes
<b>1. Wireline restricted operating mode switch</b> <p>c00ic133w.eps</p>	<p>To slow rotation and thrust, press top.</p> <p>To allow normal rotation and thrust press bottom.</p>	Used when adding pipe and using wireline tracking.
<b>2. Shuttle lockout switch</b> <p>c00ic709h.eps</p>	<p>To prevent shuttle function, press top.</p> <p>To allow shuttle function, press bottom.</p>	Use when adding/removing single pieces of pipe.



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# Operation Overview

## Chapter Contents

<b>Planning . . . . .</b>	<b>66</b>
<b>Setting Up at Jobsite . . . . .</b>	<b>66</b>
<b>Drilling . . . . .</b>	<b>67</b>
<b>Backreaming . . . . .</b>	<b>67</b>
<b>Leaving Jobsite . . . . .</b>	<b>68</b>
<b>Storing Equipment . . . . .</b>	<b>68</b>



## **Planning**

1. Gather information about jobsite. See page 71.
2. Inspect jobsite. See page 72.
3. Classify jobsite. See page 74.
4. Plan bore path. See page 76.
5. Check supplies and prepare equipment. See page 88.
6. Load equipment. See page 96.

## **Setting Up at Jobsite**

1. Prepare jobsite. See page 87.
2. Mix drilling fluid. page 141
3. Unload drilling unit from trailer. See page 98.
4. Assemble drill string. See page 107.
5. Position drilling unit and drill frame. See page 103.
6. Assemble strike system. See page 135.
7. Anchor drilling unit. See page 133.
8. Connect fluid system. See page 103.
9. Calibrate tracker with beacon that will be installed in beacon housing. See tracker operator's manual.

## Drilling

1. Start system. See page 103.
2. Engage DrillLok™ if desired. See page 146.
3. Drill first pipe. See page 112.
4. Record bore path. See page 123.
5. Enable automated pipeloader system. See page 113.
6. Add pipe. See page 114.
7. Drill remaining pipes in pipe box.
  - Correct direction. See page 119.
  - Engage cruise control. See page 170.
  - Shift pipe box. See page 161.
8. Add additional drill pipe to empty box (see page 163) to complete bore.
9. Surface drill head. See page 123.
  - Remove drill head.
  - Grease downhole tool (AT mode).



## Backreaming

1. Assemble backream string. See page 126.
2. Start drilling unit and adjust throttle.
3. Set drilling fluid flow. Check that fluid flows through all nozzles.
4. Remove extra drill pipe from pipe box (see page 166) to complete backream.
5. Remove remaining pipe to complete backream.
6. Remove pullback device. See page 129.

### Backreaming Tips

- Plan backreaming job before drilling. Plan bore path as straight as possible. Check bend limits of pullback material. Check that appropriate pullback devices are on hand.
- Keep all bends as gradual as possible.
- Drilling fluid quality is a key factor in backreaming success. Contact your Ditch Witch® dealer for information on testing water, selecting additives, and mixing drilling fluid.
- Backreaming requires more fluid than drilling. Make sure enough fluid is used.



## **Leaving Jobsite**

1. Remove downhole tools.
2. Remove anchors. See page 135.
3. Rinse unit and downhole tools. See page 190.
4. Disassemble strike system and disconnect from fluid system. See page 135.
5. Stow tools. See page 191.
6. Load unit onto trailer. See page 96.

## **Storing Equipment**

1. For cold weather storage, antifreeze drilling unit see "Antifreeze Drilling Unit" on page 188.
2. For long-term storage, disconnect battery disconnect switch.

# Prepare

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## **Gather Information**

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

### **Review Job Plan**

Review blueprints or other plans and make sure 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.

### **Notify One-Call Services**

Contact your local One-Call (811 in USA) or the One-Call referral number (888-258-0808 in USA and Canada) to have underground utilities located before digging. Also contact any utilities that do not participate in the One-Call service. Mark proposed path with white paint prior to contacting One-Call or utilities.



### **Examine 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.

### **Arrange for Traffic Control**

If working near a road or other traffic area, contact local authorities about safety procedures and regulations.

### **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.

## Inspect Site

Inspect 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
- signs of utilities (See "Inspect Jobsite" on page 74.)
- traffic
- access
- soil type and condition
- water supply
- sources of locator interference (rebar, railroad tracks, etc.)

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

## Identify Hazards

Identify safety hazards and classify jobsite. See "Classify Jobsite" on page 74.



**WARNING** Jobsite hazards could cause death or serious injury. Use correct equipment and work methods. Use and maintain proper safety equipment. 274-050; 274-724 (2P)

### To help avoid injury:

- Wear personal protective equipment including hard hat, safety eye wear, and hearing protection.
- Do not wear jewelry or loose clothing.
- Notify One-Call and companies which do not subscribe to One-Call.
- Comply with all utility notification regulations before digging or drilling.
- Verify location of previously marked underground hazards.
- Mark jobsite clearly and keep spectators away.

**Remember, jobsite is classified by hazards in place -- not by line being installed.**

## **Select Start and End Points**

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

### **Slope**

Fluid system should be parked on a level site. Consider how slope will affect drilling unit setup, bending pipe, and fluid flow out of hole. Assess the risks on each slope to determine if factors affecting risks create an unsafe condition for drilling.

### **Traffic**

Vehicle and pedestrian traffic must be a safe distance from drilling equipment. Allow at least 10' (3 m) buffer zone around equipment.

### **Space**

Check that starting and ending points allow enough space for gradual pipe bending. See "Minimum Setback" on page 82.

Check that there is enough space to work and to set up electric strike system.

### **Comfort**

Consider shade, wind, fumes, and other site features.

Drill downhill when possible so fluid will flow away from drilling unit.



## Classify Jobsite

### Inspect Jobsite

- Follow U.S. Department of Labor regulations on excavating and trenching (Part 1926, Subpart P) and other similar regulations.
- Contact your local One-Call (811 in USA) or the One-Call referral number (888-258-0808 in USA and Canada) to have underground utilities located before digging. Also contact any utilities that do not participate in the One-Call service.
- Inspect jobsite and perimeter for evidence of underground hazards, such as:
  - “buried utility” notices
  - utility facilities without overhead lines
  - gas or water meters
  - junction boxes
  - drop boxes
  - light poles
  - manhole covers
  - sunken ground
- Have an experienced locating equipment operator sweep area within 20' (6 m) to each side of proposed path. Verify previously marked line and cable locations.
- Mark location of all buried utilities and obstructions.
- Classify jobsite.

### Select a Classification

Jobsites are classified according to underground hazards present.

<b>If working . . .</b>	<b>then classify jobsite as . . .</b>
within 10' (3 m) of a buried electric line	electric
within 10' (3 m) of a natural gas line	natural gas
in concrete, sand, or granite which is capable of producing crystalline silica (quartz) dust	crystalline silica (quartz) dust
within 10' (3 m) of any other hazard	other

**NOTICE:** If you have any doubt about jobsite classification, or if jobsite might contain unmarked hazards, take steps outlined previously to identify hazards and classify jobsite before working.

## **Apply Precautions**

Once classified, precautions appropriate for jobsite must be taken.

### **Electric Jobsite Precautions**

Use one or both of these methods.

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

### **Natural Gas Jobsite Precautions**

Position equipment upwind from gas lines and use one or both of these methods.

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



### **Crystalline Silica (Quartz) Dust Precautions**

Crystalline silica dust is a naturally occurring substance found in soil, sand, concrete, granite, and quartz. Breathing silica dust particles while cutting, drilling, or working materials may cause lung disease or cancer. To reduce exposure:

- Use water spray or other means to control dust.
- Refer to U.S. Department of Labor Occupational Safety and Health Administration guidelines to learn more about appropriate breathing protection and permissible exposure limits.

### **Other Jobsite Precautions**

You may need to use different methods to safely avoid other underground hazards. Talk with those knowledgeable about hazards present at each site to determine which precautions should be taken or if job should be attempted.



## Plan Bore Path

Plan the bore path, from entry to end, before drilling begins. The 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. See your Ditch Witch® dealer for details.

If not using bore planning software, mark the bore path on the ground with spray paint or flags, or record it on paper for operator reference.

**For complicated bores**, consult an engineer. Have the jobsite surveyed and bore path calculated. Be sure the engineer knows minimum entry pitch, bend limits of drill pipe, bend and tension limits of pullback material, pipe lengths, and location of all underground utilities.

**For less complicated bores**, plan the bore based on four measurements:

- recommended bend limit
- entry pitch
- minimum setback
- minimum depth

**IMPORTANT:** See the following pages for more information about these measurements. If not using bore planning software, see "Bore Path Calculator" on page 83 and use these measurements to help plan your bore.

## Recommended Bend Limits

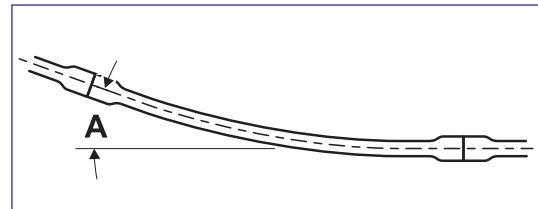
Ditch Witch® drill pipes are designed to bend slightly during operation. Slight bending allows for steering and correcting direction. Bending beyond recommended limits will cause damage that might not be visible. This damage adds up and will later lead to sudden drill pipe failure.

**IMPORTANT:** Consider recommended bend limits during any bend, not just during bore entry.

### Pipe Pitch

Drill pipe is tested to bend at a maximum percent pitch.

Make sure pitch (A) changes no more than the following percentages over the full length of each pipe.



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JT Power Pipe® HD	JT Forged	AT pipe	AT flush pipe
8.0%	9.3%	6.4%	6.1%



**NOTICE:** Bending drill pipe more sharply than recommended will damage pipe and cause failure over time. Changes in pitch must be **equally distributed** over the length of a pipe. Maximum changes in pitch within 1-2' (300-600 mm) of pipe create sharp bends that will damage pipe.

Monitor the pitch of each pipe with the tracker remote display on the operator's console.

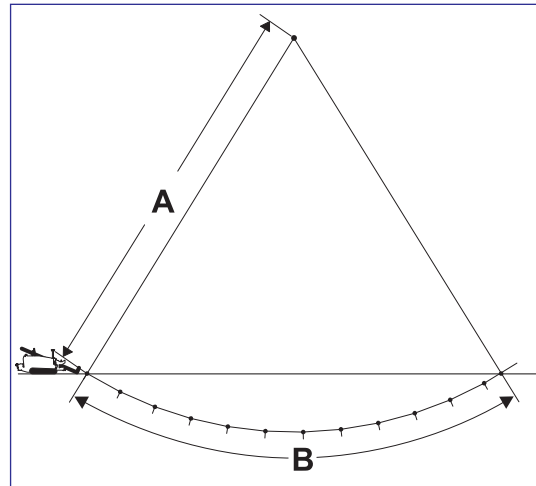
## Bend Radius

**JT30 Power Pipe® HD** drill pipes have a tested minimum bend radius of 123' (37.5 m). This means that a 90-degree bend in the bore path:

- has a radius (A) of 123' (37.5 m)
- requires approximately 193' (58.8 m) of drill pipe (B).

**JT30 Power Pipe® Forged** drill pipes have a tested minimum bend radius of 108.2' (33 m). This means that a 90-degree bend in the bore path:

- has a radius (A) of 108' (32.9 m)
- requires approximately 170' (51.8 m) of drill pipe (B).



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## AT

JT30 All Terrain drill pipes have a tested minimum bend radius of 145' (47.2 m). This means that a 90-degree bend in the bore path:

- has a radius (A) of 145' (47.2 m)
- requires approximately 228' (69.5 m) of drill pipe (B).

## AT Flush

JT30 All Terrain Flush drill pipes have a tested minimum bend radius of 153' (46.6 m). This means that a 90-degree bend in the bore path:

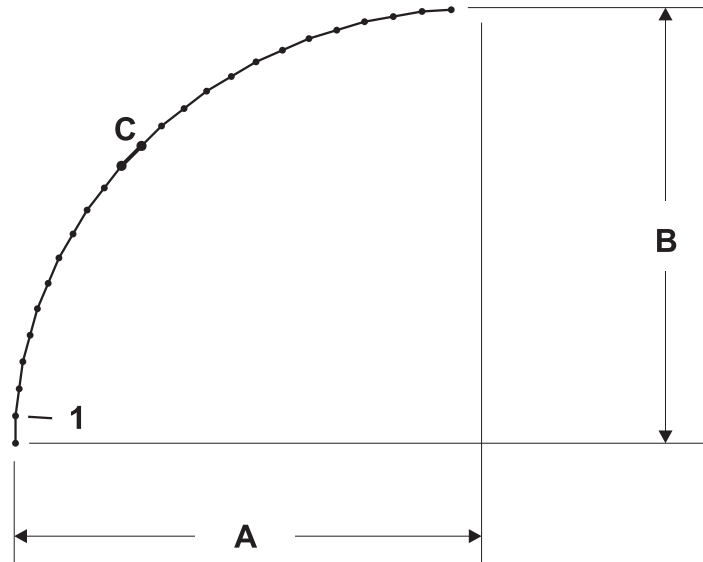
- has a radius (A) of 153' (46.6 m)
- requires approximately 241' (73.5 m) of drill pipe (B).

**NOTICE:** Bending drill pipe more sharply than recommended will damage the pipe and cause failure over time.

- If bend radius is reduced, drill pipe life is reduced.
- If bend radius is increased, drill pipe life is increased.

**IMPORTANT:** Use the charts on the next page to keep bends within safe limits.

## Pipe-By-Pipe Bend Limits



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## JT Power Pipe® HD

Pipe (C)	Forward (B)	Deflection (A)	Pipe (C)	Forward (B)	Deflection (A)
1	9' 10" (3.0 m)	0' 4.7" (0.12 m)	11	94' 9.9" (28.90 m)	44' 7.9" (13.61 m)
2	19' 7.2" (5.97 m)	1' 6.9" (0.48 m)	12	100' 9.4" (30.72 m)	52' 5.9" (16 m)
3	29' 3.0" (8.92 m)	3' 6.3" (1.07 m)	13	106' 1.2" (32.34 m)	60' 9.3" (18.52 m)
4	38' 8.5" (11.8 m)	6' 3.0" (1.91 m)	14	110' 8.8" (33.75 m)	69' 5.5" (21.17 m)
5	47' 11.0" (14.61 m)	9' 8.6" (2.96 m)	15	114' 7.9" (34.95 m)	78' 5.8" (23.92 m)
6	56' 9.8" (17.32 m)	13' 10.9" (4.24 m)	16	117' 10.2" (35.92 m)	87' 9.5" (26.76 m)
7	65' 4.3" (19.92 m)	18' 9.6" (5.73 m)	17	120' 3.5" (36.66m)	97' 3.9" (29.66 m)
8	73' 5.7" (22.4 m)	24' 4.3" (7.42 m)	18	121' 11.5" (37.17m)	107' 0.3" (32.62 m)
9	81' 1.6" (24.73 m)	30' 6.6" (9.31 m)	19	122' 10.1" (37.44 m)	116' 9.9" (35.61 m)
10	88' 3.1" (26.90 m)	37' 4.0" (11.38 m)	20	123' 0" (37.49 m)	123' 0" (37.49 m)

**JT Power Pipe® Forged**

Pipe (C)	Forward (B)	Deflection (A)	Pipe (C)	Forward (B)	Deflection (A)
1	0' 5.5" (0.14 m)	9' 11.8" (3.04 m)	10	43' 0.2" (13.11 m)	86' 4.3" (26.32 m)
2	1' 10.1" (0.56 m)	19' 10.6" (6.06 m)	11	51' 3.1" (15.62 m)	92' 0.1" (28.04 m)
3	4' 1.6" (1.26 m)	29' 7.4" (9.03 m)	12	60' 0" (18.29 m)	96' 10.4" (29.52 m)
4	7' 3.7" (2.23 m)	39' 1.1" (11.92 m)	13	69' 1.7" (21.07 m)	100' 10.9" (30.76 m)
5	11' 4.2" (3.46 m)	48' 2.9" (14.7 m)	14	78' 7.5" (23.96 m)	104' 0.9" (31.72 m)
6	16' 2.6" (4.94 m)	56' 11.7" (17.37 m)	15	88' 4.2" (26.92 m)	106' 4.4" (32.42 m)
7	21' 10.4" (6.66 m)	65' 2.6" (19.88 m)	16	98' 3.0" (29.95 m)	107' 8.9" (32.84 m)
8	28' 3.0" (8.61 m)	72' 10.9" (22.22 m)	17	108' 2" (32.97 m)	108' 2" (32.97 m)
9	35' 3.9" (10.77 m)	79' 11.7" (24.38 m)			

**AT Pipe**

Pipe (C)	Forward (B)	Deflection (A)	Pipe (C)	Forward (B)	Deflection (A)
1	9' 4.7" (2.9 m)	0' 3.7" (0.1 m)	13	108' 2.9" (33.0 m)	48' 6.2" (14.8 m)
2	18' 9" (5.7 m)	1' 2.6" (0.4 m)	14	114' 3.2" (34.8 m)	55' 8.8" (17.0 m)
3	28' 0.3" (8.5 m)	2' 8.8" (0.8 m)	15	119' 9.7" (36.5 m)	63' 3.8" (19.3 m)
4	37' 2.2" (11.3 m)	4' 10.2" (1.5 m)	16	124' 10.1" (38.1 m)	71' 3" (21.7 m)
5	46' 2.2" (14.1 m)	7' 6.6" (2.3 m)	17	129' 4.3" (39.4 m)	79' 6" (24.2 m)
6	54' 11.9" (16.8 m)	10' 10" (3.3 m)	18	133' 4" (40.7 m)	88' 0.2" (26.8 m)
7	63' 6.8" (19.4 m)	14' 8.1" (4.5 m)	19	136' 8.9" (41.7 m)	96' 9.3" (29.5 m)
8	71' 10.5" (21.9 m)	19' 0.8" (5.8 m)	20	139' 7" (42.5 m)	105' 8.8" (32.2 m)
9	79' 10.6" (24.3 m)	23' 11.9" (7.3 m)	21	141' 10" (43.2 m)	114' 10.3" (35.0 m)
10	87' 6.6" (26.7 m)	29' 5" (9.0 m)	22	143' 5.8" (43.7 m)	124' 1.3" (37.9 m)
11	94' 10.3" (28.9 m)	35' 4" (10.8 m)	23	144' 6.5" (44.1 m)	133' 5.4" (40.7 m)
12	101' 9.1" (31.0 m)	41' 8.5" (12.7 m)	24	145' (44.2 m)	145' (44.2 m)

**AT flush pipe**

<b>Pipe (C)</b>	<b>Forward (B)</b>	<b>Deflection (A)</b>	<b>Pipe (C)</b>	<b>Forward (B)</b>	<b>Deflection (A)</b>
<b>1</b>	9' 4.2" (2.9 m)	0' 3.4" (0.1 m)	<b>14</b>	115' 6.5" (35.2 m)	52' 8.5" (16.1 m)
<b>2</b>	18' 7.9" (5.7 m)	1' 1.7" (.4 m)	<b>15</b>	121' 5.5" (37.0 m)	59' 11.4" (18.3 m)
<b>3</b>	27' 10.9" (8.5 m)	2' 6.8" (.8 m)	<b>16</b>	126' 11.0" (38.7 m)	67' 6.6" (20.6 m)
<b>4</b>	37' 0.5" (11.3 m)	4' 6.6" (1.4 m)	<b>17</b>	131' 10.8" (40.2 m)	75' 5.6" (23.0 m)
<b>5</b>	46' 0.5" (14.0 m)	7' 1.1" (2.1 m)	<b>18</b>	136' 4.7" (41.6 m)	83' 8.0" (25.5 m)
<b>6</b>	54' 10.5" (16.7 m)	10' 2.2" (3.1 m)	<b>19</b>	140' 4.4" (42.8 m)	92' 1.6" (28.1 m)
<b>7</b>	63' 6.0" (19.4 m)	13' 9.6" (4.2 m)	<b>20</b>	143' 9.9" (43.8 m)	100' 9.8" (30.7 m)
<b>8</b>	71' 10.6" (21.9 m)	17' 11.3" (5.5 m)	<b>21</b>	146' 9.0" (44.7 m)	109' 8.5" (33.4 m)
<b>9</b>	80' 0.0" (24.4 m)	22' 7.0" (6.9 m)	<b>22</b>	149' 1.4" (45.5 m)	118' 9.0" (36.2 m)
<b>10</b>	87' 9.9" (26.8 m)	27' 8.6" (8.5 m)	<b>23</b>	150' 11.2" (46.0 m)	127' 11.1" (39.0 m)
<b>11</b>	95' 3.8" (29.1 m)	33' 3.8" (10.2 m)	<b>24</b>	152' 2.2" (46.4 m)	137' 2.4" (41.8 m)
<b>12</b>	102' 5.4" (31.2 m)	39' 4.4" (12.0 m)	<b>25</b>	152' 10.4" (46.6 m)	146' 6.3" (44.7 m)
<b>13</b>	109' 2.4" (33.3 m)	45' 10.0" (14.0 m)	<b>26</b>	153' 0.0" (46.6 m)	153' 0.0" (46.6 m)



## Entry Pitch

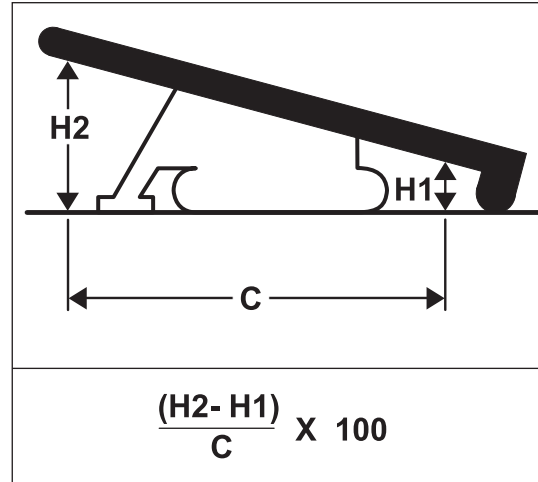
Entry pitch is the slope of the drill frame compared with the slope of the ground. Determine entry pitch one of two ways:

### 1. With Pitch Beacon

- Lay pitch beacon on the ground and read pitch.
- Lay pitch beacon on drill frame and read pitch.
- Subtract ground pitch from drilling unit pitch.

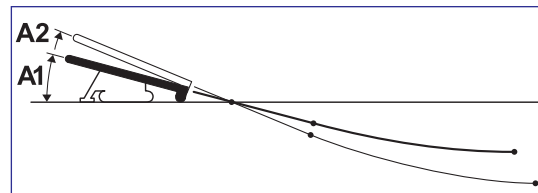
### 2. With Measurements

- Measure from the ground to front end of drill frame (H1).
- Measure from the ground to back end of frame (H2).
- Subtract (H1) from (H2). Record this number.
- Measure the distance between front and back points (C).
- Divide (H2-H1) by (C), then multiply by 100. This is your pitch.



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**IMPORTANT:** A shallow entry pitch (A1) allows you to reach horizontal sooner and with less bending. Increasing entry pitch (A2) makes minimum setback longer and deeper.

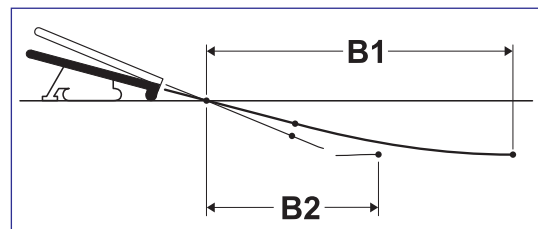


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## Minimum Setback

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

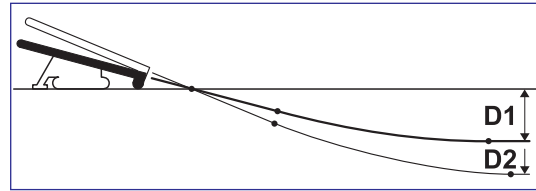
**NOTICE:** If setback is too small (B2), you will exceed bend limits and damage the pipe.



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## Minimum Depth

Because you must bend pipe gradually, entry pitch and bend limits determine how deep the pipe will be when it becomes horizontal. This is called the **minimum depth**.



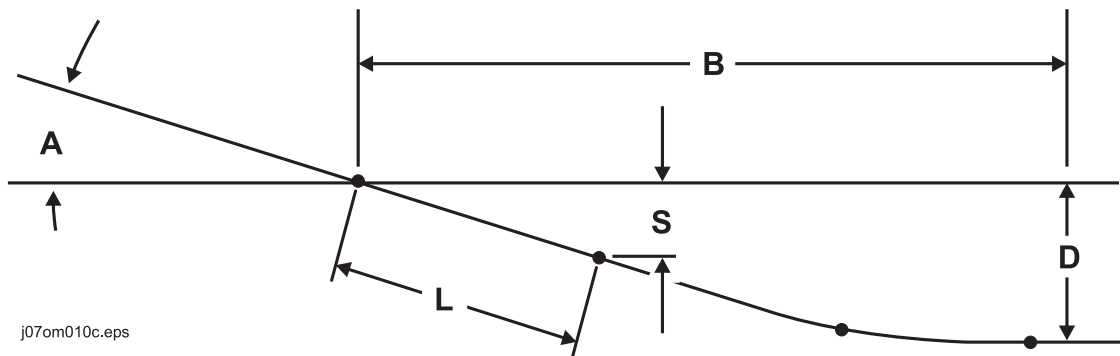
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- To reduce minimum depth (D1), reduce entry pitch. This also decreases setback.
- To increase minimum depth (D2), increase entry pitch. This also increases setback.

## Bore Path Calculator

Entry pitch, setback, and minimum depth work together with bend limits to determine the bore path. To find the setback (B) and entry pitch (A) that will take you to the desired minimum depth (D), use the chart below.

### JT Power Pipe® HD

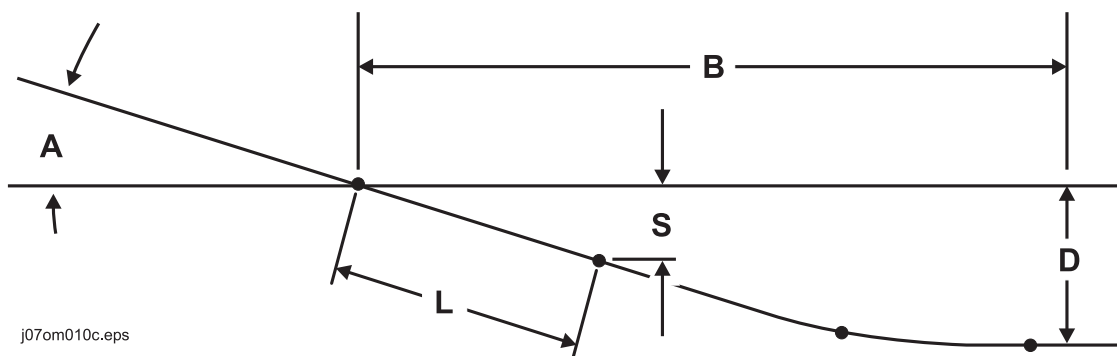


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Minimum depth (D)	Entry pitch (A)	Setback (B)	Depth to begin steering (S)
3 ft 5 in (1.04 m)	18% / 10.0°	29 ft 11 in (9.12 m)	1 ft 7 in (0.48 m)
3 ft 11 in (1.19 m)	19% / 11.0°	32 ft 0 in (9.75 m)	1 ft 8 in (0.51 m)
4 ft 6 in (1.37 m)	21% / 12.0°	34 ft 1 in (10.39 m)	1 ft 10 in (0.56 m)
5 ft 2 in (1.57 m)	23% / 13.0°	36 ft 2 in (11.02 m)	2 ft 0 in (0.61 m)
5 ft 10 in (1.78 m)	25% / 14.0°	38 ft 2 in (11.63 m)	2 ft 2 in (0.66 m)
6 ft 6 in (1.98 m)	27% / 15.0°	40 ft 3 in (12.27 m)	2 ft 3 in (0.69 m)
7 ft 2 in (2.18 m)	29% / 16.0°	42 ft 3 in (12.88 m)	2 ft 5 in (0.74 m)

**IMPORTANT:** Numbers in table based on **123' (37.5 m) minimum bend radius** and beacon housing, EZ-Connect connector, transition sub, and 1/3 of first drill pipe (L, totaling 8' 8" [2.6 m]) in the ground before steering.

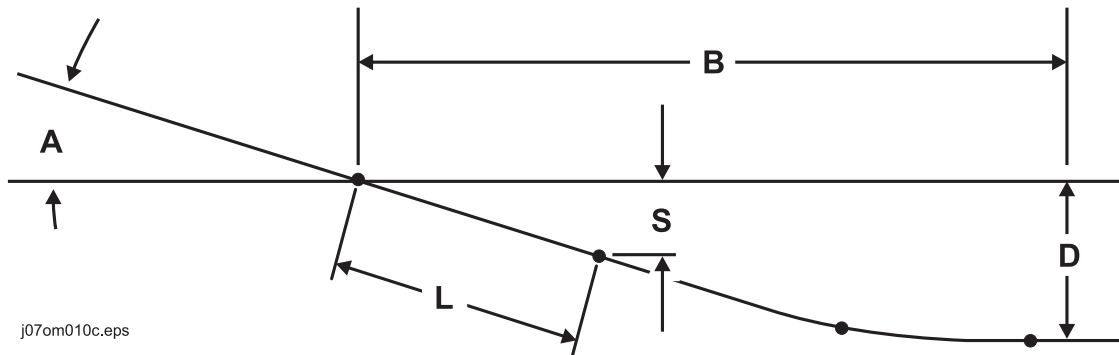


**JT Power Pipe® Forged**


Minimum depth (D)	Entry pitch (A)	Setback (B)	Depth to begin steering (S)
3 ft 4 in (1.01 m)	18% / 10.2°	27 ft 10 in (8.48 m)	1 ft 7 in (0.48 m)
3 ft 10 in (1.17 m)	20% / 11.3°	29 ft 10 in (9.09 m)	1 ft 9 in (0.53 m)
4 ft 5 in (1.35 m)	22% / 12.4°	31 ft 9 in (9.68 m)	1 ft 11 in (0.58 m)
5 ft 1 in (1.55 m)	24% / 13.5°	33 ft 9 in (10.29 m)	2 ft 1 in (0.63 m)
5 ft 8 in (1.73 m)	26% / 14.5°	35 ft 8 in (10.87 m)	2 ft 3 in (0.69 m)
6 ft 5 in (1.96 m)	28% / 15.6°	37 ft 7 in (11.46 m)	2 ft 5 in (0.74 m)
7 ft 1 in (2.16 m)	30% / 16.7°	39 ft 6 in (12.04 m)	2 ft 7 in (0.79 m)

**IMPORTANT:** Numbers in table based on **108' (32.9 m) minimum bend radius** and beacon housing, EZ-Connect connector, transition sub, and 1/3 of first drill pipe (L, totaling 8' 8" [2.6 m]) in the ground before steering.

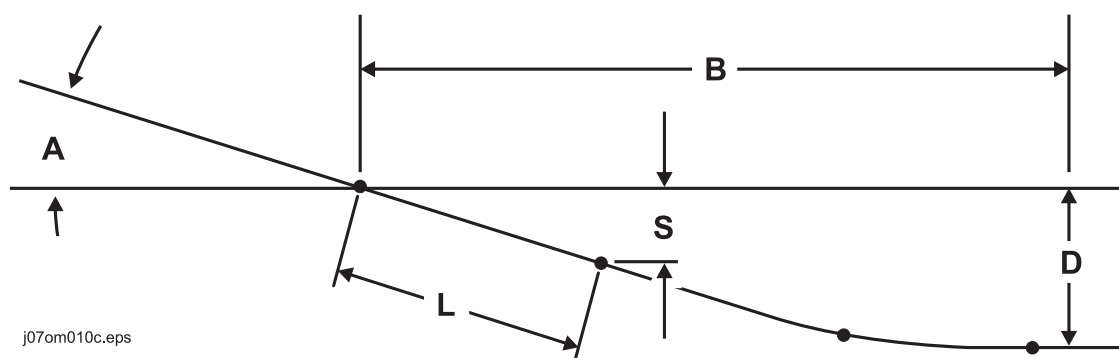
**AT pipe**



Minimum depth (D)	Entry pitch (A)	Setback (B)	Depth to begin steering (S)
3 ft 5 in (1.0 m)	18% / 10.2°	31 ft 11 in (9.7 m)	1 ft 1 in (0.33 m)
4 ft 1 in (1.2 m)	20% / 11.3°	34 ft 7 in (10.5 m)	1 ft 3 in (0.38 m)
4 ft 9 in (1.5 m)	22% / 12.4°	37 ft 4 in (11.4 m)	1 ft 4 in (0.41 m)
5 ft 6 in (1.7 m)	24% / 13.5°	40 ft 0 in (12.2 m)	1 ft 6 in (0.46 m)
6 ft 3 in (1.9 m)	26% / 14.6°	42 ft 7 in (13.0 m)	1 ft 7 in (0.48 m)
7 ft 1 in (2.2 m)	28% / 15.6°	45 ft 2 in (13.8 m)	1 ft 8 in (0.51 m)
7 ft 11 in (2.4 m)	30% / 16.7°	47 ft 8 in (14.5 m)	1 ft 10 in (0.56 m)

**IMPORTANT:** Numbers in table based on **145' (44.2 m) minimum bend radius** and beacon housing and 1/3 of first drill pipe (L, totaling 6' 4" [1.9 m]) in the ground before steering.



**AT Flush Pipe**


Minimum depth (D)	Entry pitch (A)	Setback (B)	Depth to begin steering (S)
3 ft 7 in (1.1 m)	18% / 10.2°	33 ft 5 in (10.2 m)	1 ft 2 in (0.36 m)
4 ft 3 in (1.3 m)	20% / 11.3°	36 ft 2 in (11.0 m)	1 ft 3 in (0.38 m)
4 ft 11 in (1.5 m)	22% / 12.4°	38 ft 12 in (11.9 m)	1 ft 5 in (0.43 m)
5 ft 9 in (1.7 m)	24% / 13.5°	41 ft 10 in (12.8 m)	1 ft 6 in (0.46 m)
6 ft 6 in (2.0 m)	26% / 14.6°	44 ft 7 in (13.6 m)	1 ft 8 in (0.51 m)
7 ft 5 in (2.3 m)	28% / 15.6°	47 ft 4 in (14.4 m)	1 ft 9 in (0.53 m)
8 ft 4 in (2.5 m)	30% / 16.7°	50 ft 1 in (15.3 m)	1 ft 10 in (0.56 m)

**IMPORTANT:** Numbers in table based on **153' (46.6 m) minimum bend radius** and beacon housing and 1/3 of first drill pipe (L, totaling 6' 4" [1.9 m]) in the ground before steering.

## Prepare Jobsite



**WARNING** Jobsite hazards could cause death or serious injury. Use correct equipment and work methods. Use and maintain proper safety equipment. 274-050; 274-724 (2P)

### To help avoid injury:

- Classify jobsite as electric if jobsite classification is in question or if the possibility of unmarked electric utilities exists.
- Expose lines by hand before digging. Cutting high voltage cable can cause electrocution.
- Remove all vegetation near operator's station. Contact with trees, shrubs, or weeds during electrical strike could result in electrocution.

## Mark Bore Path

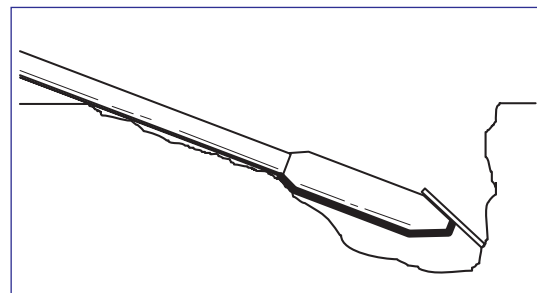
Mark your planned bore path and all located utility lines with flags or paint.

## Prepare Entry Point

For bore to be successful, first pipe must be straight as it enters the ground. See "Align the Joints" on page 156..

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 start. Drill head will tend to move in easiest direction (toward surface) when rotated near the surface.

To prevent bending or straining pipe, position drilling unit for straight entry.



j07om011c.eps



## **Check Supplies and Prepare Equipment**

### **Check Supplies**

- receiver/transmitter or tracker with spare batteries, if needed
- extra batteries for DrillLok™ remote, if needed
- beacons with new and spare batteries
- two-way radios with new and spare batteries
- quick wrench (see page 153)
- transition sub
- anchoring equipment and accessories
- bits, screens, nozzles (see page 147)
- adapters, pipe, beacon housings
- marking flags or paint
- water and additional hoses
- fuel
- drilling fluid additives (see page 144)
- spare fuses
- keys
- backreamers, swivels, pulling devices (see page 150)
- wash down hose and spray gun
- duct tape
- spray lubricant
- tool joint compound (see page 197)
- electrically insulating boots and gloves
- personal protective equipment, such as hard hat and safety glasses
- notepad and pencil

## **Prepare Equipment**

### **Fluid Levels**

- fuel
- diesel exhaust fluid (DEF)
- hydraulic fluid
- engine coolant
- battery charge
- engine oil

### **Condition and Function**

- filters (air, oil, hydraulic)
- fluid pump
- couplers
- tires and tracks
- pumps and motors
- drilling fluid mixer
- hoses and valves
- water tanks



## **Assemble Accessories**

### **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.



# Drive

## Chapter Contents

**Start Unit** ..... **92**

**Steer Unit** ..... **92**

- Tips to Reduce Track Wear .....92
- Safe Slope Operation .....93

**Shut Down Unit** ..... **94**





## Start Unit

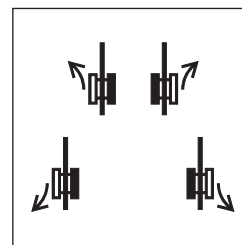
1. Insert key.
2. Turn key clockwise. See page 24 for more information.
3. Run engine at low throttle for 5 minutes.

## Steer Unit

To steer drilling unit while using tethered or wireless ground drive controller (page 168), follow instructions for type of steering desired.

**To steer while moving forward**, push forward and move to left or right. Drilling unit will turn to left or right.

**To steer while moving backward**, pull back and move to left or right. Drilling unit will turn to left or right.



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**For tight steering in low speed**, move control to left or right limit, then forward or backward as needed. Tracks will counter-rotate and turn drilling unit in a tight circle.

## Tips to Reduce Track Wear

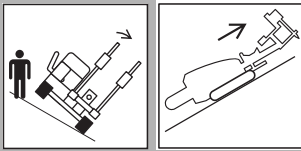
Rubber tracks are best suited at soil-based job sites with minimal rock and debris. Sharp objects such as gravel, steel shards, and broken concrete will damage rubber tracks and undercarriage components. Excessive operation on concrete or asphalt will shorten track life. When storing your machine, keep tracks away from rain and direct sunlight.

Wash tracks daily to remove foreign objects and abrasive soil from sprockets and idler rollers. Drive slowly and make wide turns when possible. Regularly check undercarriage components (sprocket, rollers, idler) for wear and damage. Maintain proper track tension. (See "Check Track Tension and Condition" on page 202.)

To prevent premature wear, avoid the following:

- Spinning tracks under heavy load.
- Turning on sharp objects such as stones, stumps and debris.
- Quick turns or "spin" turns on asphalt or concrete.
- Driving over curbs, ledges, and sharp objects.
- Driving with track edges pressed against hard walls, curbs or other objects.
- Driving on slopes.
- Operating on corrosive materials such as salt or fertilizer. Wash immediately.

## Safe Slope Operation



**WARNING** Tipover possible. Machine can tip over and crush you.

### To help avoid injury:

- Always operate from the uphill side of the unit.
- Drive cautiously at all times.
- Never jerk control levers. Use a steady even motion.

Operating safely on a slope depends upon many factors including:

- Distribution of machine weight (weight of machine may change due to configuration)
- Even or rough ground conditions
- Potential for ground giving way causing unplanned tilt forward, reverse or sideways
- Nearness of ditches, ruts, stumps or other obstructions and sudden changes in slope
- Speed
- Turning
- Operator skill



These varying factors make it impractical to specify a maximum safe operating angle in this manual. It is therefore important for the operator to be aware of these conditions and adjust operation accordingly. Maximum engine angle and braking performance are two absolute limits which must never be exceeded. These maximums are stated below since they are design limits. These design limits usually exceed the operating limits and must never be used alone to establish safe operating angle for variable conditions.

Maximum engine lubrication angle – 47°

Maximum service brake retarding force – equal to traction of both tracks.

Maximum secondary brake retarding force – equal to traction of one track.

Maximum park brake holding force – equal to traction of both tracks.

## **Shut Down Unit**

1. Stop track movement.
2. Lower drill frame and stabilizers to the ground.
3. Run engine at high throttle with no load for one minute, then low throttle with no load for two minutes to cool.
4. Turn ignition switch to STOP.
5. Remove key.

# Transport

## Chapter Contents

**Lift** ..... **96**

- Pipe Box Lifting Procedure ..... 96

**Load** ..... **96**

- Tie Down ..... 97
- Unload ..... 98

**Tow** ..... **98**



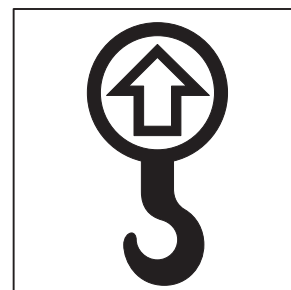
## Lift

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

### Pipe Box Lifting Procedure

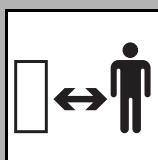
Pipe box lifting points are identified by lifting decals. Lifting at other points is unsafe and can damage machinery.

See "Remove/Install Pipe Box" on page 158.



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## Load



Crushing weight could cause death or serious injury. Stay away. 275-326

#### To help avoid injury:

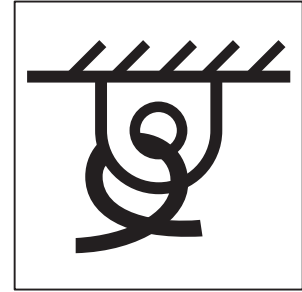
- Attach trailer to tow vehicle before loading or unloading.
- Load and unload trailer on level ground.
- Block trailer wheels.
- Prevent trailer sway by loading ten to fifteen percent of total vehicle weight (equipment plus trailer) on tongue.

1. Start drilling unit engine.
2. Using tethered (page 27) or wireless (page 29) ground drive controller, pull power mode switch into low position.
3. Move drilling unit to rear of trailer and align with ramps.
4. Slowly drive unit onto trailer.
5. Lower stabilizers to trailer floor.
6. Lower drill frame to trailer floor.
7. Stop engine when unit is safely positioned on trailer bed for proper tongue weight.
8. Attach tiedowns to drilling unit where indicated on page 97.
9. Ensure that all covers are properly secured.

## Tie Down

### Points

Tiedown points are identified by tiedown decals. Securing to trailer at other points can damage machinery.



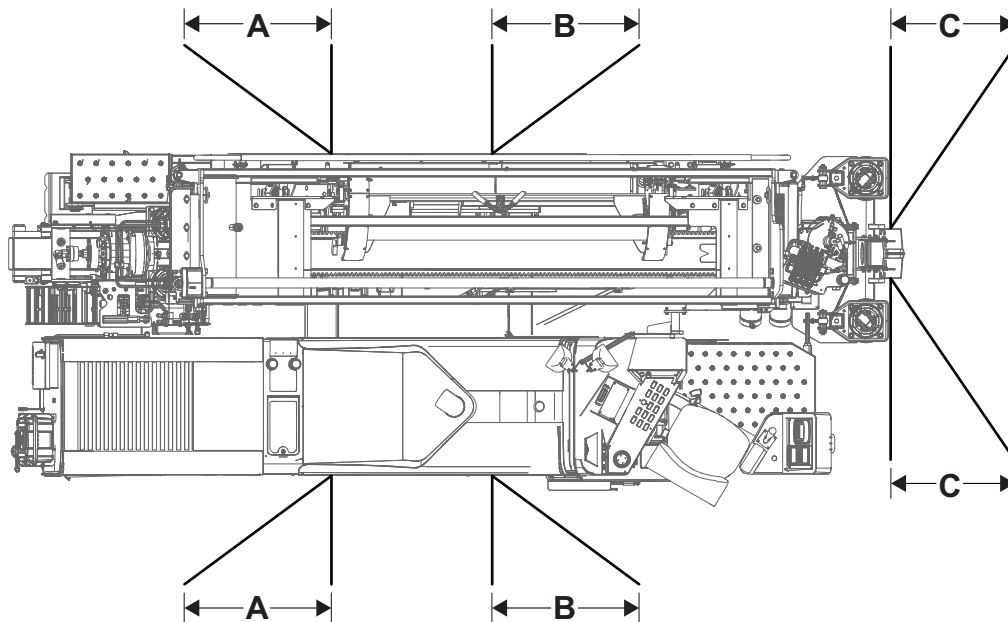
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### Procedure

#### NOTICE:

- Wrenches can open after engine shutdown. Ensure that any downhole tool or pipe in wrenches is attached to spindle or removed before transport.
- Use Grade 7-3/8" (18.7 cm) transport chain to secure drilling unit.

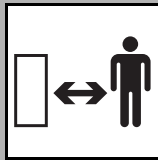
Loop a transport chain around each tie down point. See chart below for correct distances between tiedown ends. Make sure tiedowns are tight before transporting.



**Note:** If hauling unit without pipe box, remove remaining pipe in drill frame chute.

Distance	U.S.	Metric
A	12-45"	31-114 cm
B	12-45"	31-114 cm
C	less than 55"	less than 140 cm

## Unload



**WARNING**  
Crushing weight could cause death or serious injury. Stay away. 275-326

### To help avoid injury:

- Attach trailer to vehicle before loading or unloading.
- Load and unload trailer on level ground.
- Ensure trailer wheels are blocked.

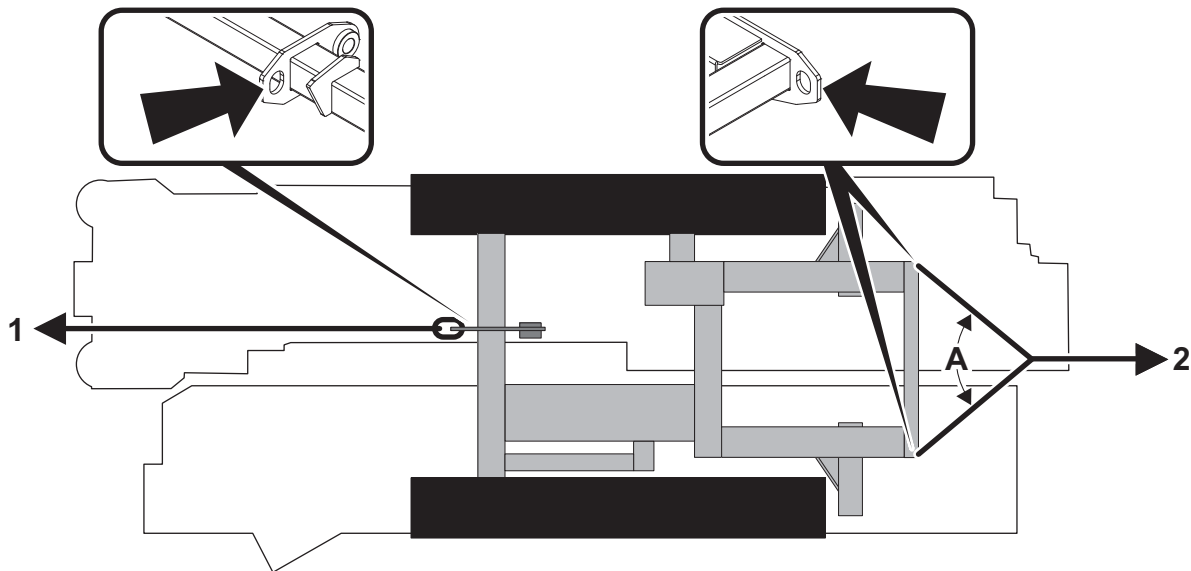
1. Lower ramps.
2. Remove tiedowns.
3. Start drilling unit engine.
4. Using tethered (page 27) or wireless (page 29) ground drive controller, pull power mode switch into low position.
5. Raise stabilizers.
6. Raise drill frame.
7. Slowly back unit down trailer or ramps.

## Tow

Under normal conditions, drilling unit should not be towed. If towing is necessary:

- tow for short distances at less than 1 mph (1.6 km/h),
- use maximum towing force of 1.5 times unit weight,
- use towing chains appropriately rated for maximum towing force,
- attach chains to indicated tow points facing towing vehicle (shown),
- disengage track planetaries.

If **front** tow points are facing towing vehicle, loop chain (1) through tow point and pull straight forward. If **back** tow points are facing towing vehicle, loop chain (2) through each tow point and bring them together to a central pull point. Arrange chains so that angle A is always less than 120°.

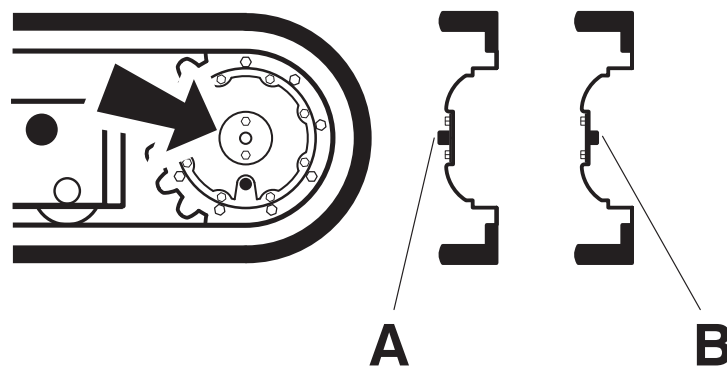


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**To disengage track planetaries**, reverse small cover plate in center of planetary on each track drive.

**IMPORTANT:** When planetaries are disengaged, unit has no brakes.



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A. Normal operation      B. Towing





# Conduct a Bore



## Chapter Contents

<b>Position Equipment</b>	<b>103</b>
<b>Connect Fluid System</b>	<b>103</b>
<b>Start System</b>	<b>103</b>
<b>Prime Drilling Fluid Pump</b>	<b>104</b>
<b>Operate Carriage Control</b>	<b>105</b>
<b>Clamp Pipe</b>	<b>106</b>
<b>Assemble Drill String</b>	<b>107</b>
• Prepare Beacon Housing	110
• Attach Transition Sub	110
• Attach Beacon Housing	110
• Connect Drill Pipe	111
<b>Drill First Pipe</b>	<b>112</b>
<b>Enable Automated Pipeloader System</b>	<b>113</b>
<b>Add Pipe</b>	<b>114</b>
<b>Correct Direction</b>	<b>119</b>
• Basic Rules	119
• Procedure	120
• Drill Head Position	120

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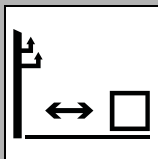
<b>Use Carve Mode . . . . .</b>	<b>121</b>
<b>Record Bore Path . . . . .</b>	<b>123</b>
<b>Surface Drill Head . . . . .</b>	<b>123</b>
<b>Backream. . . . .</b>	<b>125</b>
<b>Remove Pipe . . . . .</b>	<b>127</b>
<b>Remove Pullback Device . . . . .</b>	<b>129</b>

## Position Equipment

1. Review bore plan and select drilling unit position and fluid unit position. See "Select Start and End Points" on page 73.
2. Move equipment into selected positions.
3. Drive anchors. (See "Anchor System" on page 133.)
4. Connect and test electric strike system. (See "Electric Strike System" on page 135.)



## Connect Fluid System



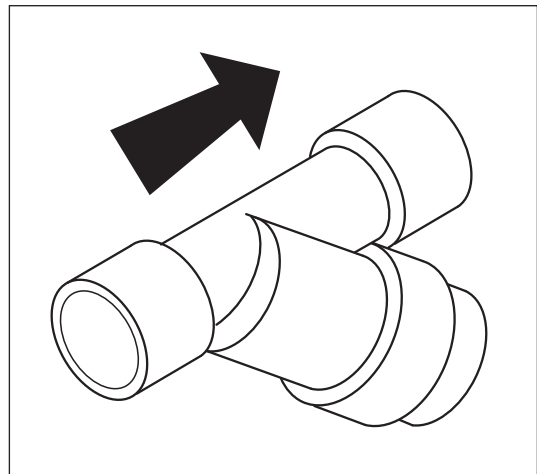
**⚠ DANGER**

Electric shock will cause death or serious injury. Stay away. 274-049

**To help avoid injury:** Do not connect drilling unit to a public or private (business or home) water supply. If an electrical strike occurs while drilling unit is connected to a fluid system, the fluid system will also become electrified.

1. Connect fluid hose from mixing system to drilling fluid pump. A 2.0" (50.8 mm) or larger, non-collapsible hose is required.
2. Install y-strainer between mixing unit and drilling fluid pump. Position strainer so that drilling fluid flows in the direction of the arrow. In most cases, positioning strainer at outlet of mixing unit gives best results.

**IMPORTANT:** Clean y-strainer regularly. See page 208.



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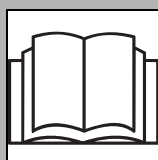
## Start System

1. Start drilling unit and remote fluid unit. Allow both engines to warm up.

**IMPORTANT:** Ensure that mixture of drilling fluid matches drilling conditions. See "Drilling Fluid" on page 141.

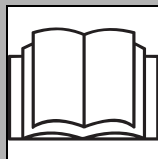
2. Enable DrillLok™ mode if desired. See "DrillLok™" on page 146.
3. Press top of drilling unit throttle switch. Engine will increase to full throttle. If you do not want to use autothrottle mode, return switch to center position.

## Prime Drilling Fluid Pump

**⚠ WARNING**

Read operator's manual. Know how to use all controls. Your safety is at stake. 273-475.

**To help avoid injury:** Failure to prime the drilling fluid pump will cause flow fluctuations, which will make it difficult to control the washwand.

**⚠ WARNING**

Pressurized fluid or air could pierce skin and cause severe injury. Refer to operator's manual for proper use. 270-6035

Prime drilling fluid pump each time tank is changed. To prime the pump:

1. Fill drilling fluid hose and connect hose to unit.
2. Operate mixing/transfer pump at full speed for 1 - 3 minutes to discharge air from system.
3. Return mixing/transfer pump to normal operating speed and continue the bore.
4. If drilling fluid pressure surges are observed, repeat step 2.

## Operate Carriage Control

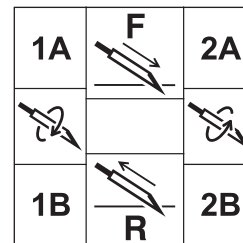
### Drilling

During normal drilling operation, the thrust/rotation joystick controls both operations and allows any combination of the two based on the position of the joystick:

- Push joystick toward 1A for forward thrust with clockwise rotation.

**NOTICE:** Counterclockwise rotation can unthread pipe in the ground.

- Push joystick toward 2A for forward thrust with counterclockwise rotation.
- Pull joystick toward 2B for reverse thrust, with counterclockwise rotation.
- Pull joystick toward 1B reverse thrust, with clockwise rotation.



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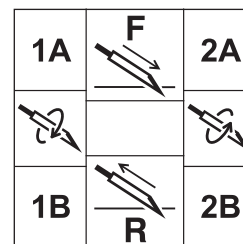
### Assisted Makeup

During pipe change operations when front wrench is closed and carriage is on front or rear home, the thrust/rotation joystick only controls the speed and direction of rotation. The machine controller manages thrust and matches the speed and direction of rotation to smoothly thread or unthread pipe sections.

Push joystick toward 1A or 1B for clockwise rotation (machine controlled forward thrust).

Push joystick toward 2A or 2B for counterclockwise rotation (machine controlled reverse thrust).

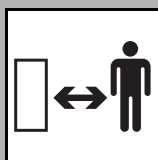
If the thrust/rotation joystick is moved straight forward or backward so there is no rotation, only thrust is controlled.



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## Clamp Pipe



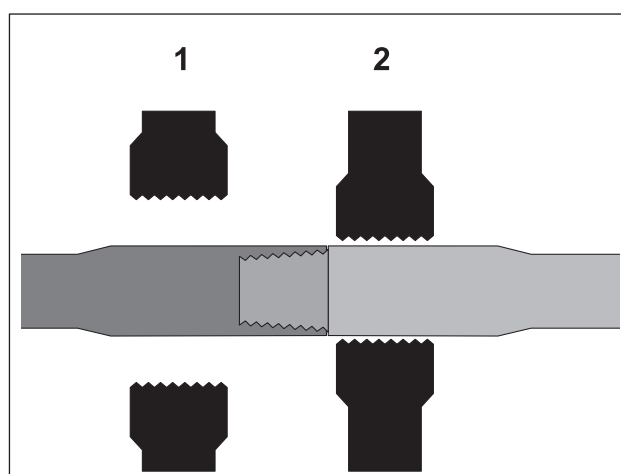
**DANGER** Turning shaft will kill you or crush arm or leg. Stay away.

**To help avoid injury:** Only clamp pipe at reinforced end. Clamping anywhere else on the pipe will weaken the pipe. Pipe can later break, even when operating under normal loads.

**NOTICE:** Ensure that any downhole tool or pipe in tool joint vises is attached to spindle or removed before transport. Wrenches can open after engine shutdown.

Clamp on pipe when joint is between wrenches (1 and 2). Always clamp on the larger diameter areas on either side of the tool joint face.

**NOTICE:** Clamping pipes on top of female end threads can damage threads. Only clamp female pipe ends behind the threads.



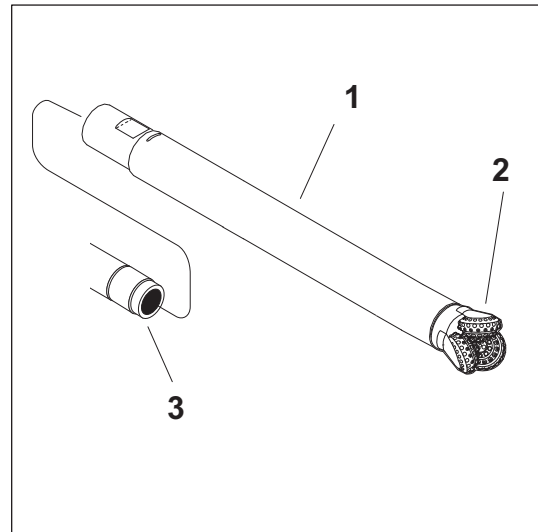
DrillPipe\_Clamp.eps

## Assemble Drill String



### AT Mode (AT Pipe)

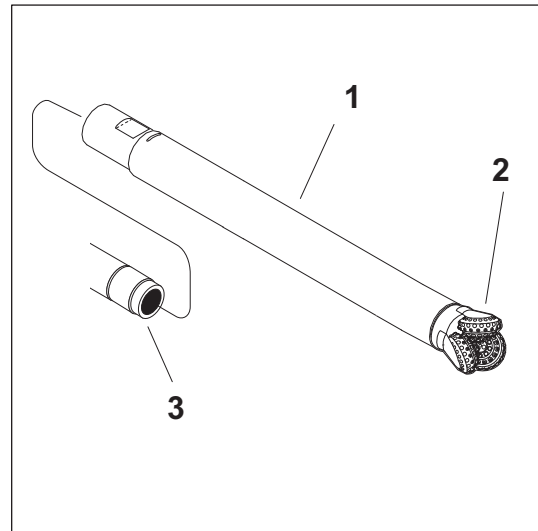
1. Rockmaster tool
2. bit
3. JT30 AT drill pipe



j15om031h.eps

### AT Mode (Flush Pipe)

1. Rockmaster tool
2. bit
3. JT30 AT Flush drill pipe



j15om031h.eps



## **Prepare Rockmaster™ Tool**

1. Select bit. Ensure that bit has suitable number of nozzles for jobsite conditions. See page 147.
2. Install bit onto Rockmaster tool using the wrench set and scribe line technique. See page 153 for correct procedures.
3. Ensure that Rockmaster tool is properly lubricated (from last usage). If using Rockmaster tool for the first time, lubricate the tool:
  - Remove plug from tool.
  - Install zerk.
  - Rotate the tool by hand while pumping tool with MPG until grease comes out at the seal.
4. Install beacon, following beacon instructions for:
  - battery replacement
  - beacon positioning
5. Install beacon housing lid.
6. Follow beacon instructions to check beacon operation.
7. Follow tracker instructions to calibrate beacon.

## **Attach Lead Pipe (Optional)**

1. Start drilling unit engine.
2. Apply TJC (tool joint compound) to shoulders and threads, and thread lead pipe onto saver sub.
3. Clamp rear wrench.
4. Use machine power to connect lead pipe to saver sub. Tighten to full machine torque.

## **Attach Downhole Tool**

See "Quick Wrench" on page 153.

## **Machine Torque**

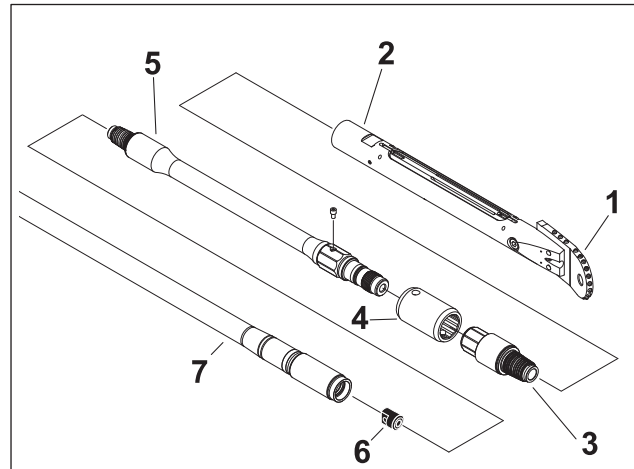
1. Remove blocks from pipe guides.
2. Pull tool into lower wrench.
3. Close wrench.
4. Use machine torque to tighten joint fully.

## **Quick Wrenches**

1. Lube joints with TJC (tool joint compound).
2. Attach quick wrenches to the joint in the join position and tighten joint.

## **AT Dirt Mode (AT Pipe)**

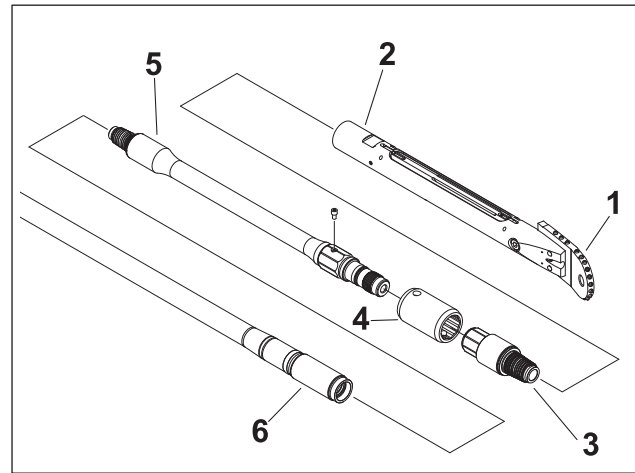
1. bit
2. beacon housing
3. adapter
4. collar
5. transition sub
6. inner spindle spacer
7. JT30 AT drill pipe or AT Flush pipe



EZ\_ConnectsAT.eps

## **JT Mode**

1. bit
2. beacon housing
3. adapter
4. collar
5. transition sub
6. JT30 drill pipe (Power Pipe<sup>®</sup> HD or Power Pipe<sup>®</sup> Forged)



EZ\_Connects.eps



## **Prepare Beacon Housing**

1. Select nozzles and bit.

**IMPORTANT:** A variety of nozzles and bits are available to suit your particular job conditions. See page 147 for more information, or contact your Ditch Witch® dealer.

2. Insert nozzle into beacon housing.
3. Attach bit to beacon housing.
4. Install beacon, following beacon instructions for:
  - battery replacement
  - beacon positioning.
5. Install beacon housing lid.
6. Follow beacon instructions to check beacon operation.
7. Follow tracker instructions to calibrate beacon.

## **Attach Transition Sub**

1. Remove blocks from pipe guides.
2. Pull transition sub into front wrench.
3. Close wrench.
4. Lube joints.
5. Use machine torque to tighten joint fully.

## **Attach Beacon Housing**

Use machine torque to attach beacon housing.

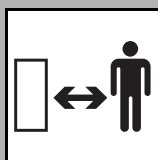
1. Pull beacon housing into front wrench.
2. Close wrench.
3. Use machine torque to tighten joint fully.

## **Connect Drill Pipe**



1. Lower shuttle guard.
2. Start drilling unit engine.
3. Align drill pipe in front wrench.
4. Clamp tool joint in front wrench. See "Clamp Pipe" on page 106.
5. Disconnect from pipe:
  - Rotate spindle counterclockwise until threads on pipe segments are disengaged from each other. Carriage will move backward as pipe rotates counterclockwise.
  - Stop rotation and move carriage backward until it stops on the rear stop switch.
6. Load pipe:
  - Make sure pipe box is positioned correctly.
  - Open grippers or make sure they are open.
  - Grippers open as pipe is lowered.
  - Close grippers around pipe.
  - Lubricate pipe threads at front wrench.
  - Move pipe to spindle.
  - Raise pipe lifters.
7. Connect pipe:
  - Move carriage forward until spindle meets back end of pipe joint. Rotate spindle clockwise until pipe begins to spin. Relax grippers slightly.
  - Move carriage forward until pipe joints meet at front wrench.
  - Rotate spindle clockwise. Carriage will move forward as pipe threads tighten.
  - Rotate clockwise until spindle stops turning, and joint is fully tightened.
  - Open grippers.
  - Retract shuttles fully.
  - Open front wrench.

## Drill First Pipe



Turning shaft will kill you or crush arm or leg. Stay away.

### To help avoid injury:

- Keep everyone at least 10' (3 m) away from turning drill string.
- Push pipe slowly. Forcing can bend string. Do not use bent pipe.



Jobsite hazards could cause death or serious injury. Use correct equipment and work methods. Use and maintain proper safety equipment. 274-050; 274-724 (2P).

## AT Mode

1. Turn on drilling fluid.
2. Visually check for drilling fluid flow.
3. Turn drill outer pipe to starting position.
4. Rotate inner spindle clockwise.
5. Slowly move carriage forward. Drill first pipe as straight as possible.
6. Monitor gauges.
  - If inner rotation torque approaches 800 ft•lb (1080 N•m), slow carriage travel.
  - If inner rotation stalls, stop carriage thrust. If inner rotation does not resume, pull pipe back.

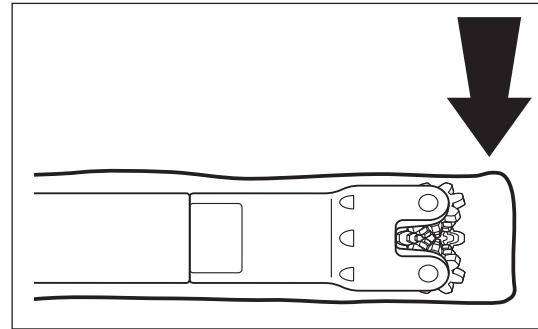
## AT Dirt/JT Mode

1. Turn on drilling fluid.
2. Visually check for drilling fluid flow.
3. Turn drill bit to starting position.
4. Slowly move carriage forward. Drill first pipe as straight as possible.
5. Monitor gauges.

## Swab the Hole

**IMPORTANT:** Swab hole after each pipe is drilled to remove cuttings and keep the hole clear (AT Mode). Some conditions may require more frequent swabbing.

1. Move carriage forward until carriage touches rear wrench.
2. Move carriage to rear of drill frame with drilling fluid and inner rotation on.
3. Move carriage forward until pipe joint is properly located between wrenches for joint breakout.



j07om047c.eps

## Enable Automated Pipeloader System

Add Pipe	Remove Pipe
<ol style="list-style-type: none"> <li>1. Ensure pipe box is properly positioned.</li> <li>2. Open front wrench.</li> <li>3. Retract shuttles.</li> <li>4. Adjust engine to full throttle for add pipe function to work.</li> <li>5. Press top of add pipe/manual/remove pipe switch. If any steps are skipped, the machine display will inform the operator which steps to take to continue operation.</li> <li>6. Grippers will open, pipe will be lifted, pipe box checked (pipe available), then lowered into shuttles. If no pipe is detected, the operator is instructed to move the pipe box before continuing.</li> </ol>	<ol style="list-style-type: none"> <li>1. Ensure pipe box is properly positioned.</li> <li>2. Open front wrench.</li> <li>3. Retract shuttles.</li> <li>4. Adjust engine to full throttle for remove pipe function to work.</li> <li>5. Press bottom of add pipe/manual/remove pipe switch. If any steps are skipped, the machine display will inform the operator which steps to take to continue operation.</li> <li>6. Grippers will open, pipe will be lowered and lifted out of shuttles.</li> <li>7. Ensure pipe box column is not full. If pipe box column is full, shift pipe box to the next empty column.</li> </ol>

**IMPORTANT:** If operator leaves the seat **during** an add or remove pipe cycle when the machine display shows "Adding (or removing) pipe", the pipe cycle will pause and the display will show "PIPE paused in <pipe state>". When returning to the seat, the display will show three cycling messages that prompt you to re-enable the system: "PIPE LOADER paused"; "to continue..."; "press RESUME switch." If you leave the seat while the display shows the pipe cycle is "ready" or "waiting", it is not necessary to re-enable the system.

## Add Pipe

### AT Mode

1. Press top of drilling unit throttle switch. Engine will increase to full throttle.
2. Enable automated pipeloader system if desired. See "Enable Automated Pipeloader System" on page 113.
3. Break joint at SaverLok<sup>®</sup> body.

Manual Pipeloader Controls	Automated Pipeloader Control
<ul style="list-style-type: none"> <li>• Turn inner rotation off and position pipe between wrenches. See "Clamp Pipe" on page 106.</li> <li>• If spindle brake is set, disengage it, rotate outer pipe to 3 o'clock, and close front wrench.</li> <li>• Locate drill head.</li> <li>• Rotate spindle counterclockwise.</li> <li>• Carriage moves back slowly as threads separate.</li> <li>• After threads are fully separated, stop rotation and move carriage to back of frame until rear stop indicator is lit in right console.</li> </ul>	<ul style="list-style-type: none"> <li>• Turn inner rotation off and position pipe between wrenches. See "Clamp Pipe" on page 106.</li> <li>• If spindle brake is set, disengage it, rotate outer pipe to 3 o'clock, and close front wrench.</li> <li>• Locate drill head.</li> <li>• Rotate spindle counterclockwise.</li> <li>• Carriage moves back slowly as threads separate.</li> <li>• After threads are fully separated, stop rotation and move carriage to back of frame until rear stop indicator is lit in right console.</li> <li>• While carriage is moving, grippers will grip, pipe is lubed, and machine display shows corresponding messages.</li> </ul>

4. Load pipe.

Manual Pipeloader Controls	Automated Pipeloader Control
<ul style="list-style-type: none"> <li>• Ensure that lift arms are completely lowered.</li> <li>• Close grippers.</li> <li>• Move pipe in shuttles to spindle and lube threads at wrench.</li> <li>• Raise pipe in box.</li> </ul>	<ul style="list-style-type: none"> <li>• With carriage on rear stop switch at back of drill frame (light is on in right console), press RESUME. Display changes to "Adding Pipe". Pipe is moved to spindle, pipe in box is lifted.</li> <li>• Display reads "ADD PIPE waiting".</li> </ul>



5. Connect pipe to SaverLok® body.

Manual Pipeloader Controls	Automated Pipeloader Control
<p><b>IMPORTANT:</b> Always rotate clockwise unless breaking pipe joint. Rotating counterclockwise will separate joints.</p> <ul style="list-style-type: none"> <li>• Move carriage forward until SaverLok meets pipe.</li> <li>• Rotate spindle clockwise until SaverLok threads onto pipe.</li> <li>• Relax grippers.</li> </ul>	<p><b>IMPORTANT:</b> Always rotate clockwise unless breaking pipe joint. Rotating counterclockwise will separate joints.</p> <ul style="list-style-type: none"> <li>• Move carriage forward until SaverLok meets pipe.</li> <li>• Rotate spindle clockwise until SaverLok threads onto pipe.</li> <li>• Press RESUME. Grippers will relax.</li> </ul>

6. Connect new pipe.

Manual Pipeloader Controls	Automated Pipeloader Control
<ul style="list-style-type: none"> <li>• Slowly move carriage forward to allow inner rod to match up and rotate spindle clockwise until pipe threads together.</li> <li>• To fully tighten joint, slowly rotate pipe until spindle stops turning.</li> <li>• Open wrench.</li> <li>• Open grippers fully.</li> <li>• Retract shuttles.</li> <li>• Lower pipe lifters.</li> </ul>	<ul style="list-style-type: none"> <li>• Slowly move carriage forward to allow inner rod to match up and rotate spindle clockwise until pipe threads together.</li> <li>• Press RESUME. Display changes to "Adding Pipe". Grippers open, shuttles retract, and pipe lifters lower. Display returns to "ADD PIPE waiting".</li> <li>• To fully tighten joint, slowly rotate pipe until spindle stops turning.</li> <li>• Open wrench. If wrench will not open, look at machine display.</li> </ul>





7. Press and hold quick fill fluid pump switch until pipe fills and fluid pressure begins to rise.
8. Adjust fluid flow control to set flow to appropriate level.
9. Set clock position for steering or rotate spindle.
10. Turn inner rotation on.
11. Slowly move carriage forward. Adjust rotation speed control according to bit size and soil conditions.
12. Engage and set cruise control as desired. See "Cruise Control" on page 170.
13. Monitor gauges.
  - If inner rotation torque reaches 800 ft•lb (1080 N•m), slow carriage travel.
  - If inner rotation stalls, stop carriage travel. If inner rotation does not resume, pull pipe back.
14. Locate drill head with tracker at least every half-length of pipe.

**IMPORTANT:** To improve accuracy of depth estimate, turn inner rotation off, disengage spindle brake, and rotate outer pipe to 3 o'clock.

15. Engage spindle brake, if desired, and drill rest of pipe.

**IMPORTANT:** If steering, rotate to desired clock position, engage spindle brake and drill.

## JT Mode



1. Press top of drilling unit throttle switch. Engine will increase to full throttle.
2. Enable automated pipeloader system if desired. See "Enable Automated Pipeloader System" on page 113.
3. Break joint at saver sub.

Manual Pipeloader Controls	Automated Pipeloader Control
<ul style="list-style-type: none"><li>• Position pipe in wrenches. See "Clamp Pipe" on page 106.</li><li>• Locate drill head.</li><li>• Rotate pipe to 12 o'clock position.</li><li>• Close front wrench.</li><li>• Rotate spindle counterclockwise.</li><li>• Carriage moves back slowly as threads separate.</li><li>• After threads are fully separated, stop rotation and move carriage to back of frame until rear stop indicator is lit in right console.</li></ul>	<ul style="list-style-type: none"><li>• With pipe loader enabled, see "Enable Automated Pipeloader System" on page 113. Position pipe in wrenches. See "Clamp Pipe" on page 106.</li><li>• Locate drill head.</li><li>• Rotate pipe to 12 o'clock position.</li><li>• Close front wrench.</li><li>• Rotate spindle counterclockwise.</li><li>• Carriage moves back slowly, as threads separate.</li><li>• After threads are fully separated, stop rotation and move carriage to back of frame until rear stop indicator is lit in right console.</li><li>• While carriage is moving, grippers will grip, pipe is lubed, and machine display shows corresponding messages.</li></ul>

4. Load pipe.

Manual Pipeloader Controls	Automated Pipeloader Control
<ul style="list-style-type: none"><li>• Ensure that lift arms are completely lowered.</li><li>• Close grippers.</li><li>• Move pipe in shuttles to spindle and lube front threads at wrench.</li><li>• Raise pipe in box.</li></ul>	<ul style="list-style-type: none"><li>• With carriage on rear stop switch at back of drill frame (light is on in right console), press RESUME. Display changes to "Adding Pipe".</li><li>• Pipe is moved to spindle, pipe in box is lifted. Display reads "ADD PIPE waiting".</li></ul>

5. Connect pipe to saver sub.

Manual Pipeloader Controls	Automated Pipeloader Control
<p><b>IMPORTANT:</b> Always rotate clockwise unless breaking pipe joint. Rotating counterclockwise will separate joints.</p> <ul style="list-style-type: none"> <li>• Move carriage forward until saver sub meets pipe.</li> <li>• Rotate spindle clockwise until saver sub threads onto pipe.</li> <li>• Relax grippers.</li> </ul>	<p><b>IMPORTANT:</b> Always rotate clockwise unless breaking pipe joint. Rotating counterclockwise will separate joints.</p> <ul style="list-style-type: none"> <li>• Move carriage forward until saver sub meets pipe.</li> <li>• Rotate spindle clockwise until saver sub threads onto pipe.</li> <li>• Press RESUME. Grippers will relax.</li> </ul>

6. Connect new pipe.

Manual Pipeloader Controls	Automated Pipeloader Control
<ul style="list-style-type: none"> <li>• Slowly move carriage forward until new pipe meets pipe in wrench.</li> <li>• Rotate spindle clockwise until pipes thread together.</li> <li>• To fully tighten joint, slowly rotate pipe until spindle stops turning.</li> <li>• Open wrench.</li> <li>• Open grippers fully.</li> <li>• Retract shuttles.</li> <li>• Lower pipe lifters.</li> </ul>	<ul style="list-style-type: none"> <li>• Slowly move carriage forward until new pipe meets pipe in wrench.</li> <li>• Rotate spindle clockwise until pipes thread together.</li> <li>• Press RESUME. Display reads "Adding Pipe", grippers open, shuttles retract, pipe lifters lower. Display reads "ADD PIPE waiting".</li> <li>• To fully tighten joint, slowly rotate pipe until spindle stops turning.</li> <li>• Open wrench. If wrench will not open, look at machine display. It may say that pipe row is empty, no pipe at rear, no pipe at front, or pipe box needs to be moved. After pipe box has been moved to the new row, the front wrench can be opened.</li> </ul>

7. Press and hold quick fill fluid pump switch until pipe fills and fluid pressure begins to rise.
8. Adjust fluid flow control to set flow to appropriate level.
9. Rotate spindle.
10. Slowly move carriage forward. Adjust rotation speed control according to bit size and soil conditions.
11. Engage and set cruise control as desired. See "Cruise Control" on page 170.
12. Monitor gauges.
13. Locate drill head with tracker at least every half-length of pipe.

## **Correct 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 current position to bore plan, and steering drill head as needed.

## **Basic Rules**

### **General**

- Steering ability depends on soil condition; bit, drill head, and nozzle used; roll of drill head; and distance pushed without outer rotation.
- All corrections should be made as gradually as possible. See “Recommended Bend Limits” on page 77.
- 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.

### **JT Mode**

- Do not push an entire piece of drill pipe into ground without rotation. This can exceed bend radius and cause pipe failure.

### **AT Mode**

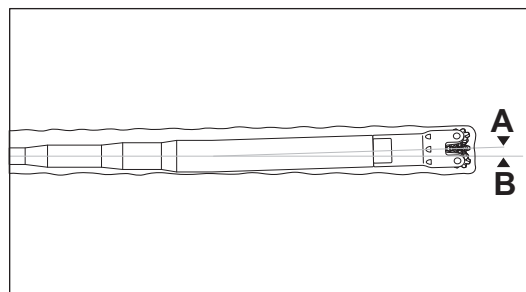
- Steering in rock is slower than steering in other soil conditions. Be patient.
- Inner shaft is rotating at all times when AT mode is selected and inner rotation switch is on.
- Stop outer rotation and engage spindle brake when making directional changes.
- Depth estimate and pitch accuracy improve if drill head is at 3 o'clock when reading is taken.
- Pull back 6" (152 mm) of pipe before checking pitch.

## Procedure

1. Locate drill head. Take readings available with your beacon and locating equipment such as:

- depth

**IMPORTANT:** In AT mode, depth estimate improves if drill head is at 3 o'clock position (A) rather than horizontal (B).



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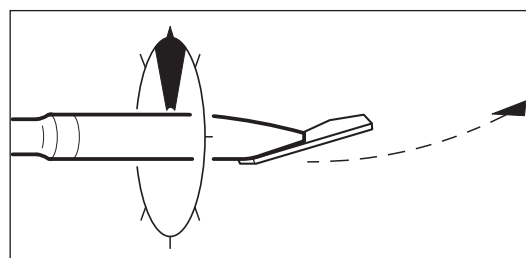
- pitch
- left/right information
- temperature
- beacon roll

2. Compare position to bore plan. Determine direction drilling should go.
3. Position drill head.
4. Drill in pipe.

## Drill Head Position

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

1. Read beacon roll.
2. Slowly rotate pipe until locator displays desired beacon roll.



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## To change direction:

JT mode	AT mode
<ol style="list-style-type: none"> <li>1. Rotate pipe to clock position you intend to travel.</li> <li>2. Push pipe into ground.</li> </ol>	<ol style="list-style-type: none"> <li>1. Rotate outer pipe to clock position you intend to travel.</li> <li>2. Engage spindle brake.</li> <li>3. Engage inner rotation and push pipe into ground.</li> </ol>

## To move forward without changing direction:

JT mode	AT mode
<ol style="list-style-type: none"> <li>1. Rotate pipe.</li> <li>2. Push pipe into ground.</li> </ol>	<ol style="list-style-type: none"> <li>1. Rotate outer pipe.</li> <li>2. Engage inner rotation and push pipe into ground.</li> </ol>

## Use AutoCarve



AutoCarve helps the operator change direction when thrust stalls in difficult soil conditions while drilling in JT or AT dirt mode. AutoCarve rotates the bit clockwise and counterclockwise to grind away soil, clearing a path to improve steering through tough formations. AutoCarve does not replace AT drill mode.

Movement	Description
alternating clockwise and counterclockwise rotation	<p>Enables the downhole tool to carve tough soil formations. Rotation speed can be adjusted during autocarving.</p> <p><b>NOTICE:</b> 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.</p>
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 joystick is pulled rearward. High-speed pullback is not available in autocarve mode.

## Operation

**IMPORTANT:**

- 2-speed thrust is not allowed in AutoCarve mode.
- AutoCarve mode is disabled while front wrench is closed.
- Adding or removing pipe does not affect AutoCarve position.

1. **Position downhole tool for carving.** Rotate the toolhead to the desired position.
2. **Turn on AutoCarve mode.** Press top of AutoCarve switch.
3. **Begin carving.** Move thrust control to full forward and then release to neutral to start alternating rotation. Adjust thrust and rotation speed as needed during carving.
4. **Adjust thrust speed.** Press and hold the Resume switch until carriage begins to move forward, then release switch. Press Resume repeatedly to increase thrust speed to desired setting. To reduce thrust speed, press Set switch.
5. **Set carve window.** Use the Carve Window Potentiometer to set the desired range of travel. Adjust as needed while carving.
6. **Adjust rotation speed.** Move rotation control to full clockwise rotation. Press the Set/Resume switch to decrease/increase rotation speed. Adjust as needed while carving.

**IMPORTANT:** For finer adjustment, press the multi-use button while adjusting thrust or rotation. Be aware, however, this also activates the reaming function and will change steering direction unless the tool is stopped at the original position before releasing multi-use button.

7. **Pause carving.** Move thrust control back from neutral.
8. **Resume carving.** Move thrust control to full forward and then release to neutral to start alternating rotation.
9. **Ream a newly carved section.** After carving a few inches, press and hold the 2-Speed button and move rotation control to full clockwise rotation for maximum rotation. When tool rotates freely, reduce rotation speed and stop at desired carve position. Release 2-Speed button and resume carving.

**IMPORTANT:** If full rotation seems restricted and insufficient to ream the hole, move carriage back slightly until full rotation is possible, then move carriage forward while rotating.

10. **Exit carve mode.** Press bottom of AutoCarve switch. Carriage movement and rotation will stop. Continue normal drilling.

**Note:** For quicker setup during a long bore, autocarve thrust and rotation settings are retained until the unit is shut down.

## Record Bore Path



Locate 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 site and record depth and rough location of pullback.

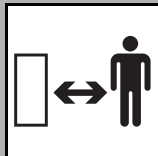
Subsite® Electronics bore tracking software is also available for plotting and tracking your bore path. It utilizes a Subsite Electronics tracking system, including a tracker, display, and tracking beacon, and special software. The display can store jobs in its memory or the system can be run in the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

## Surface Drill Head



**⚠ DANGER**

Moving tools will kill or injure. Never use pipe wrenches on drill string. 273-278



**⚠ DANGER**

Turning shaft will kill you or crush arm or leg. Stay away.

### To help avoid injury:

- Tracker operator and drill operator should maintain two-way communication.
- Keep everyone clear of the exposed drill string.
- No one should enter pit until clear communication is given by the drill operator that the drill unit is shut down. If using DrillLok™ (See "DrillLok™" on page 146.), do not enter pit until green light on drill unit is lit.
- Drill operator should be instructed to discontinue drill string rotation as soon as drill bit exits the bore. Use thrust only to extend drill string beyond exit hole.



1. Guide drill head to target pit or up through surface. Make all bends gradual. See "Recommended Bend Limits" on page 77.
2. Clean area around exit point.
3. Turn fluid flow control to off position as soon as drill head emerges.
4. Allow tracker operator to turn off tracker or use DrillLok™ to disable drilling unit thrust/pullback and rotation hydraulics. Tracker operator waits at least 16 seconds for green light to enter pit and change tools.
5. Clean drill head especially around threads.
6. Disconnect EZ-Connect joint or use quick wrench to remove drill head. Keep threads clean. See "Quick Wrench" on page 153.

## Backream



Sometimes it is necessary to drill a pilot hole first, then enlarge the hole to accommodate larger product. As a general rule, the final hole should be 1.5 times larger than the diameter of the product being installed. The number of passes needed depends on soil conditions. Do not try to increase hole size too much in one pass. Several passes using successively larger reamers will save wear on machine.

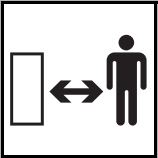


**⚠ DANGER** Moving tools will kill or injure. Never use pipe wrenches on drill string. 273-278



**⚠ WARNING** Jobsite hazards could cause death or serious injury. Use correct equipment and work methods. Use and maintain proper safety equipment. 274-050; 274-724 (2P)

**To help avoid injury:** Continue to use strike system during backreaming.



**⚠ DANGER** Turning shaft will kill you or crush arm or leg. Stay away.

**To help avoid injury:**

- Maintain two-way communication with tracker operator.
- Begin backream only when tracker operator has communicated that everyone is clear of the exposed backream string.
- Do not 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.

**Assemble Backream String**

1. Select backreaming devices. See "Backreamers" on page 150.
2. Determine fluid rate requirements and install appropriate nozzles to provide sufficient flow. See "Backream Fluid Requirements" on page 151 and "Nozzles" on page 147.
3. Attach backreamer to beacon housing if tracking backream.
4. Install beacon, following beacon instructions for:
  - battery replacement
  - beacon positioning
5. Install beacon housing lid. See page 148.
6. Follow beacon instructions to check beacon operation.
7. Follow tracker instructions to calibrate beacon.
8. Use quick wrenches to attach transition sub to drill pipe string.
9. Use quick wrenches to attach backreamer/beacon housing assembly to transition sub.
10. Attach additional pullback devices or product to end of backreamer/beacon housing assembly.

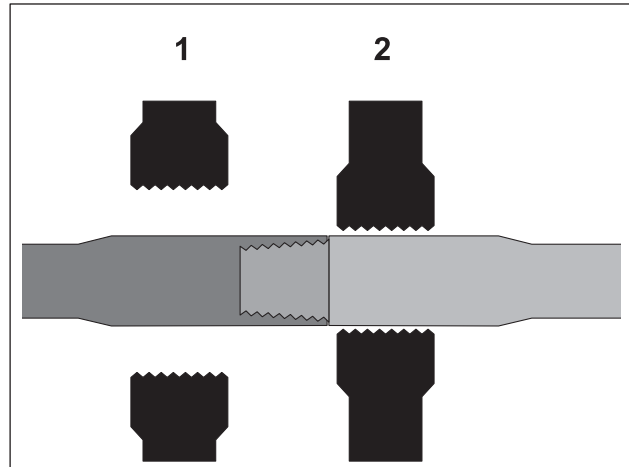
**Begin Backream**

1. After backream assembly is attached to pipe, tracker operator should:
  - leave pit and stand away from the exposed drill string.
  - if using DrillLok™, turn on tracker to enable drilling unit thrust/pullback and rotation.
  - if not using DrillLok, communicate to drill operator that backream string is clear.
2. Turn on drill fluid and pressurize drill pipe. Verify that jets are open.
3. Without rotating, slowly pull back until reamer contacts bore hole opening. Do not lodge reamer in hole.
4. Begin slow rotation and pullback.
5. Increase drilling fluid flow and rotation as the backream string enters the ground.
6. If tracking backream, tracker operator may continue tracking when the backream string is no longer visible.

## Remove Pipe



1. Enable automated pipeloader system if desired. See "Enable Automated Pipeloader System" on page 113.
2. Position pipe joint between wrenches.
3. Clamp pipes with both wrenches (1,2). Always clamp on the large diameter areas of either side of the tool joint face. See "Clamp Pipe" on page 106.



DrillPipe\_Clamp.eps

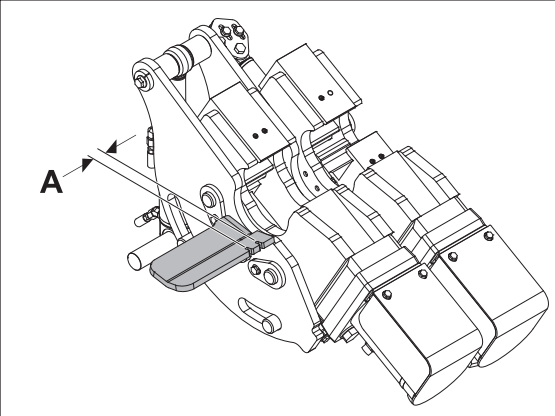
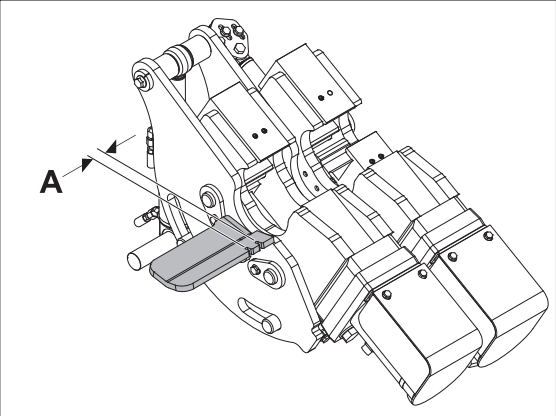
4. Break front joint.
  - Turn rear wrench counterclockwise to break joint.
  - Open rear wrench and rotate wrench clockwise to original position.
5. Grip pipe.

Manual Pipeloader Controls	Automated Pipeloader Control
<ul style="list-style-type: none"> <li>• Lift pipe out of shuttles. Grippers will open as pipe is lifted.</li> <li>• Extend shuttles to spindle position.</li> <li>• Close grippers. Relax grippers to allow pipe to rotate.</li> <li>• Lower lifters.</li> </ul>	<ul style="list-style-type: none"> <li>• Press RESUME. Display reads "Removing Pipe" and shuttles extend, grippers grip fully then relax open, and pipe lifters lower.</li> <li>• Display reads "REM PIPE Waiting"</li> </ul>

6. Separate front joint.

Manual Pipeloader Controls	Automated Pipeloader Control
<ul style="list-style-type: none"> <li>• Rotate spindle counterclockwise to separate pipe.</li> <li>• Continue to rotate until joint is fully separated.</li> </ul>	<ul style="list-style-type: none"> <li>• Rotate spindle counterclockwise to separate pipe.</li> <li>• Continue to rotate until joint is fully separated.</li> </ul>

## 7. Break rear joint.

Manual Pipeloader Controls	Automated Pipeloader Control
<ul style="list-style-type: none"> <li>Close rear wrench.</li> <li>Rotate spindle counterclockwise until joint is loosened at saver sub. <b>Do not</b> fully unthread joint.</li> <li>Open rear wrench.</li> <li>Move carriage back until front end of pipe is between the two markers on the pipe guide (A).</li> </ul>	<ul style="list-style-type: none"> <li>Close rear wrench.</li> <li>Rotate spindle counterclockwise until joint is loosened at saver sub. <b>Do not</b> fully unthread joint.</li> <li>Open rear wrench.</li> <li>Move carriage back until front end of pipe is between the two markers on the pipe guide (A).</li> </ul>
 <p>j22om099h.eps</p>	 <p>j22om099h.eps</p>
<ul style="list-style-type: none"> <li>Close grippers.</li> <li>Rotate spindle counterclockwise until saver sub is separated from pipe.</li> <li>Move carriage to back of frame until rear stop indicator is lit in right console.</li> </ul>	<ul style="list-style-type: none"> <li>Press RESUME. Grippers close.</li> <li>Rotate spindle counterclockwise until saver sub is separated from pipe.</li> <li>Move carriage to back of frame until rear stop indicator is lit in right console.</li> </ul>

## 8. Load pipe into pipe box.

Manual Pipeloader Controls	Automated Pipeloader Control
<ul style="list-style-type: none"> <li>Retract shuttles to delivery chute.</li> <li>Release grippers and raise lift arms to place pipe in box.</li> <li>Lube front threads.</li> </ul>	<ul style="list-style-type: none"> <li>Press RESUME. Display reads "Removing Pipe", shuttles will retract to delivery chute, threads are lubed, grippers release pipe, and pipe lifters raise to place pipe in box.</li> <li>Display reads "REM PIPE Waiting".</li> </ul>

9. Attach saver sub to next pipe.

Manual Pipeloader Controls	Automated Pipeloader Control
<ul style="list-style-type: none"> <li>Move carriage forward until saver sub touches pipe.</li> <li>Rotate spindle to thread saver sub onto pipe. Carriage moves forward slowly as pipe threads together. Slowly tighten joint to full machine torque.</li> </ul>	<ul style="list-style-type: none"> <li>Move carriage forward until saver sub touches pipe.</li> <li>Rotate spindle to thread saver sub onto pipe. Carriage moves forward slowly as pipe threads together. Slowly tighten joint to full machine torque.</li> </ul>

10. Open front wrench to release pipe.
11. Check pipe box flags to see if row is full. If so, move pipe box to next empty row.

**NOTICE:** Damage can occur when lifting with too many pipes in a column. Be aware of the number of pipes in the column and check indicator flags as column is filled.

## Remove Pullback Device

The pullback device can be removed when the last pipe is on the frame. It can also be removed when a target pit along the bore path has been reached. Remaining pipe is then pulled back and removed.



**DANGER** Moving tools will kill or injure. Never use pipe wrenches on drill string. 273-278

1. Press bottom of drilling unit throttle switch until engine is at low throttle.
2. Turn off drilling fluid.
3. Turn drilling unit engine off.
4. Clean pullback device.
5. Disconnect pullback material.
6. Use quick wrenches to remove pullback device.





# Systems and Equipment

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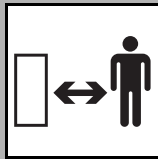
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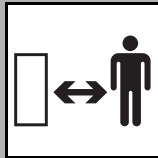
## Anchor System



Crushing weight could cause death or serious injury. Stay away. 275-326

### To help avoid injury:

- Drive anchors properly before drilling.
- Stand on platform when operating anchor controls.
- Wear high-top protective boots with legs of pants completely tucked inside.
- Wear protective gloves.
- If you are not driving two anchors to full depth, drive optional ground rod into soil away from drilling unit and connect ground rod to drilling unit.
- If drilling conditions do not allow for anchor use, use external tiedowns.



Turning shaft will kill you or crush arm or leg. Stay away.

**To help avoid injury:** Do not replace anchor collar bolt with one longer than original. Clothing could catch on turning shaft.

## Select Anchor

Two anchor types are available. Choose the correct anchor type based on jobsite conditions.

Anchor type	Situation used
rock bit	hard/soft rock, asphalt, concrete, cobble
auger bit	soft soil to hard soil, soft rock

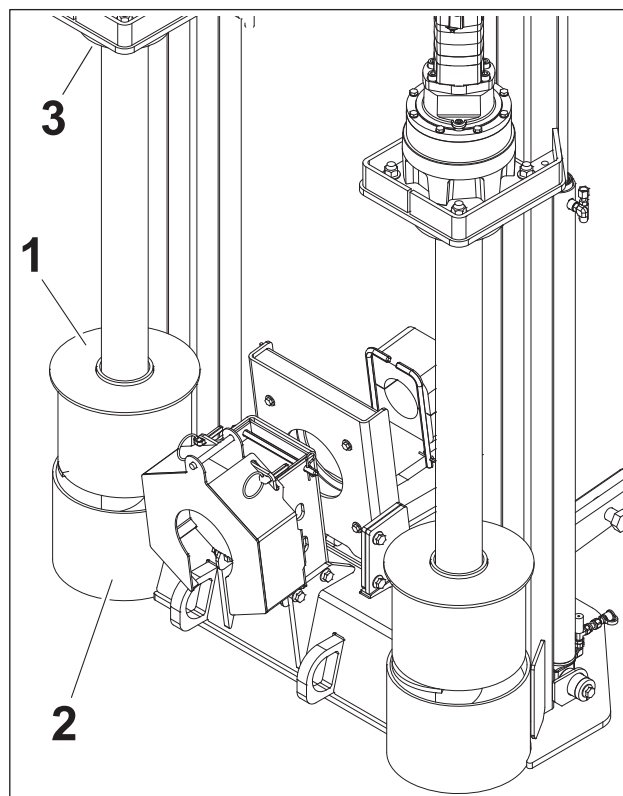
**IMPORTANT:** Do not attempt to operate anchor controls while drill fluid is on. Drill fluid operation may divert power from anchor system so that anchor controls perform poorly.

## Drive Anchors (Rock)

1. Raise anchor shaft to top of anchor frame.

**NOTICE:** Centering cap **MUST** be positioned in centering tube to prevent damage to anchor.

2. Use high speed rotation and low thrust speed to drive anchor into ground.
3. Stop rotation and carefully position cap (1) into centering tube (2). Continue rotation and drive anchor into the ground.
4. Anchor is set when auger shaft flange (3) rests firmly on cap (1) and centering tube (2).
5. Repeat process for other anchor.
6. Leave anchors attached to anchor drivers.



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## Drive Anchors (Soil)

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

1. Raise anchor shaft to top of anchor frame.
2. Use rotation and thrust controls to drive anchor into ground.

**NOTICE:**

- Rotate augers slowly and thrust hard to thread auger into the ground.
- Centering cap **MUST** be positioned in centering tube to prevent damage to anchor.

3. Stop rotation and carefully position cap (1) into centering tube (2). Continue rotation and drive anchor into the ground.
4. Anchor is set when auger shaft flange (3) rests firmly on cap (1) and centering tube (2).
5. Repeat process for other anchor.

## **Remove Anchors**

1. Use anchor rotation and thrust controls to slowly remove anchor shaft from ground.
2. Repeat process for other anchor.



## **Electric Strike System**

Any time you drill in an electric jobsite, electric strike system must be properly set up, tested, and used. Drill operator and tracker operator must wear protective boots and gloves meeting the following standards:

- Boots must have high tops and meet the electric hazard protection requirements of ASTM F2413 or ASTM F1117 when tested at 14,000 volts. Tuck legs of pants completely inside boots.
- Gloves must have 17,000 AC maximum use voltage, according to ASTM specification D120.

If working around higher voltage, use gloves and boots with appropriately higher ratings.

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

Read and follow “Electric Jobsite Precautions” on page 75. Review safety procedures before each job.

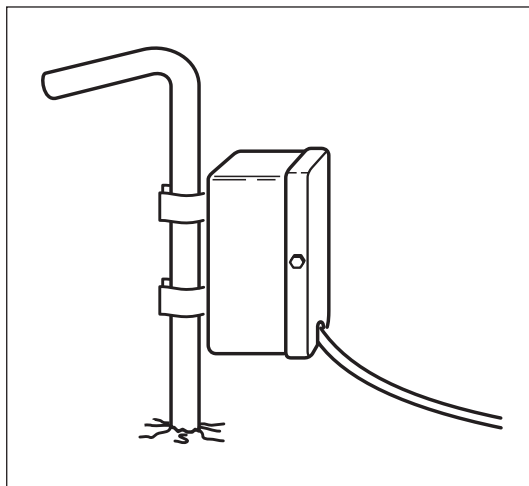
## **FCC Statement**

The Electric Strike System has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, can cause harmful interference to radio communications. Operation of this equipment in a residential area could cause harmful interference which the user will be required to correct at his own expense.

Changes or modifications not expressly approved in writing by The Charles Machine Works, Inc. may void the user's authority to operate this equipment.

## Assemble Voltage Detector

1. Drive voltage stake into ground at least 6' (2 m) away from any part of system.
2. Clip voltage limiter to voltage stake.



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## Test Strike System

If system fails any part of this test, see "Troubleshoot Strike System" on the following page. Do not drill until test is completed successfully.


1. Turn on drilling unit.
2. Verify that display is connected to ESID control module.
3. To test alarms and strobe, press the test button on the left console.
4. Press the ESID soft key to view test results and historical data stored in the machine display. This data includes:
  - ESID bar graph
  - alphanumeric readout showing volts and amps
  - current diagnostic codes, or diagnostic codes detected during previous tests
5. Use Electric Strike Simulator to test voltage and current sensors. See page 139.



## Troubleshoot Strike System

When strike system detects a problem, a diagnostic code will be displayed. Anytime this happens, go to the ESID menu and select test function to retest. If a diagnostic 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
ESID detected but not OK. Red icon shown on machine display. 	Problems in startup	Go to ESID menu and select test function. If problem goes away, retest strike system
	No power to strike system control module	Check drilling unit electrical system
		Check that harness from drilling unit to control module is connected
		Check that cable from drilling unit carries more than 10V
	Defective control module	Have control module checked or replaced
	Defective CAN bus connection	Ensure CAN cable from drilling unit to ESID control module is connected
dc513 Test Wire shows on machine display	Test wire not connected	Check that test wire is connected to ESID control module
		Check that test wire is connected to machine display
		Have ESID control module checked or replaced
Strobe light on drilling unit does not work during total test	Improper connections with control module	Check connections and wiring harness
	Defective strobe light	<ol style="list-style-type: none"> <li>1. Disconnect strobe and connect to external 12V power source.</li> <li>2. If strobe does not work, replace it.</li> </ol>
	Defective control module	Have control module checked or replaced
Alarm on drilling unit does not work during total test	Improper connections with control module	Check connections and wiring harness
	Defective alarm	<ol style="list-style-type: none"> <li>1. Disconnect alarm and connect to external 12V power source.</li> <li>2. If alarm does not work, replace it.</li> </ol>
	Defective control module	Have control module checked or replaced

Problem	Possible cause	Possible solution
Strobe light and alarm on drilling unit do not work during total test	Improper connections with control module	Check connections and wiring harness
	Defective control module	Have control module checked or replaced
dc518 POST AC I code displays and  red ESID current indicator icon shows on machine display.	Improper connections with control module	Check cable connections on control module and current transformer
	Defective current transformer	1. Disconnect current transformer. 2. Check for 20-40 ohms from pin 1 to pin 4, 20-40 ohms from pin 1 to pin 2, and less than 1 ohm from pin 2 to pin 4.
	Defective current transformer cable	1. Disconnect cable from transformer and control module. 2. Check continuity of cable. 3. If continuity is zero or cable is damaged, replace.
	Defective control module	Have control module checked or replaced
dc517 POST AC V code displays and  red ESID voltage icon shows on machine display.	Improper connection of voltage limiter to ground stake	Check voltage limiter connection to ground stake and verify that ground stake is driven into the ground
	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

## **Use Electric Strike Simulator**

Use the Electric Strike Simulator (p/n 259-506) to test voltage and current sensors on ESID. If readings are less than indicated here, replace 9V battery in simulator and retest.

### **Current Test**



#### **To test 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 Module, ESID menu on machine display.
4. Move simulator switch to "current" and press test button.
5. Watch display on machine display.
  - ESID bar graph should show 1/2 scale on display.
  - ESID % and Current "AMPS" should show 30-50% in display.

#### **To test for current at strike levels:**

1. Put two or three loops through current transformer.
2. Follow steps above to test.
3. Display should show the following:
  - ESID bar graph should show full bar.
  - Alarm and strobe should turn on.
  - ESID and STK LED should flash.

With two loops,

- Current "Amps" should be 80-110%.
- Strike indication might go on and off.

With three loops,

- Current should be 130-160%.
- Strike indication should be continuous.



## **Voltage Test**

1. Place voltage limiter on something insulated from ground and drilling unit (such as dry board or tire), but near frame of drilling unit.
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. Watch screen and lights above display on strike system.
  - ESID bar graph should show full bar.
  - Alarm and strobe should turn on.
  - ESID and STK LED should flash.
  - ESID% and voltage "volts" should show 90-110%.

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.

## Drilling Fluid



Improper handling or use of chemicals may result in illness, injury, or equipment damage. Follow instructions on labels and in material safety data sheets (MSDS).



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

- Soda ash
- Quik-Gel® dry powder bentonite (p/n 259-804)
- EZ-Mud® liquid polymer (p/n 259-805)
- Liqui-Trol™ liquid polymer suspension (p/n 259-808)
- Quik-Trol® dry powder polymer (p/n 259-809)
- Bore-Gel® drilling fluid (p/n 259-807)
- Con Det® water-soluble cleaning solution (p/n 259-810)

## Guidelines

Match drilling fluid to soil type. This chart is meant as a guideline only. See your local dealer for soil conditions and drilling fluid recommendations for your area.

Soil type	Drilling fluid recommendation
smooth, flowing sand	bentonite or Bore-Gel + medium chain polymer
coarse sand or light soil	bentonite or Bore-Gel
heavy clay	long chain polymer + Con Det
swelling clay	long chain polymer + Con Det
rock	Bore-Gel

## Polymer

This drilling fluid additive provides excellent lubrication and increases viscosity in average soils and heavy clay. In swelling clay, polymer can reduce swelling that traps pipe in the bore.

There are two types of polymer:

- long chain such as Baroid EZ-Mud
- medium chain such as Baroid Quik-Trol

## Bentonite

Bentonite is a dry powder. When properly mixed with water, it forms a thin cake on bore walls, lubricating the bore, keeping it open, and holding fluid in the bore.

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 120 ppm.
- 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.

For information on measuring funnel viscosity, see "Funnel Viscosity" on page 145.

## 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.

### IMPORTANT:

- 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.

### General mixing order:

1. Soda ash
2. Bentonite
3. Polymer
4. Con Det<sup>®</sup>

**Bore-Gel<sup>®</sup>** contains premixed bentonite, polymer, and soda ash. Use approximately 15 lb/100 gal (7 kg/380 L) in normal drilling conditions, up to 45 lb/100 gal (21 kg/380 L) in sand or gravel and up to 50 lb/100 gal (23 kg/380 L) in rock.

## Basic Fluid Recipes

Soil type	Mixture/100 gal (378 L) of water	Notes
fine sand	35 lb (16 kg) Bore-Gel®	
coarse sand	35 lb (16 kg) Bore-Gel .5 lb (225 g) No-Sag®	Add .5 lb (225 g) of Quik-Trol® for additional filtrate control
fine sand below water table	40 lb (18 kg) Bore-Gel .75 lb (340 g) Quik-Trol	Add .5 - 1 gal (2-4 L) of Dinomul® in high torque situations
coarse sand below water table	40 lb (18 kg) Bore-Gel .75 lb (340 g) Quik-Trol .75 lb (340 g) No-Sag	Add .5 - 1 gal (2-4 L) of Dinomul in high torque situations
gravel	50 lb (23 kg) Bore-Gel .75 lb (340 g) Quik-Trol .75 lb (340 g) No-Sag	Add .5 lb (225 g) of Barolift® to reduce loss of returns
cobble	50 lb (23 kg) Bore-Gel .75 lb (340 g) Quik-Trol .75 lb (340 g) No-Sag	Add .5 lb (225 g) of Barolift to reduce loss of returns
sand, gravel, clay or shale	35 - 40 lb (16-18 kg) Bore-Gel .5 pt (235 mL) EZ-Mud® .5 gal (2 L) Con Det®	Vary mixture according to percentage of sand and clay
clay	.5 lb (225 g) Poly Bore .5 gal (2 L) Con Det	Flow rate should be 3-5 parts fluid to 1 part soil. May use .25 - .5 gal (1-2 L) of Penetrol instead of Con Det
swelling/sticky clay	.75 - 1 lb (340-450 g) Poly Bore .5 - 1 gal (2-4 L) Con Det	Flow rate should be 3-5 parts fluid to 1 part soil. May use .25 - .5 gal (1-2 L) of Penetrol instead of Con Det
solid rock (shale)	40 lb (18 kg) Bore-Gel	Use .5 pt (235 mL) of No Sag for large diameter or longer bores
solid rock (other than shale)	40 - 50 lb (18-23 kg) Bore-Gel	Use .5 pt (235 mL) of EZ-Mud in reactive shales
rock/clay mixture	40 - 50 lb (18-23 kg) Bore-Gel .5 pt (235 mL) EZ-Mud	
rock/sand mixture	40 - 50 lb (18-23 kg) Bore-Gel	Use .5 pt (235 mL) of No Sag for large diameter or longer bores
fractured rock	50 lb (23 kg) Bore-Gel .5 - 1 lb (225-450 g) No-Sag	Use .5 lb (225 g) of Barolift to reduce fluid loss to formation



## **Drilling Fluid Requirements**

1. Determine drilling conditions and choose appropriate drilling fluid mix.
2. Estimate amount of supplies needed and check availability.
  - Drilling fluid
  - Water supply. If more water than can be carried with the unit will be needed, arrange to transport additional water.
  - Bentonite and/or polymer
3. Check water quality.
  - Use meter or pH test strips to test pH of water. If pH is below 9.0, add 1 lb (454 g) soda ash per tank. Test and repeat until pH is between 9 and 10.
  - Check water hardness using hardness test strips. Treat with soda ash if hardness exceeds 125 ppm.

## Funnel Viscosity

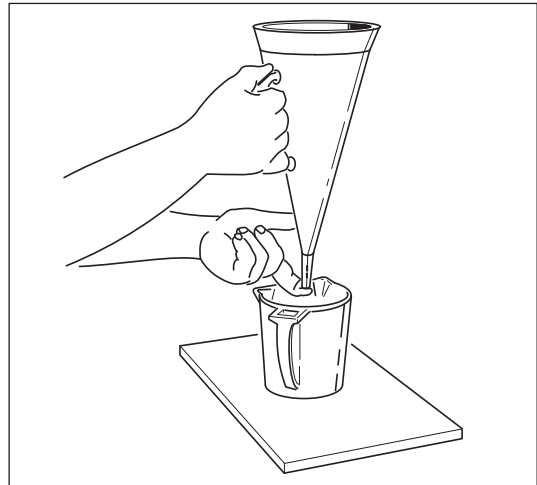
Viscosity is the measure of internal resistance of a fluid to flow; the greater the resistance, the higher the viscosity. Viscosity of drilling fluids must be controlled.

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



**IMPORTANT:** Make sure Marsh funnel is clean and free of obstruction and that you have a stopwatch available for timing the viscosity.

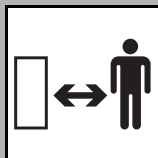
1. Using wash hose and a clean container, take a fresh sample of drilling fluid. The sample must be at least 1.5 qt (1.4 L).
2. With finger over bottom of funnel, fill with fluid from the container through the screen until fluid reaches the bottom of the screen.
3. Move funnel over 1 qt (.95 L) container.
4. Remove finger from bottom of funnel and use the stopwatch to count the number of seconds it takes for 1 qt (.95 L) of fluid to pass through the funnel. The number of seconds is the viscosity.
5. Thoroughly rinse measuring cup and Marsh funnel.



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# DrillLok™

## Overview



away.

Rotating shaft will cause death or serious injury. Stay

### To help avoid injury:

- Use DrillLok any time you change downhole tools or during other times when the drill string is exposed.
- If you are not using DrillLok, turn off drilling unit before changing downhole tools.

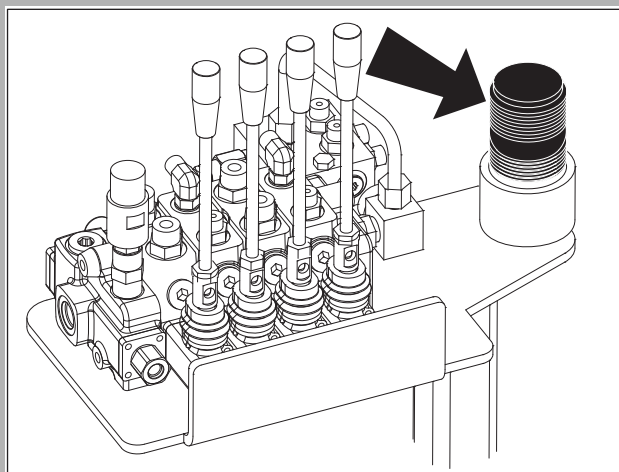
This mode allows the tracker operator to disable hydraulic power to drilling unit thrust and rotation.

**NOTICE:** This mode does not disable thrust and rotation immediately. Functions are disabled within 16 seconds.

**Troubleshooting Tip:** If thrust and rotation are not enabled check whether the green DrillLok™ light (shown), located on drilling unit anchoring console, is on. If it is, thrust and rotation have been disabled by DrillLok.

**NOTICE:** Tracker operator cannot disable thrust and rotation from tracker if DrillLok key is installed in drilling unit and turned to the deactivated position.

See "DrillLok™ key" on page 23.



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**Operation with Subsite® Electronics Tracking Equipment:** See tracker manual.

**Operation without Subsite® Electronics Tracking Equipment:** Only available on units with DrillLok™ system. See DrillLok™ operation sheet.

## Downhole Tools

### 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. See your Ditch Witch® dealer for nozzle recommendations.



### Bits

#### Selection

These charts are meant as a guideline only. No one bit works well in all conditions. See your 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
Sand bit	1	2	3	4	4	4	4
Tornado bit	2	2	2	1	1	3	4
Tuff bit	3	2	1	1	3	1	4
Steep Taper Tuff bit	2	2	1	1	2	1	4
Barracuda bit	2	1	1	2	3	4	4
Steep Taper bit	2	2	1	2	2	3	4
Hard Surface bit	3	1	2	3	4	4	4
Glacier bit	4	4	4	3	1	2	4
Rhino bit	4	4	3	3	1	1	3
Rockmaster	4	4	3	2	1	1	1
Talon bit	3	3	2	1	1	2	4



Soil	Description
sandy soil	sugar sand, blow sand, or other soils where sand is the predominant component
soft soil	sandy loam
medium soil	loams, loamy clays
hard soil	packed clays, gumbo, all compacted soils
rocky soil	chunk rock, glacial till, cobble, rip rap, gravel
soft rock	soft limestone, sandstone, shale, coral, caliche
hard rock	granite, schist, marble, hard limestone

## Installation

Remove all paint from mating surfaces before attaching any bit to housing. Install screws (p/n 107-277) and tighten bolts to 120 ft•lb (163 N•m).

## Beacon Housings

### Rockmaster Lid Installation

1. Clean all threads, bolt holes and mating surfaces.
2. Follow tightening sequence (shown).
3. Use removable thread locker (Loctite® 242 or equivalent), if desired.
4. Tighten bolts to 60-70 ft•lb (81-95 N•m).
5. Repeat tightening sequence.

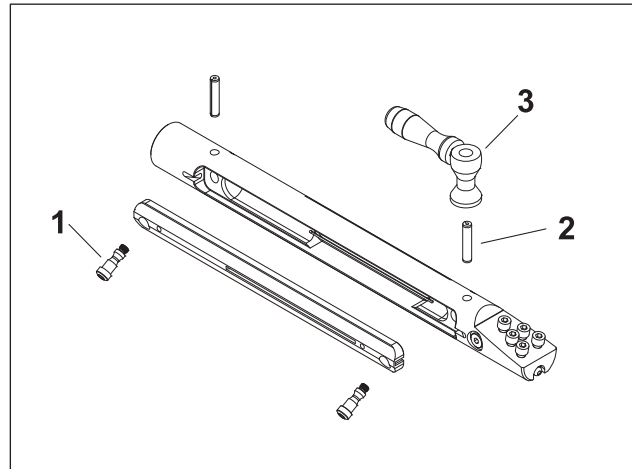


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## **Dirt Housing Lid Installation**

### **Lid Installation**

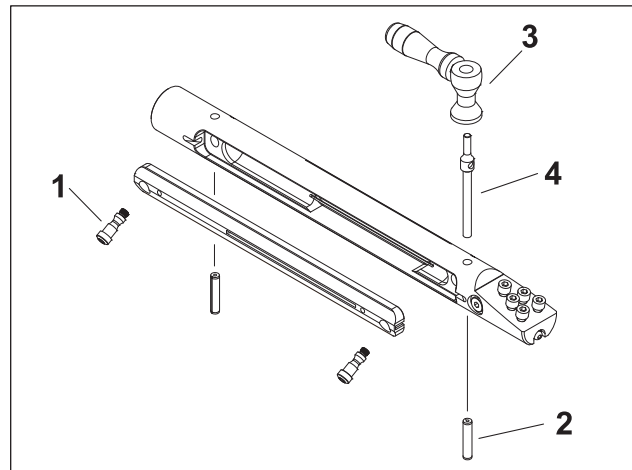
1. Clean all threads, bolt holes and mating surfaces.
2. Use removable thread locker (Loctite® 242 or equivalent), if desired.
3. Place lid on trough and install bolts (1).
4. Use punch holder (3) to drive roll pins (2) from direction shown.



BeaconHousingLid.eps

### **Lid Removal**

1. Use punch holder (3) with bolt pin driver (4) to drive out pins (2).
2. Remove bolts.
3. Remove lid.



BeaconHousingLid\_Remove.eps



## 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. See your local 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	Medium Soil	Hard Soil	Rocky Soil	Soft Rock	Hard Rock
Beavertail	3	1	1	1	3	4	4
Three Wing	4	3	3	2	1	1	4
Water Wing	4	3	2	1	2	2	4
Compact Fluted	1	1	2	2	2	3	4
Kodiak	4	3	3	2	1	2	4
Rockmaster	4	4	4	4	3	1	1

**IMPORTANT:** For soil definitions, see the chart on the previous page.

## Backream 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.



**IMPORTANT:** Use more fluid than recommended or the backream might be dry and unsuccessful.

Instructions	Example
1. Find amount of fluid needed for your size of backreamer. See the table on the next page.	<b>U.S.</b> A 6" backreamer requires at least 1.47 gal/ft.
	<b>Metric</b> A 152-mm backreamer requires at least 18.24 L/m.
2. Multiply this number by distance per minute you plan to backream. The answer is an estimate of amount of fluid you will need for each minute of backreaming.	<b>U.S.</b> 1.5 gal x 2 ft/min = 3 gal for each minute of backreaming.
	<b>Metric</b> 18 L x .5 m/min = 9 L for each minute of backreaming

**IMPORTANT:** After you have determined how much fluid you will need, see your Ditch Witch® dealer for nozzle recommendations.

**Backream Fluid Requirements**

Backreamer/product diameter		Gal/ft	L/m	Backreamer/product diameter		Gal/ft	L/m
.5 in	13 mm	0.01	0.13	13.5 in	343 mm	7.44	92.35
1 in	25 mm	0.04	0.51	14 in	356 mm	8.00	99.31
1.5 in	38 mm	0.09	1.14	14.5 in	368 mm	8.58	106.54
2 in	51 mm	0.16	2.03	15 in	381 mm	9.18	114.01
2.5 in	64 mm	0.25	3.17	15.5 in	394 mm	9.80	121.74
3 in	76 mm	0.37	4.56	16 in	406 mm	10.44	129.72
3.5 in	89 mm	0.5	6.21	16.5 in	419 mm	11.11	137.95
4 in	102 mm	0.65	8.11	17 in	432 mm	11.79	146.44
4.5 in	114 mm	0.83	10.26	17.5 in	445 mm	12.49	155.18
5 in	127 mm	1.02	12.67	18 in	457 mm	13.22	164.17
5.5 in	140 mm	1.23	15.33	18.5 in	470 mm	13.96	173.42
6 in	152 mm	1.47	18.24	19 in	483 mm	14.73	182.92
6.5 in	165 mm	1.72	21.41	19.5 in	495 mm	15.51	192.68
7 in	178 mm	2.00	24.83	20 in	508 mm	16.32	202.68
7.5 in	191 mm	2.29	28.50	20.5 in	521 mm	17.15	212.94
8 in	203 mm	2.61	32.43	21 in	533 mm	17.99	223.46
8.5 in	216 mm	2.95	36.61	21.5 in	546 mm	18.86	234.23
9 in	229 mm	3.30	41.04	22 in	559 mm	19.75	245.25
9.5 in	241 mm	3.68	45.73	22.5 in	572 mm	20.65	256.52
10 in	254 mm	4.08	50.67	23 in	584 mm	21.58	268.05
10.5 in	267 mm	4.50	55.86	23.5 in	597 mm	22.53	279.83
11 in	279 mm	4.94	61.31	24 in	610 mm	23.50	291.86
11.5 in	292 mm	5.40	67.01	24.5 in	622 mm	24.49	304.15
12 in	305 mm	5.88	72.97	25 in	635 mm	25.50	316.69
12.5 in	318 mm	6.37	79.17	25.5 in	648 mm	26.53	329.49
13 in	330 mm	6.90	85.63	26 in	660 mm	27.58	342.53

## Quick Wrench

To attach or remove downhole tools, use quick wrench to join or break the joint.



**⚠ DANGER**

Moving tools will kill or injure. Never use pipe wrenches on drill string. 273-278

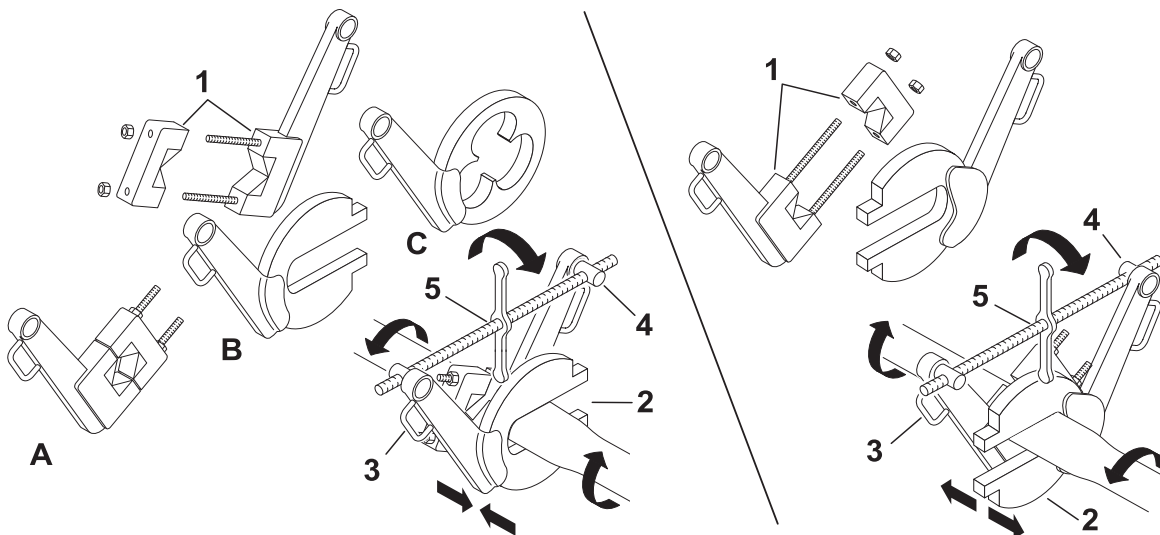


**NOTICE:** Apply TJC to threads and hand-tighten joint before attaching quick wrench components to tighten joint.

Attach quick wrench in either the join or break position.

**IMPORTANT:** Use standard jaws (A) for drill pipe and most downhole tools. Use jaws (B) for adapters, subs, or other tools that have flats. Use bit block (C) for the Rockmaster tool.

**Note:** Most tools with flats can be joined or broken with vise (standard jaw) as well as flats.



j15om081h.eps

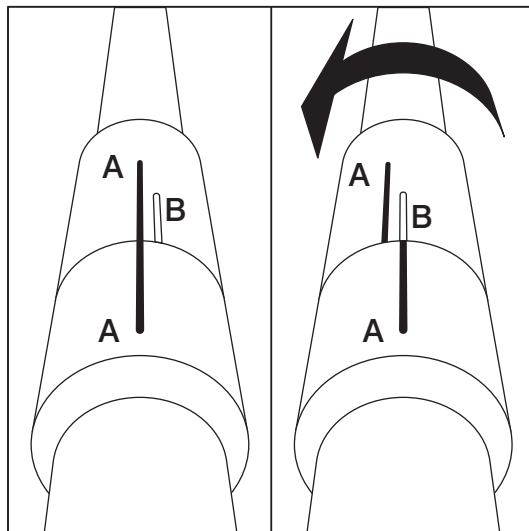
**Join**

**Break**

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

**To Join**

1. Scribe straight line across joint on both sides of separating line (A).
2. Scribe second line (B) on moveable side of joint in the opposite direction of tightening action away from first line the distance indicated below.
  - Power Pipe® HD: 3/8" (9.5 mm)
  - Power Pipe® Forged: 1/4" (6.4 mm)
  - All Terrain pipe: 1/4" (6.4 mm)
  - All Terrain Flush pipe: 1/4" (6.4 mm)
  - Thread-in backreamer accessories: 5/8" (15.9 mm)
3. Turn handle until second line (B) meets first (A).
4. Turn handle opposite direction two turns to relieve pressure.
5. Remove quick wrench components.

**To Break**

**NOTICE:** Ensure that engine is not on or DrillLok™ has disabled the unit before breaking joints.

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

## Drill Pipe

### Perform Regular Drill Pipe Care

#### Precondition New Pipe



Repeat this procedure **three times** for each piece of pipe before it is used the first time:

1. **Hand-lubricate** entire surface of threads and shoulders of both ends of pipe with copper base tool joint compound. See page 197 for recommended lubricant.
2. Join pipe and tighten joint.
3. Break joint.
4. Move pipe back to box.

**NOTICE:** Failure to follow this procedure could result in fused joints. Pipe will be damaged or destroyed.

#### Lubricate Joints Before Each Use

Lubricate threads and shoulders of male joints with copper base tool joint compound. This prevents rust and reduces wear on shoulders and threads. See page 197 for recommended lubricant.

#### Clean the Threads

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

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

#### Replace Worn SaverLok® Body

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 your drill pipe threads. Replace SaverLok body any time when its thread condition is not better than thread condition of your drill pipe. Failing to replace SaverLok body will result in damaged drill pipe. See page 234 for replacement procedure.

Precondition a new SaverLok body the same way you do new pipe.

#### Rotate Pipe Order

Because the lead drill pipe is in the ground longer, it is subjected to higher shock loads and experiences more wear. To help spread this wear evenly over all pipe, move the lead pipe from the previous job out of the first position.

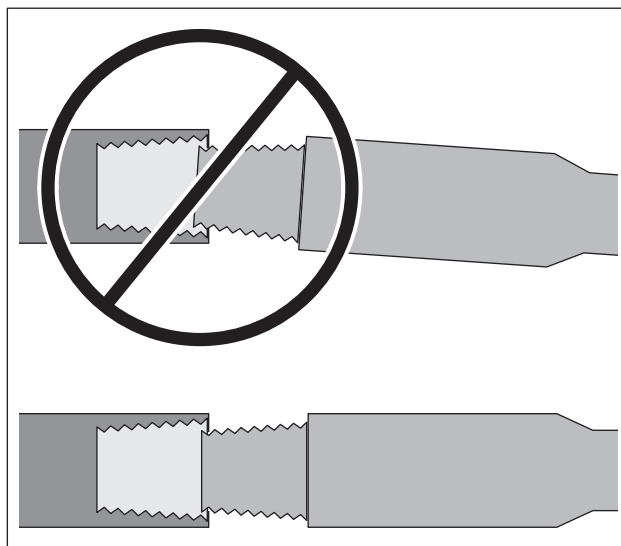


## Use Drill Pipe Correctly

### Align the Joints

Always carefully align the male and female ends of pipe before threading them together. Poor alignment can damage the threads and destroy the usefulness of the joint.

**NOTICE:** If joints get out of alignment during a bore, use frame tilt or rear stabilizers to adjust the unit.

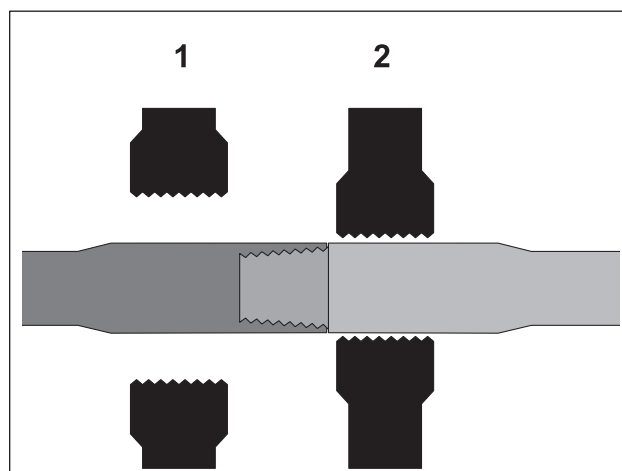


DrillPipe\_Align.eps

### Clamp Pipe Correctly

Clamp on pipe when joint is between wrenches. Clamp only on the tool joint of the drill pipe as shown. This portion of the drill pipe is designed for clamping and is considerably thicker and stronger than the rest of the pipe.

**NOTICE:** Clamping anywhere else on the pipe will weaken the pipe. Pipe can later break, even when operating under normal loads.



DrillPipe\_Clamp.eps

See "Clamp Pipe" on page 106 for more information.

## **Make Up and Break Out Joints Correctly**

**Assisted Makeup** protects threads by automatically matching carriage movement speed to rotation during makeup and breakout.

- To connect pipes together and fully tighten joint, slowly rotate pipe until spindle stops turning and full pressure is developed. Improperly tightened joints will damage the shoulder faces and threads, and will cause joints to leak or break while drilling or backreaming.
- To disconnect pipes, slowly rotate spindle counterclockwise. Carriage will move back automatically as threads fully separate.

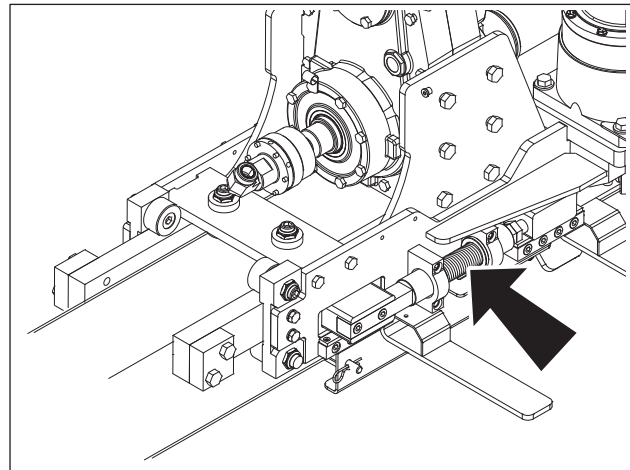


**IMPORTANT:** If assisted makeup is not functioning, unit will not thrust or rotate while carriage is on front or rear home with front wrench closed. Press and hold multi-use button to operate thrust and rotation and follow these instructions.

**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. This will help prevent thread crossing, galling, and shoulder swelling.

### **Makeup**

- Carefully move carriage forward until spindle (or pipe) contacts threads of pipe in the wrench and begins to collapse spring on the side of the carriage (shown). Stop thrusting and rotate clockwise until spring is fully relaxed. Carefully move thrust forward as you spin the threads together, keeping the spring as relaxed as possible.
- **Tighten joints fully.** Once the joint is connected and the shoulder faces are touching, tighten to full machine torque. Improperly tightened joints will damage the shoulder faces and threads, and will cause joints to leak or break while drilling or backreaming.



j22om096h.eps

### **Breakout**

Carefully move the carriage backward until the spring on the side of the carriage is almost fully collapsed. Do not fully collapse the spring. Stop thrusting and rotate counterclockwise until spring is fully relaxed. Carefully move thrust backward and spin the threads apart, keeping the spring as relaxed as possible until the pipe joint is fully separated.

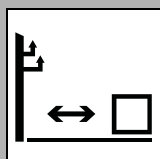
## Do not Overwork the Pipe

Never exceed the bend radius for your pipe. See "Recommended Bend Limits" on page 77. Do not oversteer.

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

## Pipeloader

### Remove/Install Pipe Box

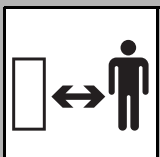


**DANGER**

Electric shock will cause death or serious injury. Stay away. 274-049

**To help avoid injury:**

- Do not attempt to load and unload pipe while drilling or backreaming. Unprotected worker can be injured by electric strike.
- On electrical jobsite, load and unload pipe only if loader is wearing electrically insulating boots and gloves.



**WARNING**

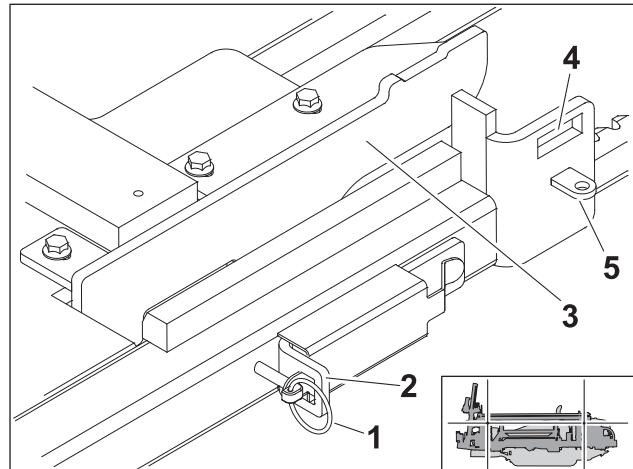
Crushing weight could cause death or serious injury. Stay away. 275-326.

**To help avoid injury:**

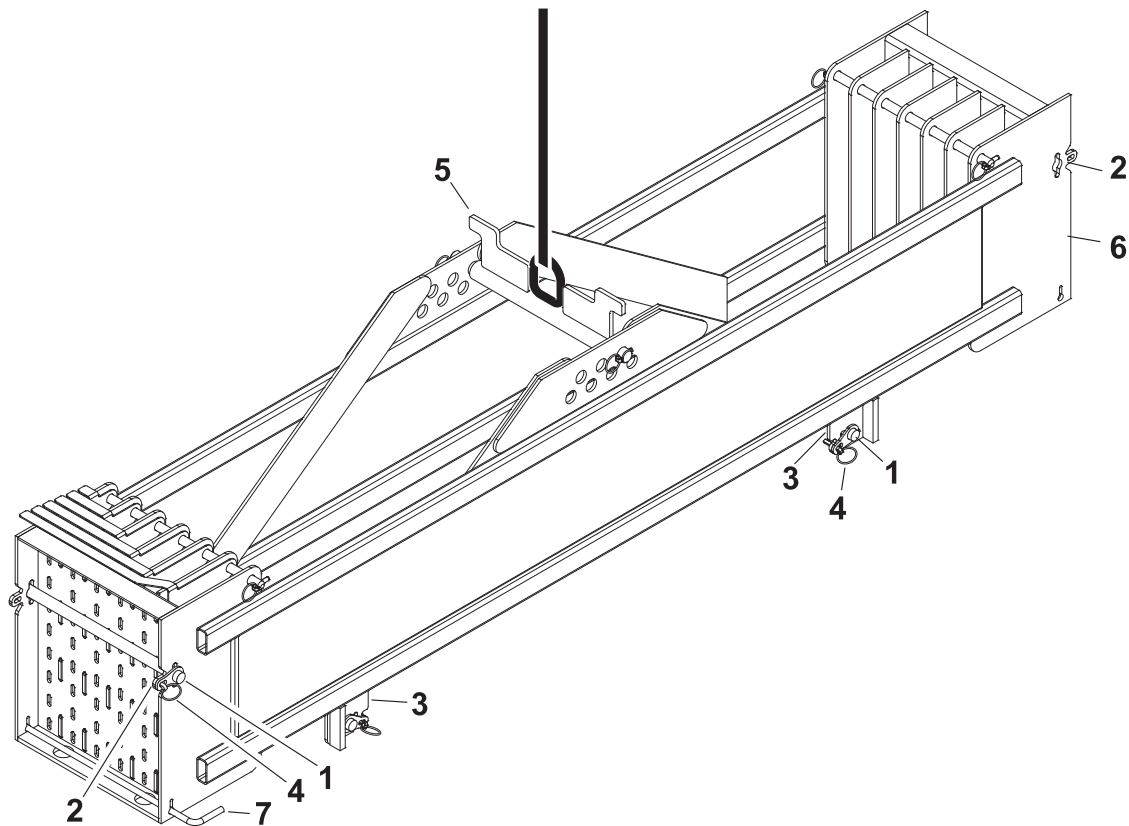
- Always walk around unit and check for obstructions before moving load.
- Use crane capable of supporting the equipment's size and weight. See page 239 or measure and weigh equipment before lifting.
- Never remove pins from ends of pipe box until you have attached lifting device. Box may fall if pipe lift switch is pressed without end pins in place.
- Lift only one box of pipe at a time.
- Do not take your eyes off moving load. Always look in the direction load is moving.
- Never swing a load over people.

## Prepare

1. Press pipe lift switch to fully raise first row of pipe.
2. Remove pins (1) and support bars (2) from drill frame storage pockets.
3. Insert each support bar (2) into opening (4) and allow it to sit on chute (3) and retain with pin (1) through tab (5).
4. Press pipe lower switch to lower pipes in chute.



## Remove Pipe Box



1. Remove support rods (1) from pipe box storage (2).
2. Insert support rods into pipe supports (3) and retain with pins (4).
3. Install lift block (5) and adjust to match drill frame angle.
4. Remove threaded caps (6) from back pins.
5. Remove front (7) pin.
6. Move pipe box off of drill frame.

## **Install Pipe Box**

1. Move pipe box over pipeloader and lower into position.
2. Install threaded caps on back pins.
3. Install front pin.
4. Remove lift block and pin.

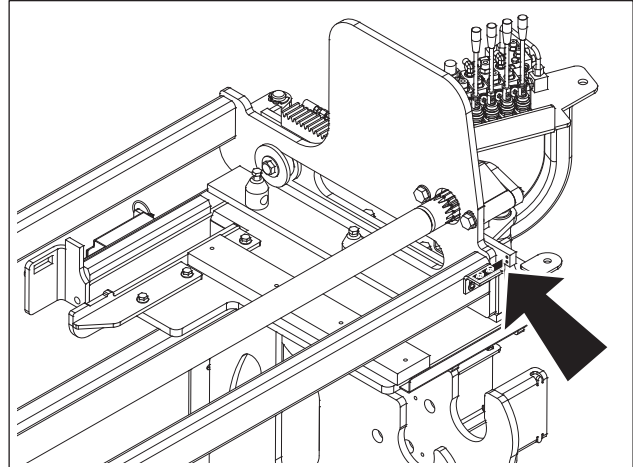
***NOTICE:*** Pipe box should only be installed onto pipeloader when pipe box shuttle is in first row position.

## Shift Pipe Box

**IMPORTANT:** Lift arms must be fully raised for pipe box to move.

### Drilling

1. Shift pipe box when both pipe box status lights are off (column is empty). If automated pipel loader is being used, the main display will inform you that it is time to move the pipe box.



j22om017h.eps

2. Release pipe box switch when box hits mechanical stops, then move back to align mechanical pointer in center of appropriate dot on decal (shown) for new column.



j21om097h.eps

### Backreaming

1. Shift pipe box when active column is full. Indicator flag will lift partially when there is room for one more pipe.

**NOTICE:** Damage can occur when lifting with too many pipes in a column. Be aware of the number of pipes in the column and check indicator flags as column is filled.

2. Release pipe box switch when mechanical pointer is in center of appropriate dot on decal (shown) for new column.

## Correct Dropped Pipe

To return a dropped pipe to the drill string, turn off engine and manually retrieve pipe. Return it to the pipe box by loading it as a single piece of pipe. See "Add Single Pipe" on page 164.

## Correct Misaligned or Jammed Pipe

One pipe box status light on and one light off indicates a misaligned or jammed pipe. Turn off engine and inspect pipe in active column.

- If one end of a drill pipe is jammed and will not drop correctly from pipe box, inspect pipe box position. If pipe box appears to be improperly aligned with discharge chute, return to operator's station and move pipe box slightly until mechanical pointer is in center of appropriate dot on decal (see page 161) for active column.
- If drill pipe is bent, remove it from pipe box and discard.

**NOTICE:** If neither of the causes and solutions outlined above correct the misaligned or jammed pipe, contact your Ditch Witch® dealer for assistance.

## Rotate Drill Pipe Order

Rotating the lead pipe is a manual process. Rotate drill pipes in the drill string weekly.

### Guidelines

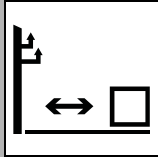
- Rotate only as many columns as used on the longest bore of the week. For example, if the longest bore was 320' (98 m), then only rotate the four columns used.
- Plan to rotate the pipes during the longest bore of the week.

### Procedure

1. Before beginning pullback, temporarily remove next pipe from the box. See "Add/Remove Single Pipe" on page 163. Close both auxiliary pipe loaders.
2. Follow regular pullback procedure to load remaining pipe into pipe box.
3. When all pipes (except lead pipe on AT units) have been returned to pipe box, open both auxiliary pipe loaders, see "Add/Remove Single Pipe" on page 163, place the pipe that was temporarily removed in step 1 into the remaining position in the delivery chute.
4. Turn off engine.
5. Close both auxiliary pipe loaders.

## Add/Remove Single Pipe

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

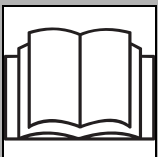


**⚠ DANGER**

Electric shock will cause death or serious injury. Stay away. 274-049

**To help avoid injury:**

- Do not attempt to load and unload pipe while drilling or backreaming. Unprotected worker can be injured by electric strike.
- On electrical jobsite, load and unload pipe only if loader is wearing electrically insulating boots and gloves.



**⚠ WARNING**

Read operator's manual. Know how to use all controls. Your safety is at stake. 273-475

**To help avoid injury:**

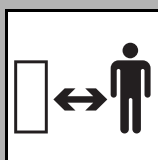
- Open or close **both** auxiliary pipe loaders. Moving shuttles with one auxiliary pipe loader open and one closed will damage equipment and cause possible injury.
- Carriage must be in full back position to load and unload pipe.
- Drill pipe is heavy. Have enough people on hand to manually add or remove single pipe to pipe box.



## Add Single Pipe

1. Ensure pipe box is positioned properly. See "Shift Pipe Box" on page 161.

**NOTICE:** If loading more than one column full of pipe, start by filling an inside column, then shift box inward and load pipe in the next empty column.

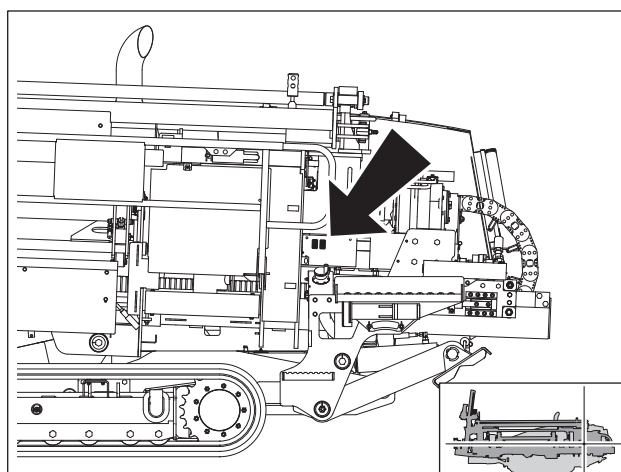


Crushing weight could cause death or serious injury. Use proper procedures and equipment or stay away.

### To help avoid injury:

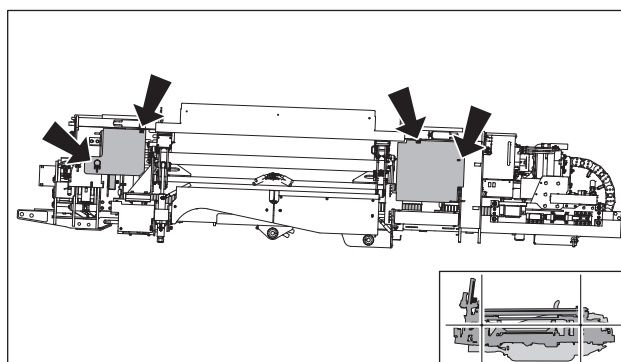
- Drill pipe is heavy. Have enough people on hand to manually add or remove single pipe to pipe box.
- Do not attempt to move shuttles until everyone is at least 10 ft (3 m) away from machine.

2. Press top of shuttle lockout switch (shown) to prevent shuttle operation.
3. Remove both pins so shuttle guard lays flat against the side of the machine.



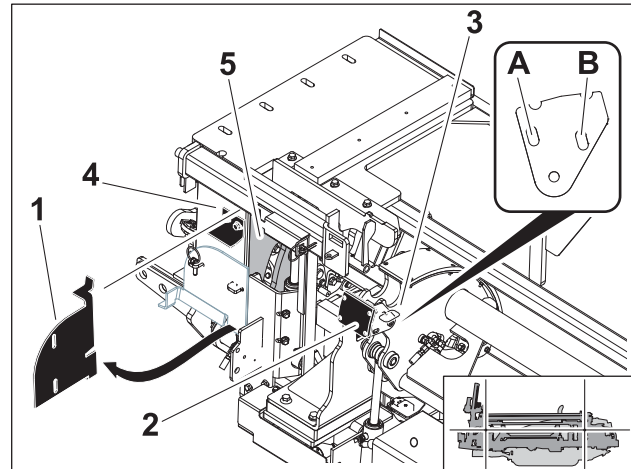
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4. Unlock pins on shuttle covers (shown) and lay down on shuttle guard.



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5. Remove pipe guide (1) from drill frame and insert in slot on drill frame.
6. Press bottom of shuttle lockout switch to allow shuttle operation. Move at least 10 ft (3 m) away from drill.
7. Raise pipe lifter.
8. Move shuttles out half way (45°).
9. Lower pipe lifters.
10. Press top of shuttle lockout switch to prevent shuttle operation.
11. Ensure backup bracket (4) on drill frame allows pipe guide to align with front face (5) on drill frame, adjust if necessary.
12. Pull pin (3) from slot (A) on shuttle, rotate auxiliary pipe loader (2) down, and install pin in slot (B).



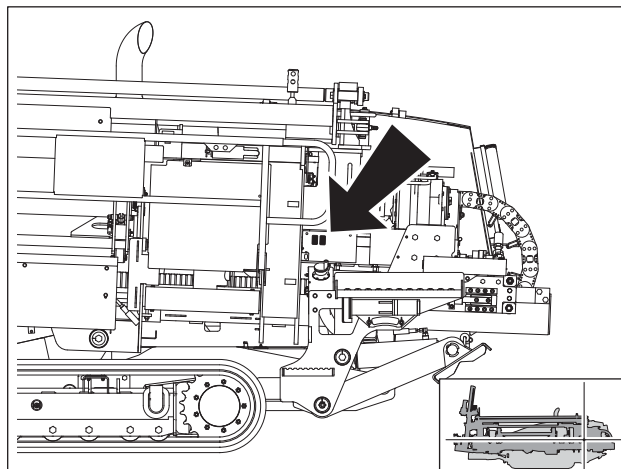
**Note:** This step creates a temporary shuttle stop position at 45°.

13. Repeat step 11 for rear auxiliary pipe loader.
14. Load a pipe in auxiliary pipe loaders with lower end resting against pipe guide (1).
15. Press bottom of shuttle lockout switch to allow shuttle operation. Move at least 10 ft (3 m) away from drill.
16. Move auxiliary shuttle in.
17. Raise pipe into column.
18. Move shuttle out.
19. Repeat steps 14-18 to load more pieces of pipe.
20. Press top of shuttle lockout switch to prevent shuttle operation.
21. Close both auxiliary pipe loaders. Pins must be inserted in slot (A) and held in place with retaining pins.
  - Place pipe guide in storage position (shown) and secure in place with retaining pins.
  - Close shuttle covers.
  - Raise shuttle guard to horizontal position for drilling operation.
  - Press bottom of shuttle lockout switch to allow shuttle operation.
  - move at least 10 ft (3 m) away from drill.
  - If shuttle will not retract after completing single pipe operations, hold retract pipe shuttle switch and momentarily press multi-use button to reset shuttles to normal operation (shuttles will retract).

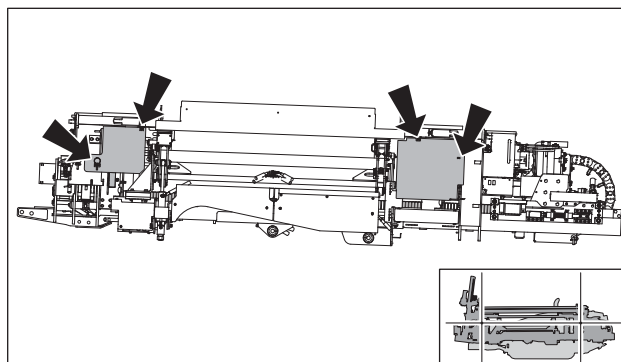
## Remove Single Pipe

Unload drill pipe loaded with auxiliary pipe loaders.

1. Ensure pipe box is positioned properly. See "Remove/Install Pipe Box" on page 158.
2. Press top of shuttle lockout switch (shown) to prevent shuttle operation.
3. Remove both pins so shuttle guard lays flat against the side of the machine.
4. Unlock pins on shuttle covers (shown) and lay down on shuttle guard.

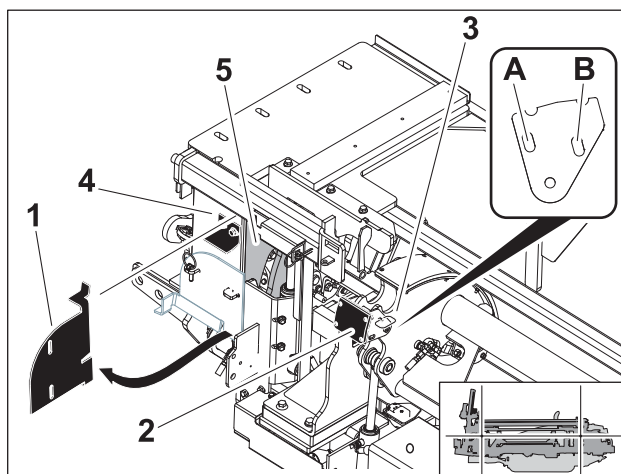


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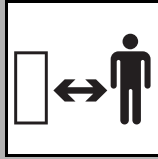


j34om001h.eps

5. Remove pipe guide (1) from drill frame and insert on slot on drill frame.
6. Press bottom of shuttle lockout switch to allow shuttle operation.
7. Move shuttles out half way (45°).
8. Press top of shuttle lockout switch to prevent shuttle operation.
9. Pull pin (3) from slot (A) on shuttle, rotate auxiliary pipe loader (2) down, and install pin in slot (B).
10. Repeat step 10 for rear auxiliary pipe loader.
11. Press bottom of shuttle lockout switch to allow shuttle operation.



j34om002h.eps



Crushing weight could cause death or serious injury. Use proper procedures and equipment or stay away.

**To help avoid injury:**

- Drill pipe is heavy. Have enough people on hand to manually add or remove single pipe to pipe box.
- Do not attempt to move shuttles until everyone is at least 10 ft (3 m) away from machine.

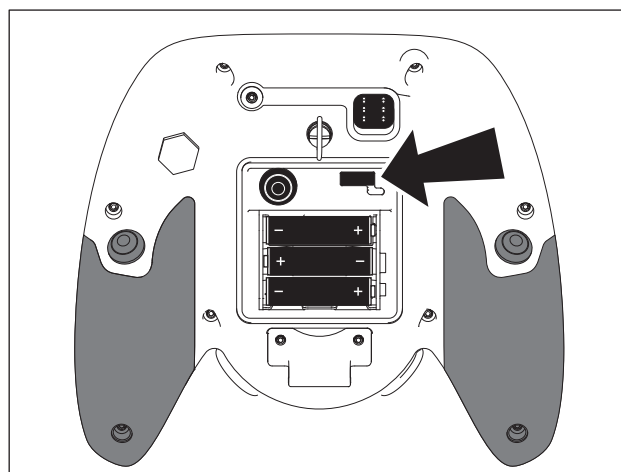


12. Raise pipe lifter.
13. Move shuttle in, auxiliary pipe loaders should be beneath pipe column.
14. Lower pipe into auxiliary pipe loaders.
15. Move shuttle out.
16. Press top of shuttle lockout switch to prevent shuttle operation.
17. Remove pipe from auxiliary pipe loaders and store properly.
18. Repeat steps 12-18 to unload remaining added drill pipe.
19. After all added drill pipe is unloaded with auxiliary pipe loaders:
  - Close both auxiliary pipe loaders. Pins must be inserted in slot (A) and held in place with retaining pins.
  - Place pipe guide in storage position (shown) and secure in place with retaining pins.
  - Close shuttle covers.
  - Raise shuttle guard to horizontal position for drilling operation.
  - Press bottom of shuttle lockout switch to allow shuttle operation.
  - move at least 10 ft (3 m) away from drill.
  - If shuttle will not retract after completing single pipe operations, hold retract pipe shuttle switch and momentarily press multi-use button to reset shuttles to normal operation (shuttles will retract).

## Wireless Ground Drive Controller

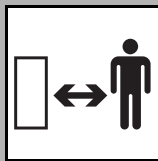
### Before each use

1. Check transmitter unit battery status. Replace batteries if necessary. See page 208.
2. Ensure USB key (shown) is installed. This key is a lockout feature to prevent unauthorized use.



Remote\_USB.eps

### Operation



270-6037

Equipment can be operated by remote control. Stay away.

#### To help avoid injury:

- Keep drilling unit in sight at all times when using wireless ground drive controller.
- Keep a safe distance away from drilling unit when operating wireless ground drive controller.
- Ensure bystanders are not near the area the drilling unit will be driven.
- Remove strap from around neck when using wireless controller near moving parts. Place wireless controller in storage box after use. Take care not to store with neck strap on top of switches.

**EMERGENCY STOP:** Press engine stop on wireless remote or machine.

1. Start the remote transmitter by moving the power/start/horn switch up until communication link indicator is steady yellow and then blinks green. Clear wireless remote control light (page 4) will shine on the machine being controlled.
2. Move power/start/horn switch up again with speed/direction control in neutral until horn sounds..

**IMPORTANT:** Wireless controller will shut down after one minute of inactivity. Move power/start/horn switch up to restart.

3. To drive machine, select the desired drive mode. Press one or both operator presence switches and then set throttle and use the joystick to steer.
4. Shut down the transmitter by moving power/start/horn switch down until LED indicators go off.

## Troubleshooting

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

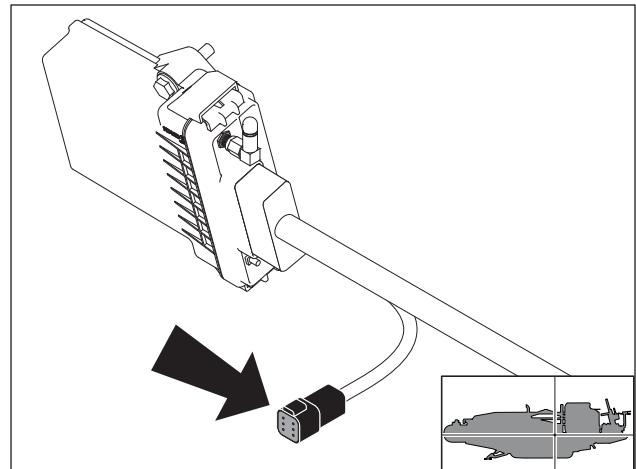
If communication link indicator is blinking yellow, communication between transmitter and receiver has stopped. Move wireless remote closer to machine while maintaining a safe distance. If in an area with interference, try changing the channel (see below).

If communication link indicator is red, communication has been lost. Shut down wireless remote and restart to try to enable communication. If that doesn't work, contact your Ditch Witch® dealer.

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

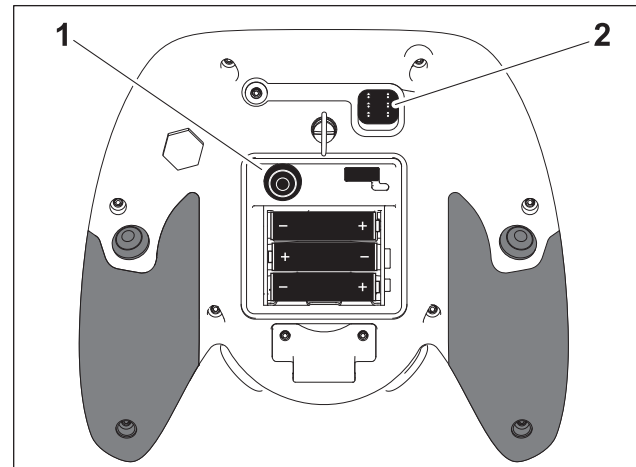
### To change channels:

1. Turn machine ignition key on with engine off.
2. Connect harness (shown) to transmitter (2).
3. Ensure battery indicator is solid green.



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4. Press the channel switch (1) until communication link indicator begins to blink green/yellow and then release the channel switch.
  - Rapid blinking green indicator signals successful channel connection.
  - Blinking yellow indicator signals unsuccessful channel connection.



Remote\_Channel.eps



## Cruise Control

During the bore, you can set the desired thrust/pullback, and rotation speeds to match ground conditions. Cruise control enables the unit to maintain these settings hands-free. You can engage, disengage, override, and resume these settings at any time.

**IMPORTANT:** In order for cruise control to function, front wrench must be open and shuttles must be under pipe delivery chute (fully retracted).

## Engage

Thrust/Pullback and Rotation Cruise	Thrust/Pullback Cruise Only
<ol style="list-style-type: none"><li>1. Position joystick so that thrust or pullback and rotation are at desired speeds.</li><li>2. Press set. Machine display will show "Cruise ON."</li><li>3. Release joystick.</li></ol>	<ol style="list-style-type: none"><li>1. Position joystick to desired thrust or pullback setting.</li><li>2. Press set. Machine display will show "Cruise ON."</li><li>3. Release joystick.</li><li>4. Operator can control rotation with joystick.</li></ol> <p>In JT or AT Dirt modes, there is only clockwise rotation.</p> <p>In AT mode, there is clockwise and counterclockwise rotation so the operator can "wiggle" through cobble rock.</p> <p><b>NOTICE:</b> Counterclockwise rotation can "break out" pipe joints downhole and unthread the joint. Operator should not rotate counterclockwise long enough to unthread a joint.</p>

## Adjust Settings

Setting	Instructions
Thrust or Pullback	<ul style="list-style-type: none"><li>To increase thrust or pullback speed, set joystick in neutral position and press resume.</li><li>To decrease thrust or pullback speed, set joystick in neutral position and press set.</li></ul>
Rotation	<ul style="list-style-type: none"><li>To increase rotation speed, move joystick to left and press resume.</li><li>To decrease rotation speed, move joystick to left and press set.</li></ul>



**Note:** To obtain fine adjustments, press and hold the multi-use button while making the adjustment.

## Override

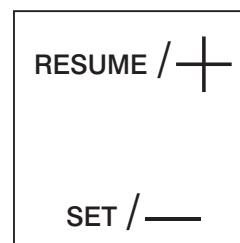
- To override thrust/pullback settings, move joystick out of neutral and beyond current setting. Unit will increase to joystick setting.
- To return to previous setting, release joystick.

## Disengage

To disengage cruise control, move joystick out of neutral in opposite direction of carriage travel. "Cruise ON" disappears from the machine display and carriage stops moving.

## Resume

- Position joystick out of neutral in direction to be resumed (forward or backward).
- Press resume. Thrust and rotation resume at the previous settings and "Cruise ON" is shown on the machine display.



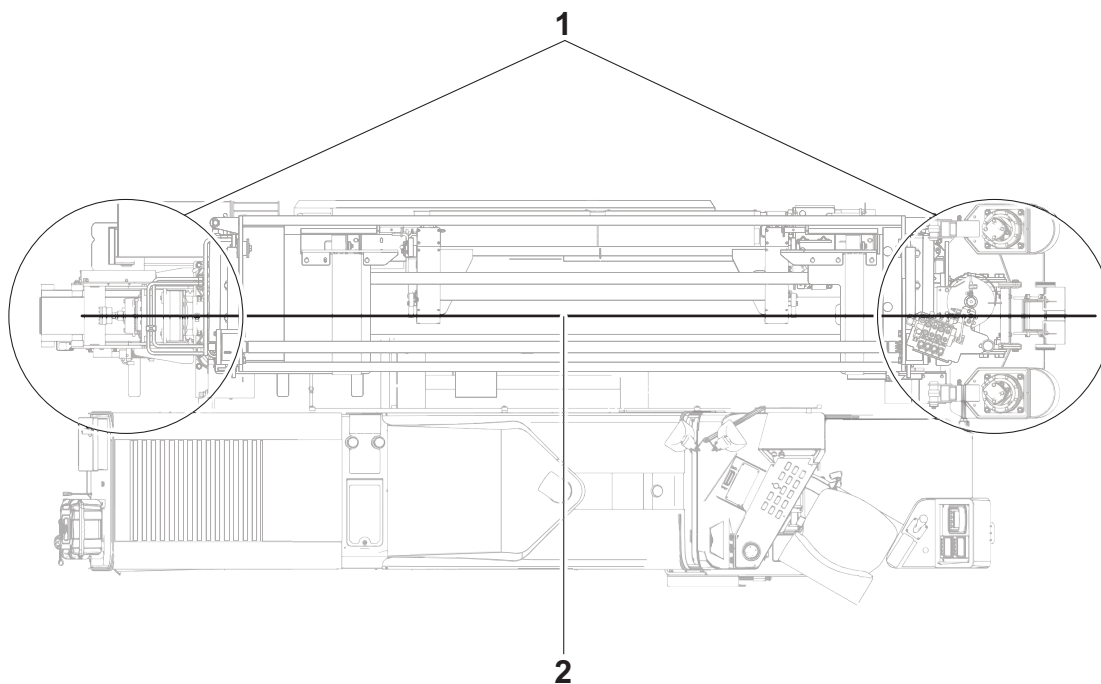
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## Wireline Tracking

**IMPORTANT:** This section is intended as an overview for the JT30 drilling unit operator. During most bores, a wireline tracking specialist is responsible for making wireline connections. For specific information about wireline tracking, including system operation and safety precautions, consult your wireline tracking equipment vendor.

The JT30 can be modified to operate a wireline tracking system by installing kit 190-1627. Wireline tracking uses a transmitter in the drilling head that is hard wired through the drill string to an offboard computer station at the rear of the unit. Each time pipe is added to the drill string, a new section of wireline is inserted through the new pipe, gearbox, and water swivel, then spliced to the tracking system. The operator must be aware of the wireline tracking specialist's activity at the front and rear of the machine.

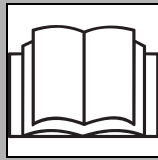


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1. Operator awareness zones

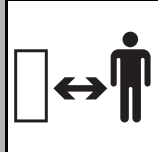
2. Wireline

## Operation



**WARNING**

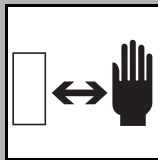
Read operator's manual. Know how to use all controls.  
Your safety is at stake. 273-475



**DANGER**

Turning shaft will kill you or crush arm or leg. Stay away.  
**To help avoid injury:** Ensure that thrust and rotation are disabled or in restricted mode while wireline tracking specialist is working at front and rear of machine.

1. Connect drill head, transition sub, and wireline beacon housing.
2. Drill first pipe. After first pipe is downhole, clamp pipe in wrenches.
3. Position next pipe in shuttles.



**WARNING**

Moving parts could cut off hand or foot. Stay away. 275-184,  
273-437,

**To help avoid injury:**

- DO NOT operate pipe box, pipeloading, anchor, setup controls, or any other controls while tracking specialist is making wireline connections.
- Maintain constant two-way communication with tracking specialist.

4. The wireline tracking specialist will:
  - Turn the wireline restricted operating mode (ROM) switch to the ON position to slow thrust and rotation. See "Wireline restricted operating mode switch" on page 63.
  - Insert a section of wireline through the pipe in the shuttles.
  - Splice one end of the new wire to the wireline in the clamped pipe.
  - Insert the other end (rear of machine) through the spindle, gearbox, and water swivel.
5. Use the pipeloading controls to move the new pipe into position and makeup the joint.
6. The wireline tracking specialist will:
  - Remove slack in the wireline.
  - Secure the wireline at the spindle.
  - Connect the wireline to the offboard computer.
  - Turn the wireline ROM switch to the OFF position to enable unrestricted thrust and rotation.
7. Install next new section of pipe.
8. Continue process for duration of bore.

## Diagnostic Codes

The JT30 / JT30 All Terrain is equipped with two diagnostic systems: engine and machine. The engine diagnostic system detects critical and non-critical errors within the engine operating system and communicates fault codes on the engine display. The machine diagnostic system detects essential and non-essential errors within the automated machine control system. These error codes are displayed on the machine display.



**To hide/recall active codes:**

**IMPORTANT:** Do not turn off ignition. Diagnostic codes are cleared each time ignition is turned off.

- Press the soft key on the machine display for the diagnostic message center. Then press the soft key on the right to hide/recall the messages. The message box will disappear, however the Warning or Stop message will remain on the screen until the fault is cleared.

## Electronic Controlled Engine Overview

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

Indicators, plus diagnostic codes and messages, on the engine display tell the operator about potential engine problems and certain engine events. 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.

## Reading Engine Diagnostic Codes

Engine diagnostic codes are shown in pop-up messages on the engine 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.

## Diagnostic Codes

Note the SPN, FMI, and description of the diagnostic code for future reference, if needed. See "Appendix" on page 251.

## Machine Diagnostic System Overview

Use the machine display to view condition of the machine automation diagnostic system. Under normal operating conditions, any diagnostic code that is recorded will be shown on the bottom line of the machine display. Non-essential codes will remain for 10 seconds and then go away. Essential codes will remain until the operator clears them from the display. If diagnostic codes are detected, the diagnostic light will either flash on and off for 10 seconds to indicate a non-essential code or repeatedly cycle on for 3 seconds and off for half a second to indicate an essential code.

## Code Severity Levels

Diagnostic codes are given one of two levels of severity.

- A **non-essential** code affects non-essential functions of the unit. If the system detects a non-essential problem, a diagnostic code will be recorded and the diagnostic light will flash for 10 seconds and then go out. Each time ignition is turned on, full operation is available until the diagnostic system detects a problem.
- An **essential** code affects rotation, thrust, drilling fluid, or ground drive. If the system detects an essential problem, a diagnostic code will be recorded and the diagnostic light will repeatedly cycle on for three seconds and off for 1/2 second. Some machine functions may not work until the problem is corrected. Each time ignition is turned on, full operation is available until the diagnostic system detects a problem.

## Machine Diagnostic Codes

The following table lists the attributes of each diagnostic code. Information presented includes: code number, condition causing code to be sent, result, and level of severity.

**IMPORTANT:** All machine diagnostic codes begin with "SPN521," followed by the three digit code number, followed by "FMI31." For example, code 12 will appear as SPN521012FMI31.



Code	Display	Condition	Result	Severity
012	START MSG	normal entry into diagnostic mode	code is not stored	n/a
013	m12VOLT OUTPUT	no 12V power to main controller	drill and drive are blocked	essential
014	m5VOLT OUTPUT	no 5V power from main controller	drill and drive are blocked	essential
015	m6VOLT DRIVER	incorrect voltage on 6V driver on main controller	drive is blocked	essential
016	p12VOLT OUT	no 12V power to pipe controller	drill fluid is blocked	essential
017	p5VOLT OUT	no 5V power from pipe controller	drill fluid is blocked	essential
018	p6VOLT DRIVER	incorrect voltage on 6V driver on pipe controller	code is stored	essential
019	MISC OUTPUT	unknown output driver continuity problem	code is stored	non-essential
020	pMISC OUTPUT	unknown output driver continuity problem in pipe controller	code is stored	non-essential
021	FRWRNCH CLOSE	no continuity to front wrench close solenoid	code is stored	non-essential
023	REWRNCH CLOSE	no continuity to rear wrench close solenoid	code is stored	non-essential
025	WRNCH CW ROT	no continuity to wrench cw rotate solenoid	code is stored	non-essential
031	WRNCH CCW ROT	no continuity to wrench ccw rotate solenoid	code is stored	non-essential
032	SHUTTLE EXT	no continuity to shuttle extend solenoid	add pipe or remove pipe is aborted and code is stored	non-essential
033	SHUTTLE RET	no continuity to shuttle retract solenoid	add pipe or remove pipe is aborted and code is stored	non-essential

Code	Display	Condition	Result	Severity
034	PIPE LIFT	no continuity to pipe lift solenoid	add pipe or remove pipe is aborted and code is stored	non-essential
035	PIPE LOWER	no continuity to pipe lower solenoid	add pipe or remove pipe is aborted and code is stored	non-essential
041	PIPE GRIP	no continuity to pipe grip solenoid	add pipe or remove pipe is aborted and code is stored	non-essential
042	PIPE REL	no continuity to pipe release solenoid	add pipe or remove pipe is aborted and code is stored	non-essential
044	LUBE FRONT	no continuity to lube front solenoid	code is stored	non-essential
045	THRUST 2 SPD	no continuity to thrust two-speed solenoid	code is stored	non-essential
046	AUX DUMP	no continuity to auxiliary dump valve	add pipe or remove pipe is aborted and code is stored	non-essential
047	PIPE BOX IN	no continuity to pipe box in solenoid	code is stored	non-essential
048	PIPE BOX OUT	no continuity to pipe box out solenoid	code is stored	non-essential
051	ROTCW/LTREV	no continuity to rotation cw/left track reverse solenoid	cruise control, carve mode, and drive are blocked	essential
052	ROTCCW/LTFWD	no continuity to rotation ccw/left track forward solenoid	cruise control, carve mode, and drive are blocked	essential
053	THRFWD/RTFWD	no continuity to thrust forward/right track forward solenoid	cruise control, carve mode, and drive are blocked	essential
054	THRBWD/RTREV	no continuity to thrust backward/right track reverse solenoid	cruise control, carve mode, and drive are blocked	essential
055	THR BRAKE REL	no continuity to thrust brake valve	cruise control and carve mode are blocked	essential
057	DRV BRAKE REL	no continuity to ground brake solenoid	code is stored	essential
058	DRIVE SELECT	no continuity to drive selector valve	drive is blocked	essential
059	TKR CNT LIGHT	no continuity to DrillLok™ light	code is stored	non-essential
061	DFLUID PUMP	no continuity to drilling fluid pump solenoid	code is stored	essential

Code	Display	Condition	Result	Severity
063	DFLUID ENABLE	no continuity to fluid enable solenoid	code is stored	essential
064	DFLUID 2 SPD	no continuity to fluid two-speed solenoid	code is stored	non-essential
074	INNER ROT CW	no continuity to inner rotation clockwise solenoid	code is stored	essential
075	INNER ROT CCW	no continuity to inner rotation counter-clockwise solenoid	code is stored	essential
076	THRUST LIMIT	no continuity to thrust limit solenoid	code is stored	non-essential
081	MAIN WRONG ID	main controller has pipe ID on CAN ID line	controller runs in service mode	essential
082	PIPE WRONG ID	pipe controller has main ID on CAN ID line	controller runs in service mode	essential
083	MAIN INVAL ID	main controller has invalid ID on CAN ID line	controller runs in service mode	essential
084	PIPE INVAL ID	pipe controller has invalid ID on CAN ID line	controller runs in service mode	essential
085	MAIN NOSAV ID	main controller has no saved ID	controller runs in service mode	essential
086	PIPE NOSAV ID	pipe controller has no saved ID	controller runs in pipelader service mode	essential
087	HARNESS POSN	ID state does not agree with harness position and cannot be resolved	controller runs in EDT only mode	essential
088	CAN BOOT TO	timeout has occurred while waiting for CAN system to boot	controller runs in service mode	essential
091	CAN PHYS ERR	errors on the CAN Bus totaling 275 have been logged	code is stored	non-essential
092	MAIN BUS OFF	main controller has shutdown CAN communications	controller runs in main service mode	essential
093	PIPE BUS OFF	pipe controller has shutdown CAN communications	controller runs in pipelader service mode	essential
094	MAIN PROTOCOL	main controller has an incorrect protocol message	code is stored	non-essential





Code	Display	Condition	Result	Severity
095	PIPE PROTOCOL	pipe controller has an incorrect protocol message	code is stored	non-essential
096	MAIN NG FAIL	main controller has detected node guard timeout	controller runs in main service mode	essential
097	PIPE NG FAIL	pipe controller has missed a node guard from the master	controller runs in pipeloader service mode	essential
098	MAIN LOG FAIL	pipe controller has had an internal software failure	controller runs in main service mode	essential
099	PIPE LOG FAIL	pipe controller has had an internal software failure	controller runs in pipeloader service mode	essential
111	TETH NG FAIL	tether controller has missed a node guard from the main controller	drive is blocked	essential
112	ESID NG FAIL	ESID controller has missed a node guard from the main controller	code is stored	non-essential
113	ICTR NG FAIL	machine display has missed a node guard from the main controller	code is stored	non-essential
131	THREAR HSW	no continuity to thrust rear home switch	add pipe and remove pipe are blocked	non-essential
132	THFRNT HSW	no continuity to thrust front home switch	add pipe and remove pipe are blocked	non-essential
133	SHUTTL HSW	no continuity to shuttle home switch	add pipe and remove pipe are blocked	non-essential
134	FWRNCH PSW	no continuity to front wrench switch	add pipe and remove pipe are blocked	non-essential
136	TH REAR STOP	no continuity to thrust rear stop switch	add pipe and remove pipe are blocked	non-essential
137	PIPE UP PSW	no continuity to pipe up switch	pipe box movement is blocked and code is stored	non-essential
138	FRONT BOX HSW	no continuity to front pipe box switch	code is stored	non-essential
139	REAR BOX HSW	no continuity to rear pipe box switch	code is stored	non-essential
141	ROTATE POS	no continuity to rotation position sensor	code is stored	non-essential
143	DFLUID GPM	no continuity to drilling fluid speed sensor	code is stored	non-essential

Code	Display	Condition	Result	Severity
146	FLOAT POS	no continuity to float position sensor	assisted makeup is blocked and code is stored	non-essential
147	TKR CONTROL	no continuity to DrillLok™ input	code is stored	non-essential
149	ANCHOR ON PSW	no continuity to anchor pressure switch	code is stored	non-essential
151	DRL JOY L/R	drill joystick left/right out of range	rotation, cruise control, and carve mode are blocked	essential
152	DRL JOY F/B	drill joystick forward/backward out of range	thrust, cruise control, and carve mode are blocked	essential
153	DRV JOY L/R	drive joystick left/right out of range	drive is blocked	essential
154	DRV JOY F/B	drive joystick forward/backward out of range	drive is blocked	essential
156	DR FLUID POT	drilling fluid potentiometer out of range	code is stored	essential
158	FAN POSN SEN	no information from engine fan pulse pickup sensor	code is stored and fan is controlled without feedback	non-essential
161	ROT PRES SEN	rotation pressure sensor out of range	code is stored	non-essential
162	THR PRES SEN	thrust pressure sensor out of range	code is stored	non-essential
163	DFLD PRES SENS	drilling fluid pressure sensor out of range	code is stored	non-essential
165	SHUTL STOP SW	no continuity to shuttle stop switch	shuttles are blocked	non-essential
171	PIPE GRIP RSW	no continuity to pipe grip rocker switch	code is stored	non-essential
172	SHUTTLE RSW	no continuity to pipe shuttle rocker switch	code is stored	non-essential
173	PIPE LIFT RSW	no continuity to pipe lift rocker switch	code is stored	non-essential
174	PIPE BOX RSW	no continuity to pipe box rocker switch	code is stored	non-essential
175	PIPE LUBE RSW	no continuity to pipe lube rocker switch	code is stored	non-essential
181	FRONT WR RSW	no continuity to front wrench rocker switch	code is stored	non-essential



Code	Display	Condition	Result	Severity
182	REAR WR RSW	no continuity to rear wrench rocker switch	code is stored	non-essential
183	ROT WR RSW	no continuity to rotating wrench rocker switch	code is stored	non-essential
184	THROTTLE RSW	no continuity to throttle rocker switch	code is stored	non-essential
185	SET/RES RSW	no continuity to set/resume rocker switch	code is stored	non-essential
191	JT/AT RSW	no continuity to JT/AT rocker switch	code is stored	non-essential
192	INNER ROT RSW	no continuity to inner rotation rocker switch	inner rotation is blocked	essential
193	INNER ROT POT	inner rotation potentiometer out of range	inner rotation is blocked	essential
194	INNER ROT JOG	inner rotation jog switch out of range	code is stored	non-essential
195	INNER ROT POS	no continuity to inner rotation position sensor	dither compensation is blocked	non-essential
196	IROT PRES SEN	inner rotation pressure out of range	code is stored	non-essential
221	LOW VOLTAGE	system voltage is below 12.5V	code is stored	non-essential
222	INNER ROT SPD	inner rotation position sensor not changing	dither compensation is blocked	non-essential
223	ROTATE SPD	rotation position sensor not changing	full auto pipe is blocked	non-essential
231	PIPELOADER RSW	more than two pipeloader rocker switches are active	pipeloader functions are blocked	essential
233	DRL/DRV SW	both drill (in seat) and drive (tether) operator presence inputs are present	unit will not drill or drive; will recover if condition clears	essential
234	ADDP/REMP SW	add pipe and remove pipe inputs both on	add pipe and remove pipe are blocked	non-essential
235	TH F/R HSW	front and rear home switch inputs both on	add pipe and remove pipe are blocked	non-essential
241	SHUTTLE RESP	shuttles not responding correctly	add pipe or remove pipe is aborted and code is stored	non-essential

Code	Display	Condition	Result	Severity
251	FLOAT ZERO	float sensor is reading too low	assisted makeup is blocked and code is stored	non-essential
252	FLOAT RANGE	float sensor is reading out of range	assisted makeup is blocked and code is stored	non-essential
253	A2D SYNCH	questionable voltage reading on controller circuit board	code is stored	non-essential
254	SETUP TABLE	error reading setup table information	add pipe and remove pipe are blocked	essential
255	MISC CODE	undefinable diagnostic code reported	code is stored	non-essential

**IMPORTANT:** All ESID diagnostic codes begin with "dc," followed by the three digit code number. For example, code 502 will appear as dc502.

Code	Display	Condition	Result	Severity
502	2.5V REF	2.5V reference error in ESID	internal reference failure, ESID may not give valid readings	
503	-5V REF	-5V reference error in ESID	internal reference failure, ESID may not give valid readings	
504	CLK RESP	clock response error	clock may not be working	
505	LCD RESP	LCD response error	LCD display may not work	
506	LED RESP	LED response error	LED display may not work	
507	LCD CONTR	LCD contrast error	LCD contrast not saved properly	
508	COP RESET	cop watchdog error	processor has reset, unknown status of ESID code	
510	STRB DVR	strobe driver output error	strobe may not function	
511	HORN DVR	horn driver output error	horn may not function	
512	BAT POWER	battery power/horn driver error	strike hold on power may not function	
513	TEST WIRE	no continuity on test wire for testing ESID	machine display may not be able to reset ESID	
515	STR VOLT	strike voltage input error		
516	STR COIL	strike current input error		



Code	Display	Condition	Result	Severity
517	POST AC V	self test ac voltage input error	self test of ac voltage stake failed	
518	POST AC I	self test ac current input error	self test of ac current coil failed	
519	POST DC V	self test dc voltage input error	self test of dc voltage input amplifier failed	
520	POST DC I	self test dc current input error	self test of dc current input amplifier failed	
521	V NOT GND	strike voltage input stake not grounded	self test of voltage stake failed	
541	ESID PHYS ERR	errors on the CAN Bus totaling 275 have been logged	code is stored in ESID	
542	ESID BUS OFF	ESID has shutdown CAN communications	CAN information is no longer transmitted to machine display	
546	MAIN NG FAIL	ESID has not received the Node Guard message from the Main Controller	ESID access via the CAN BUS may not work, but ESID will still sound strike alarms	essential
588	EEP WRITE	EEProm write error	ESID may not be able to record strike history	
589	MISC CODE	invalid error report entry	software error report	

## Service Mode

Automated functions of the JT30 are made possible by communication between five electronic controllers onboard the unit. The main controller and pipeloader controller share information as a single unit. If communication between these two controllers is lost, full operation is not possible and the unit will shift into Service Mode. Service Mode permits limited operation without automated functions and standard equipment protections. In Service Mode, an operator can complete a bore and move the unit away from the jobsite so that proper repairs can be made at a Ditch Witch® dealership.



**NOTICE:** Some automated functions that protect components from damage are NOT available in Service Mode. **Use extreme caution when operating in Service Mode.**

**IMPORTANT:** Only a qualified Ditch Witch service technician can return the unit to normal operation. Contact your Ditch Witch dealership.

This table explains how automated functions are affected in Service Mode.

Function	Normal Operation	Service Mode Operation
<b>Slow Zones</b>  Purpose: To protect carriage from high speed or high pressure impact at the front and rear of the drill frame.	Carriage speed automatically slows as the carriage approaches sensors at the front and rear of the drill frame.	Front home and rear home sensor input data is not available.  Carriage speed is limited to the slow zone speed.  To access full thrust speed/pressure, press and hold the 2-speed button. <b>Use caution to prevent damage.</b>
<b>Shuttle Safe</b>  Purpose: To protect shuttles from carriage movement.	Carriage movement stops automatically if shuttles are not retracted when carriage moves away from rear home sensor.	Front and rear home sensor input data is not available. Carriage may strike shuttles.  Operator must fully retract shuttles before moving carriage.
<b>Auto Dither</b>  Purpose: Aligns the hex inner rod and collar on AT units when threading a section of drill pipe.	In AT mode, the inner rod rotates clockwise, then counterclockwise repeatedly as carriage moves forward to align inner rod with inner rod collar.	Inputs required to establish dither are unavailable.  Operator must use manual jog potentiometer to rotate inner rod while threading pipe sections.  <b>Note:</b> In Service Mode, the ON/OFF/MANUAL switch is not required to enable the jog potentiometer.

Function	Normal Operation	Service Mode Operation
<b>Rear Stop</b>  Purpose: To stop carriage before it reaches the rear of the drill frame.	Machine automatically stops pullback when carriage reaches the rear stop sensor.	Rear stop sensor data is not available. Carriage may impact rear of drill frame.  Operator must manually slow carriage and ease it against the rear carriage stop.
<b>Assisted Makeup/Float</b>  Purpose: To protect threads on saver sub and pipe sections.	Machine automatically coordinates thrust and rotation speed to reduce thread wear/damage.	Data from the float sensor is not available.  Operator must use the joystick to manually coordinate thrust and rotation speed when threading pipe.
<b>Auto Pipe Release</b>  Purpose: To keep pipe lifters from forcing pipe through closed grippers.	When pipe grippers are positioned at pipe delivery chute, grippers automatically open when pipe lifters are raised and lowered.	Pipe gripper position data is not available.  Operator must open the grippers before raising or lowering the pipe in the grippers at the delivery chute
<b>Automated Pipe Handling</b>  Purpose: Automates most of the operations required to add or remove pipe from the drill string.	Activated with the Add/Remove Pipe switch on the operator's console. Machine automates many functions during pipe change operations.	Pipeloader automation is unavailable.  Operator must activate each function using the joystick and the pipeloader control switches on the operator's console.
<b>Machine Display</b>	Displays machine information and pipeloading status.	Data from some functions is unavailable to the machine display. Some data fields will flash, some will display "Service Mode" and a scrolling message, and others will be replaced with dashes.  Affected data fields include: float position, drill fluid, DrillLok™, cruise control, carve mode, pipeloader status, rotation, and EDT test mode.
<b>Machine Display, JT Cntrl-EDT Displays</b>	Displays addition information and status of switches, sensors, etc.	When data from a function is unavailable, three dashes (---) will be displayed.

# Complete the Job

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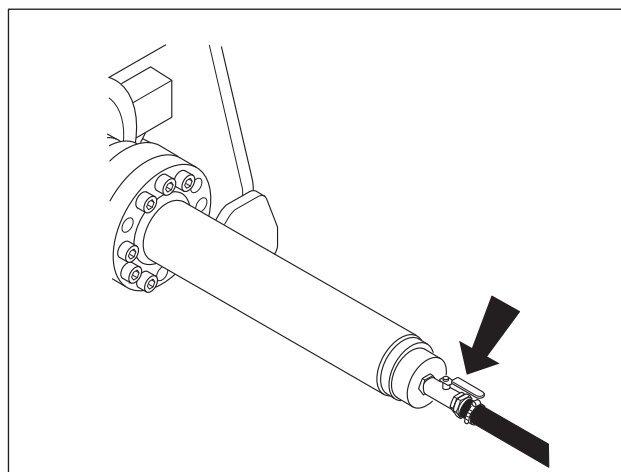


## Antifreeze Drilling Unit

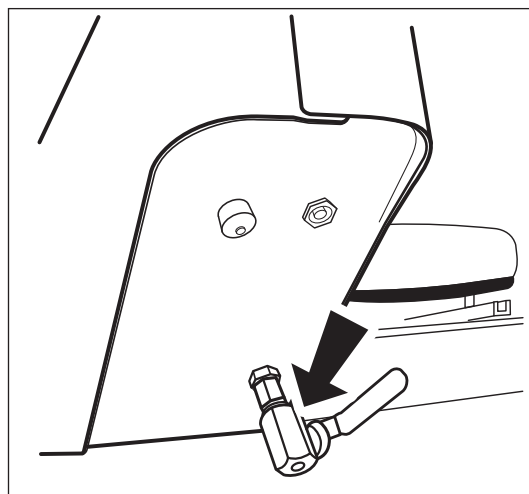
Your drilling unit can be left overnight in freezing conditions by filling fluid lines with a polypropylene-based antifreeze (p/n 265-644) with optional antifreeze system before shutdown.

### Add Antifreeze

1. Fill antifreeze tank with 8 gal (30 L) of approved antifreeze.
2. Install plug on suction side of drilling fluid pump.
3. Open valve below antifreeze tank.
4. Install optional antifreeze reclaimer adapter in spindle. Ensure valve (shown) is open.
5. Turn drilling fluid potentiometer counterclockwise to zero position.
6. Start unit and set throttle to slow position.
7. Set drilling fluid pump switch to on position.
8. Slowly turn drilling fluid potentiometer clockwise until indicator light comes on. If light does not come on, press drilling fluid pump switch.
9. Run drilling fluid pump until antifreeze comes out of spindle.
10. Turn drilling fluid pump switch to off position. Close valve on antifreeze reclaimer adapter.
11. Open valve below right operator's console (shown).
12. Repeat steps 5-8.
13. Close valve below right console when antifreeze runs out of valve below right console.
14. Turn drilling fluid pump switch to off position.



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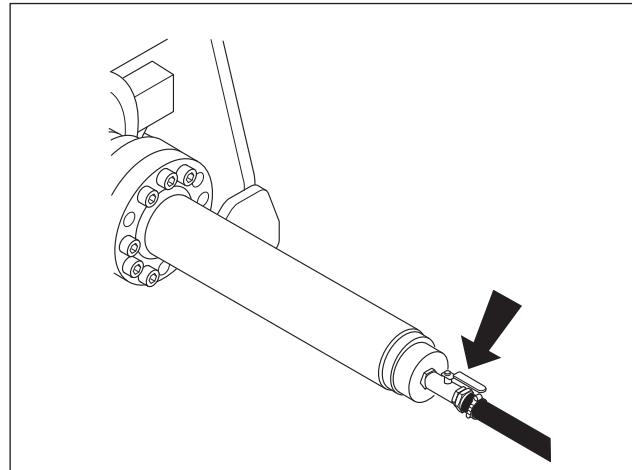


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## Reclaim Antifreeze

1. Hold hose on optional antifreeze reclaimer over top of antifreeze tank.
2. Open valve on reclaimer (shown).
3. Connect drilling fluid transfer hose from tanks to drilling fluid pump inlet.
4. Close valve below antifreeze tank.
5. Start unit and run at low throttle.
6. Turn drilling fluid pump on low speed.
7. Turn drilling fluid pump off when drilling fluid comes out of reclaimer hose.
8. Remove antifreeze reclaimer.

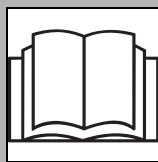
**IMPORTANT:** Antifreeze can be removed from antifreeze tank and disposed of properly or it can be reused until it is too diluted with drilling fluid to protect against freezing.



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## Rinse Equipment

### Using Washwand

**WARNING**

Pressurized fluid or air could pierce skin and cause severe injury. Refer to operator's manual for proper use. 270-6035

**To help avoid injury:**

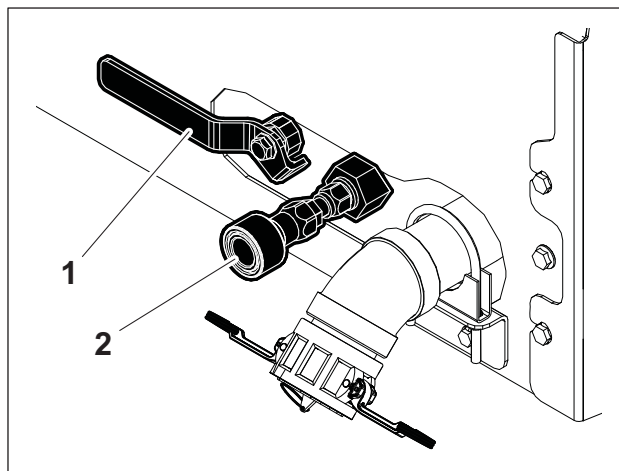
- Wear protective eyewear and clothing.
- Never use high flow when using washwand.
- Never point or aim the wand at yourself or anyone else. Keep nozzle low to the ground.
- Prime the drilling fluid pump before operating washwand. Failure to prime the drilling fluid pump will cause flow fluctuations, which will make it difficult to control the washwand. For instructions, see "Connect Fluid System" on page 103.

**NOTICE:** Do not spray water onto operator's console. Do not spray water onto electrical center in engine compartment. Electrical components could be damaged. Wipe down instead.

1. Turn fluid flow control (page 38) to low setting.
2. Connect the washwand at quick connect (2) at rear of unit. Close valve (1) to switch flow from spindle to wash wand.
3. Check surroundings before pressing handle to start pressurized fluid flow.
4. Spray water onto equipment to remove dirt and mud. Some pressure might be needed to remove dried mud from wrench area.

**IMPORTANT:** If front wrench is closed, fluid will not flow to the wash wand.

5. Release handle to stop flow.



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## **Disconnect**

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

- electric strike system voltage stake
- fluid hose

## **Stow Tools**

Make sure all quick wrenches, bits, pullback devices, and other tools are loaded and properly secured on trailer or truck.





# Service

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### 50 Hour . . . . . 210

### 100 Hour. . . . . 216

### 200 Hour. . . . . 216

### 250 Hour . . . . . 216

### 500 Hour . . . . . 218

### 1000 Hour . . . . . 220

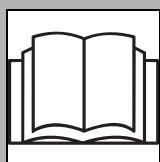
### 2000 Hour . . . . . 225

### 4500 Hour. . . . . 227

### As Needed . . . . . 227



## Service Precautions



Read operator's manual. Know how to use all controls.  
Your safety is at stake. 273-475

### To help avoid injury:

- Unless otherwise instructed, all service should be performed with engine off.
- Refer to engine manufacturer's manual for engine maintenance instructions.

## Welding Precaution

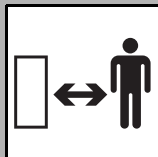
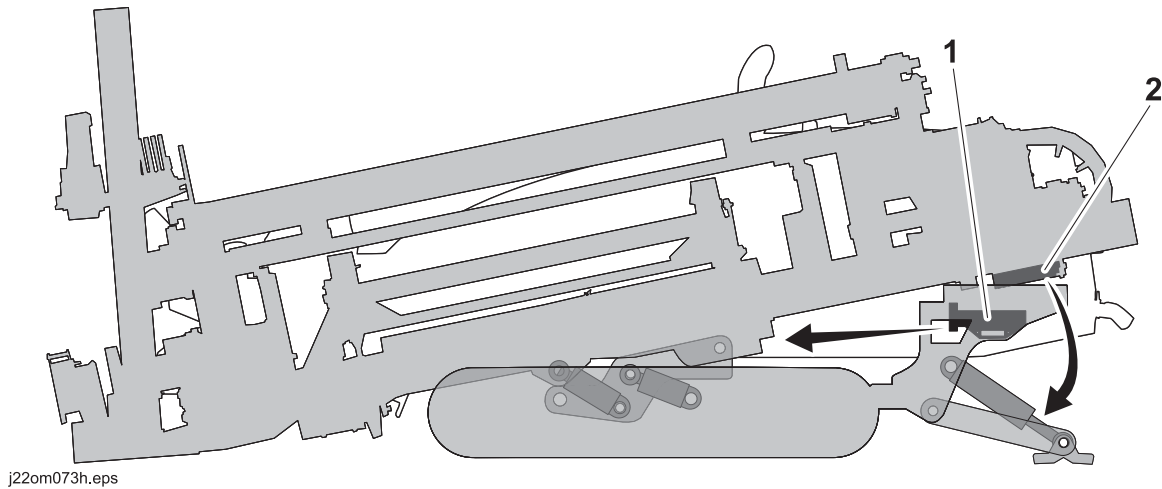
**NOTICE:** Welding can damage electronics.

- Welding currents can damage electronic components. Always disconnect the ECU ground connection from the frame, harness connections to the ECU, and other electronic components prior to welding on machine or attachments. Connect welder ground close to welding point and make sure no electronic components are in the ground path.
- Disconnect battery at battery disconnect switch before welding to prevent damage to battery. See "Check Battery" on page 236.
- Do not turn off battery disconnect switch with engine running, or alternator and other electronic devices may be damaged.

## Washing Precaution

**NOTICE:** Water can damage electronics. When cleaning equipment, do not spray electrical components with water.

## Working Under Drilling Unit



**WARNING**  
Crushing weight could cause death or serious injury. Stay  
away. 275-326

Before working under area of drilling unit supported by a stabilizer, make sure drilling unit is parked on hard surface.

1. Remove cylinder locks from storage at rear of pipe box (2) and place over extended cylinder rods (shown) with curved ends toward stabilizer shoes.
2. Lower unit until load is supported by cylinder locks.

Before working under area of drilling unit supported by **frame tilt cylinder**, make sure drilling unit is parked on hard surface.

1. Remove drill frame support stored under rear step (1) and place under drill frame (shown).
2. Lower drill frame until load is supported by drill frame support.

Replace cylinder locks or drill frame support if damaged.



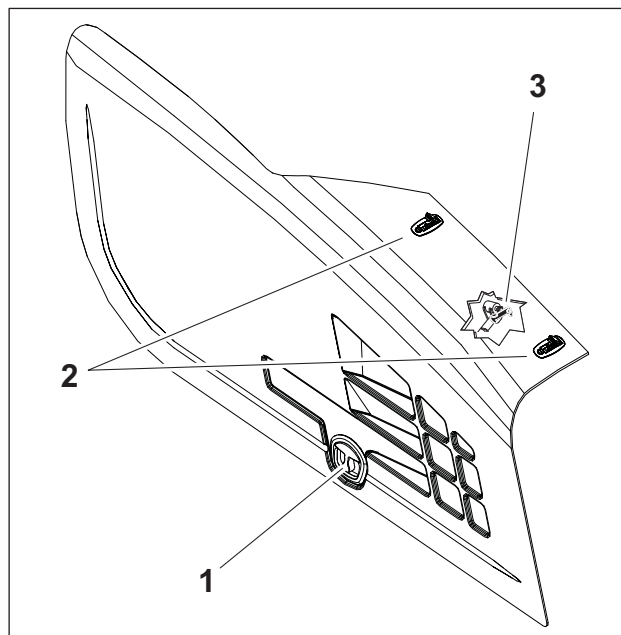
## Opening/Closing Front Hood

### To open:

1. Unlock hood at lower handle (1) and upper latches (2), if hood is locked.
2. Twist lower handle (1) and lift hood upward and outward.
3. Continue lifting hood and push inward until up-latch (3) engages.















### To close:

1. Disengage the up-latch (3) by holding it up as the hood is pulled outward using the lower handle (1).
2. Pull outward on the hood until it begins to move downward.
3. Place other hand on top outer surface of hood and firmly push downward and inward until hood is completely closed, latch upper latches.
4. Lock hood at lower handle and upper latches, if desired.



j50om015w.eps

## Recommended Lubricants/Service Key

Item	Description		
 DEO	Diesel engine oil meeting or exceeding Cummins® 20081, API CJ-4, ACEA E9 <ul style="list-style-type: none"> <li>Engine must use low SAPS oil (ash will plug aftertreatment device.)</li> <li>Use viscosity grade SAE 15W40 unless ambient temperatures below 5° F (-15° C) are expected. Lower viscosity oils must meet the performance specifications shown above.</li> </ul> API American Petroleum Institute, ACEA European Automobile Manufacturer's Association.		
 DEF	Diesel exhaust fluid (DEF) meeting ISO 22241-1 or DIN 70070		
 DEAC	Diesel engine antifreeze/coolant meeting ASTM D6210 (fully formulated)		
 NDO	SAE 30 Non-detergent oil		
 MPG	Multipurpose grease. Use polyurea based NLGI GC-LB Grade 1.5 or lithium based NLGI GC-LB Grade 2		
 WRG	Multipurpose extreme pressure water resistant grease. Use polyurea based NLGI GC-LB Grade 2		
 EPS	Open gear extreme pressure lubricant, spray (p/n 256-034)		
 MPL	Multipurpose gear oil meeting API service classification GL-5 (SAE 80W90)		
 THF	Tractor hydraulic fluid, similar to Phillips 66® HG, Mobilfluid® 424, Chevron® Tractor Hydraulic Fluid, Texaco® TDH Oil, or equivalent		
 TJC	Tool joint compound: Ditch Witch® standard (p/n 259-858) or environmental (p/n 256-1005)		
	Check level of fluid or lubricant		Check condition
	Filter		Change, replace, adjust, service or test

Proper lubrication and maintenance protects Ditch Witch® equipment from damage and failure. Service 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 "Specifications" on page 239.

For more information on engine lubrication and maintenance, see your engine manual.

**IMPORTANT:** Use the "Service Record" on page 249 to record all required service to your machine.



## Approved Coolant

This unit was filled with John Deere® Cool-Gard® II coolant before shipment from factory. Add only John Deere Cool-Gard II (p/n 255-006) or any fully-formulated, ethylene glycol based, low-silicate, heavy-duty diesel engine coolant meeting ASTM specification D6210.

### **NOTICE:**

- Do not use water or high-silicate automotive-type coolant. This will lead to engine damage or premature engine failure.
- Use only distilled water for mixing coolants. Do not use tap water.

## Approved Fuel



### **WARNING**

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

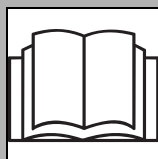
## Tier 4 Engine (U.S., Canada, EU, and Japan)

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 32° F (0° C) winter fuel blends are acceptable. See the engine operation manual for more information.

**NOTICE:** Use only Ultra Low Sulfur Diesel (less than 15ppm sulfur content in the U.S. and Canada, or 10 mg/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 used 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.

## Diesel Exhaust Fluid (DEF)



**⚠ WARNING**

Incorrect procedures could result in death, injury, or property damage. Learn to use equipment correctly.

**To help avoid injury:**

- Diesel exhaust fluid is corrosive. Avoid spills. If spill occurs wipe clean immediately.
- Avoid contact with skin. If contact occurs, rinse with water immediately.
- Avoid contact with eyes. If contact occurs, seek medical help immediately.
- Avoid ingestion. If ingested, seek medical help immediately.



This engine requires diesel exhaust fluid (DEF) to meet emission regulations. Use only high quality DEF meeting ISO 22241-1 or DIN 70070 requirements. Running this engine without DEF will increase exhaust emissions and cause engine to derate. Do not dilute or contaminate DEF or substitute other fluids. Tampering with the DEF system will increase exhaust emissions and cause the engine to derate.

DEF has other common names such as Urea, AUS 32, AdBlue, NOx Reduction Agent, and Catalyst Solution.

DEF freezes at 11.3°F (-11.5°C) but the system is designed to prevent freezing during normal operation. If DEF freezes in the tank when the engine is shut down, the system will quickly thaw DEF when engine is started.

DEF has a limited shelf life. In ideal conditions, minimum expected shelf life is 18 months. At temperatures higher than 90°F (32°C), DEF will degrade more rapidly. Do not store in direct sunlight.

Storage and transfer equipment must be compatible with DEF. Most materials (especially hoses) are not compatible and will degrade and contaminate DEF. Never use contaminated DEF. Containers made of polyethylene or polypropylene are recommended.

This machine will consume DEF at a rate between 2 and 3% of diesel consumption. Many factors affect consumption rate, but a good rule of thumb is to fill the DEF tank every other time the diesel tank is filled.

## Exhaust Cleaning

This engine has a Selective Catalytic Reduction (SCR) system that uses a small amount of DEF to convert NOx emissions in the exhaust into nitrogen and water. The SCR system cleans itself automatically, unless it is manually inhibited by the operator.

Automatic exhaust cleaning happens during normal machine operation when sensors in the engine determine the need. During an engine exhaust cleaning cycle, engine exhaust can reach high temperatures. When this happens, the high exhaust temperature icon will light.



If the jobsite is in an area where high exhaust temperature might cause a problem, inhibit exhaust cleaning through the Tier 4 menu (see "System settings key" on page 50) for the duration of the job and return to automatic cleaning when the job is finished. The exhaust cleaning inhibited icon will light and remain on until the system is returned to automatic exhaust cleaning mode.



The exhaust cleaning icon will light when the system is inhibited and an exhaust cleaning cycle is needed.



- The icon will light when an automatic cleaning is needed. If the area will allow it, return the unit to automatic cleaning mode in the Tier 4 menu and let it run automatically.
- The icon will flash when a manual cleaning is needed. Set the engine to low throttle with no load and initiate the manual exhaust cleaning cycle through the Tier 4 menu. The light will continue to flash until the manual exhaust cleaning cycle is finished (approximately 30 minutes).
- A manual exhaust cleaning cycle is required after automatic exhaust cleaning has been inhibited multiple times. If manual cleaning is not done when indicated, the engine will derate.

## Each Use

Location	Task	Notes
<b>DOWNHOLE TOOL</b>	AT Rockmaster tool	AT only; pump seal grease (p/n 255-1019)

## Downhole Tool

### Lube Rockmaster™ Tool

Lube Rockmaster tool before first use, every 8 hours, and after every bore.

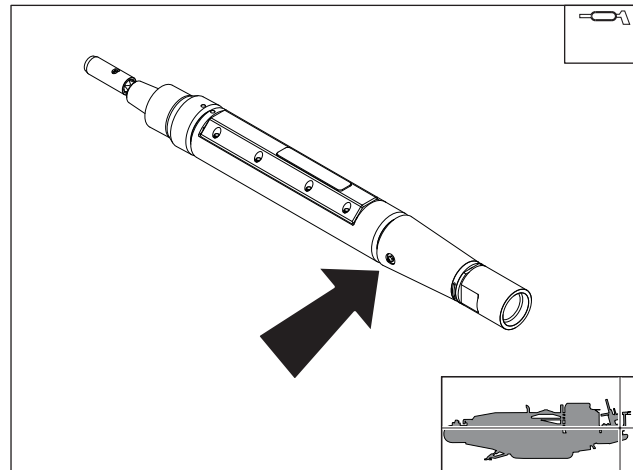
1. Remove plug (shown) from tool body and install zerk.

**IMPORTANT:** For Rockmaster tool 400-1200 only remove one plug.

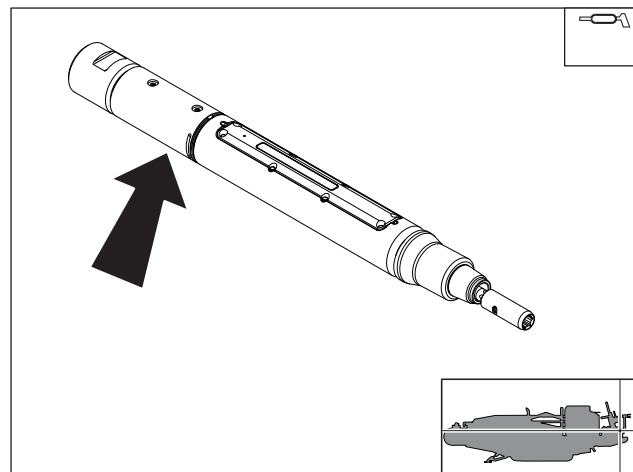
2. Inject downhole tool grease (p/n 255-1019) into zerk while rotating the bit.

**IMPORTANT:** Do not use calcium-based grease. Use only Ditch Witch® recommended grease or equivalent.

3. Continue pumping until grease seeps into the gap between the tool body and the bit.
4. Remove zerk and reinstall plug.



j50om055w.eps



j50om056w.eps



## Startup/10 Hour

Location	Task	Notes
<b>DRILLING UNIT</b>	Check track tension and condition	
	Check fuel filter water separator	
	Check engine oil level	DEO
	Check fluid pump piston seals	
	Check engine coolant level	DEAC
	Check hydraulic hoses	
	Check hydraulic fluid level	THF
	Check fluid pump oil level	NDO
	Test control switches	
	Check pipe auto lubricator spray nozzle	
	Check pipe auto lubricator level	TJC
	Clean drilling fluid y-strainer	
	Inspect crankcase breather tube	
	Empty dust ejector valve	
	Check inner rotation dither	

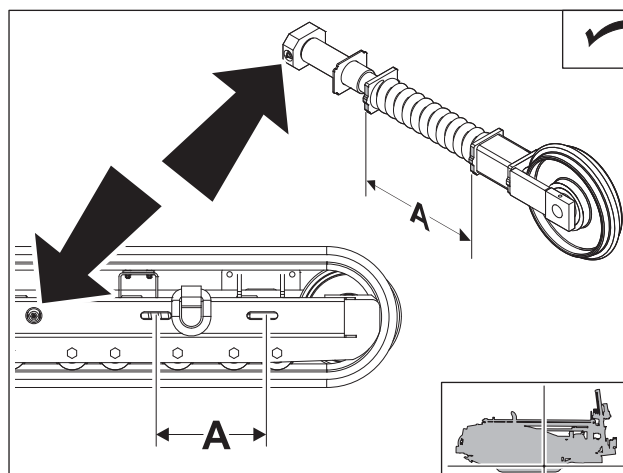
## Drilling Unit

### Check Track Tension and Condition

Check track tension and condition before startup and every 10 hours of operation and adjust or replace as needed.

#### To Adjust:

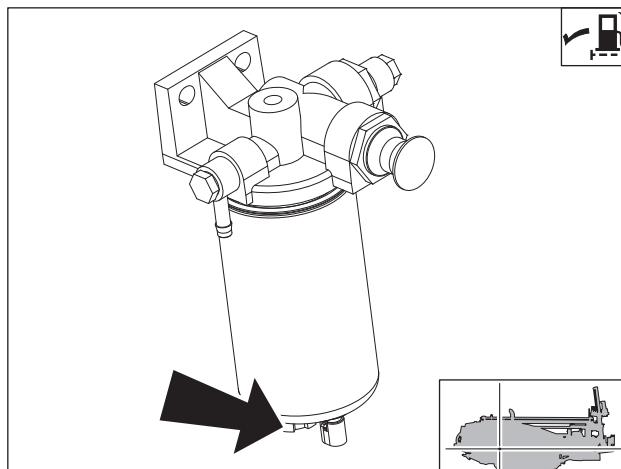
1. Pump MPG into fitting (shown) until the length of the compressed spring, dimension (A), is 12.75" (323.85 mm).
2. Drive straight forward one machine length and check tension again.



j22om050h.eps

## Check Fuel Filter Water Separator

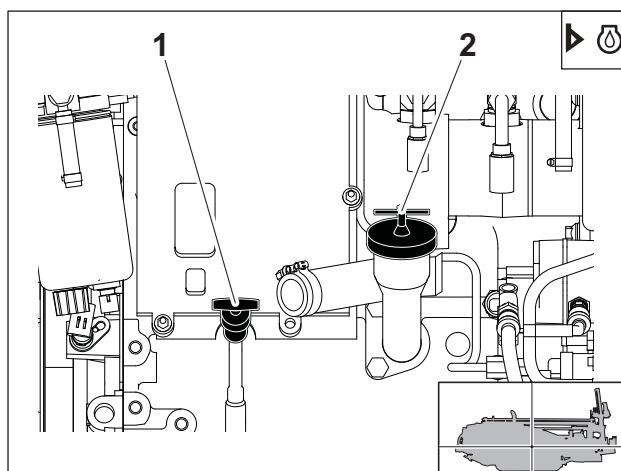
Check fuel filter water separators before startup and every 10 hours of operation. Drain water at plug (shown) as needed.



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## Check Engine Oil Level

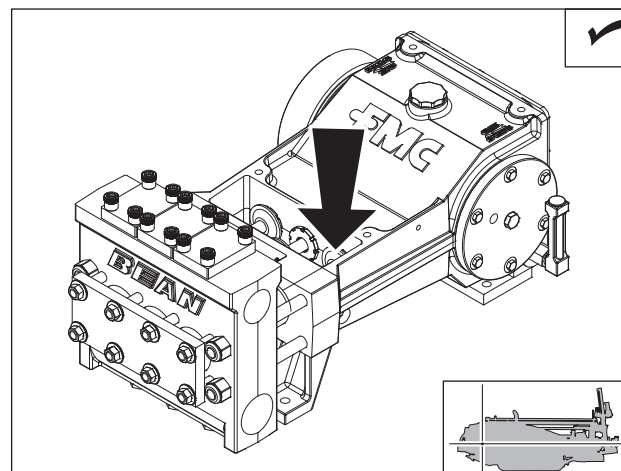
Check engine oil at dipstick (1) before startup and every 10 hours of operation. Check with unit on level surface. Add DEO at fill (2) as necessary to keep oil level at highest line on dipstick.



j34om007w.eps

## Check Fluid Pump Piston Seals

Check piston seals for signs of excessive leakage before startup and every 10 hours of operation. Replace if leakage becomes excessive.



j22om087h.eps

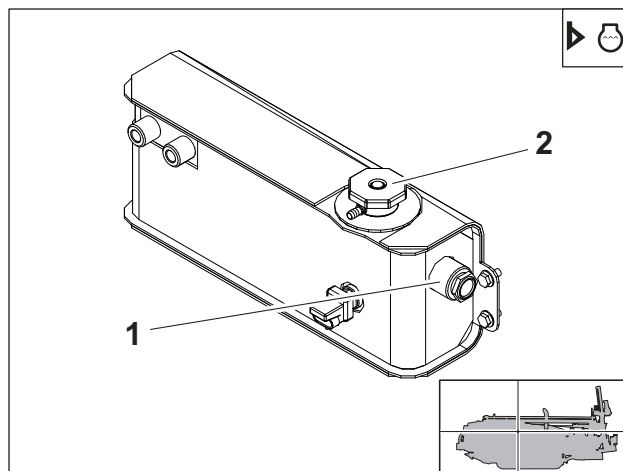




## Check Engine Coolant Level

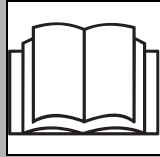
Check coolant level, with engine cool, at sight glass (1) of expansion tank before startup and every 10 hours of operation. Maintain coolant level at halfway point on sight glass. If low, add approved coolant to fill (2).

**IMPORTANT:** See "Approved Coolant" on page 198 for information on approved coolants.



j50om016w.eps

## Check Hydraulic Hoses



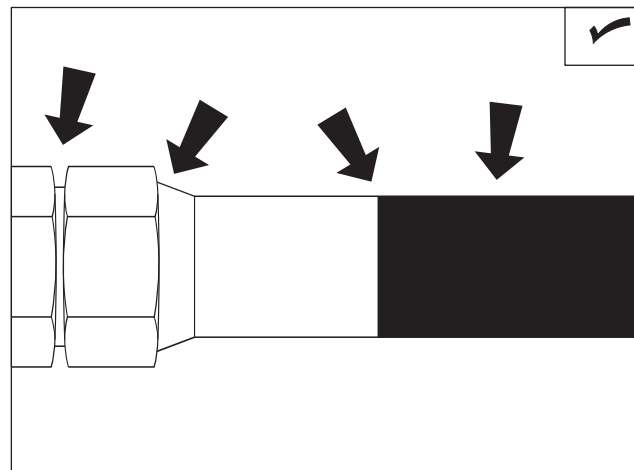
**⚠ WARNING** Pressurized fluid or air could pierce skin and cause severe injury. Refer to operator's manual for proper use. 270-6035

### To help avoid injury:

- Use a piece of cardboard or wood, rather than hands, to search for leaks.
- Wear protective clothing, including gloves and eye protection.
- Before disconnecting a hydraulic line, turn engine off and operate all controls to relieve pressure.
- Lower, block, or support any raised component with a hoist.
- Cover connection with heavy cloth and loosen connector nut slightly to relieve residual pressure. Catch all fluid in a container.
- Before using 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.



Check hydraulic hoses for leaks before startup and every 10 hours of operation.

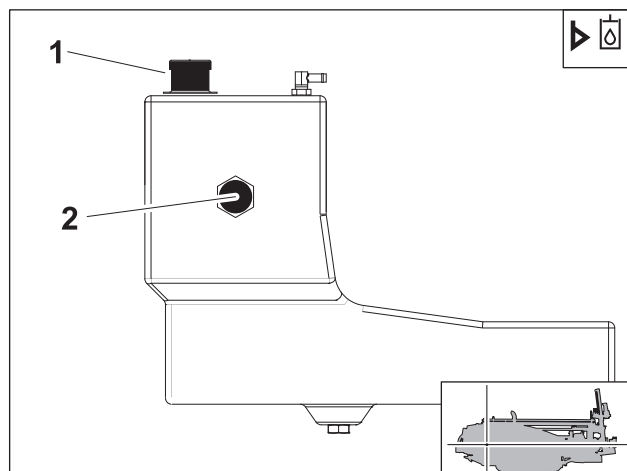


CheckHoses.eps

## Check Hydraulic Fluid Level

Check hydraulic fluid level before startup and every 10 hours of operation. Maintain fluid level at halfway point on sight glass (2), when engine is off and fluid is cool. Add THF at hydraulic fluid fill (1).

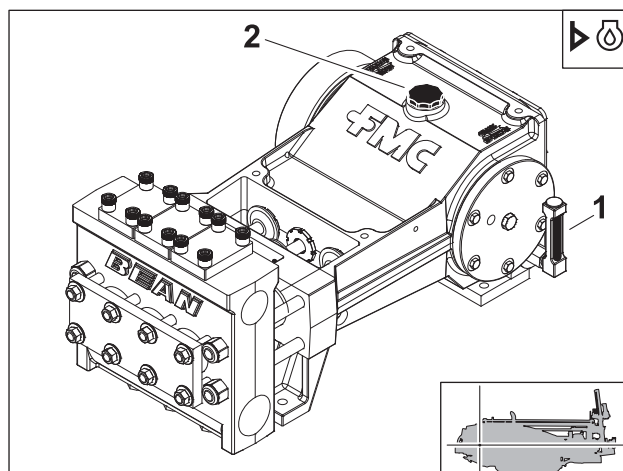
**IMPORTANT:** If hydraulic system must be opened for repair, install new filter (p/n 153-791) for first 50 hours of operation. If this filter becomes plugged in fewer than 20 hours, replace with new filter. After 50 hours of normal operation, replace with new filter (p/n 153-792).



j22om036h.eps

## Check Fluid Pump Oil Level

Check fluid pump oil level at sight glass (1) before startup and every 10 hours of operation. Add NDO at fill (2) as needed.

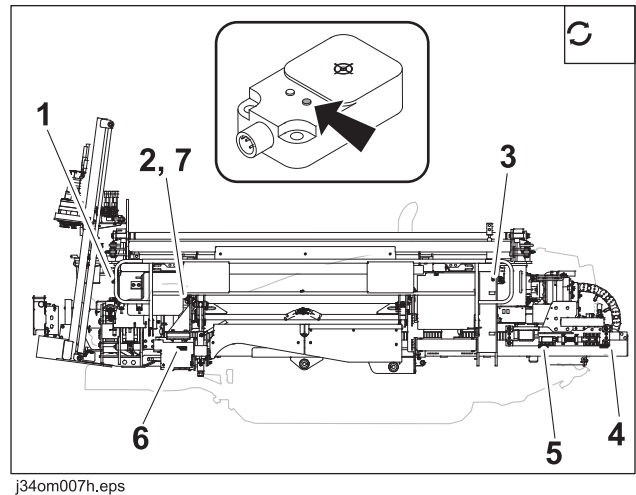


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## Test Control Switches

Check control proximity switches before startup and every 10 hours of operation and clean or replace as needed.

1. front pipe box switch
2. shuttle home switch
3. rear pipe box switch
4. rear stop switch
5. rear home switch
6. front home switch
7. shuttle stop switch



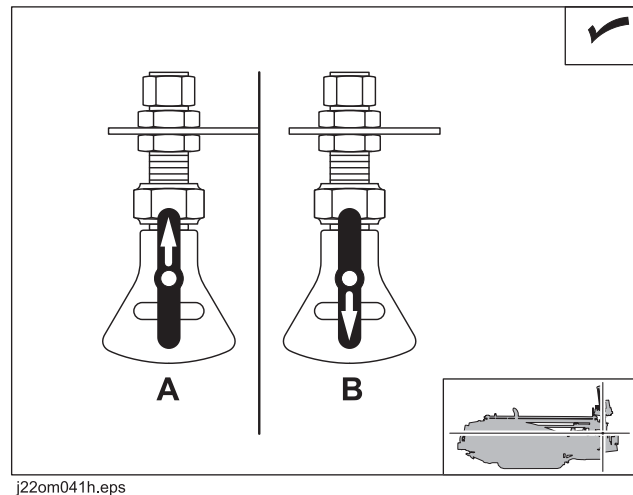
### To test:

1. Turn ignition switch to the on position. Do not start engine.
2. Place metal object above target on each switch.
3. If yellow LED on switch lights, switch sensor is working.

## Check Pipe Auto Lubricator Spray Nozzle

Check pipe auto lubricator spray nozzle before startup and every 10 hours of operation. Ensure that nozzle is free of obstructions and operates properly. Clean as needed.

**NOTICE:** Ditch Witch® tool joint compound is specially formulated to work with Ditch Witch pipe lubrication system. Use of other tool joint compounds will clog system. See “Recommended Lubricants/Service Key” on page 197 for more information.



### To clean:

1. Rotate handle to the upward, or cleanout, position (A).
2. Operate pump until obstruction is flushed.

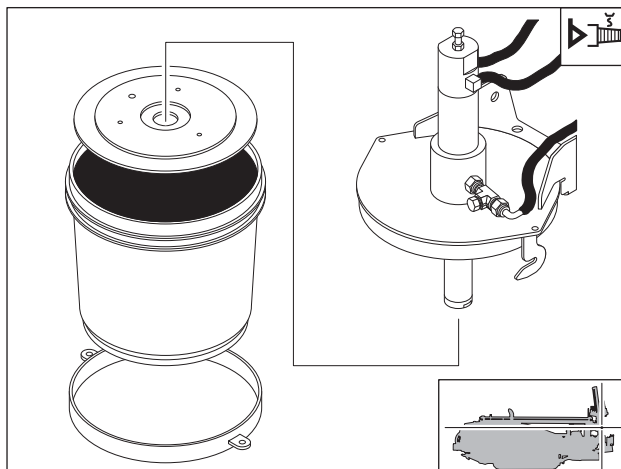
**NOTICE:** If neoprene washer comes out during flushing, entire nozzle must be replaced.

3. Rotate handle to the downward, or spray, position (B).
4. Clean nozzle guard. If necessary, pull handle/nozzle insert out of housing to clean with fine wire or solvent.

## Check Pipe Auto Lubricator Level

Check pipe auto lubricator TJC level before startup and every 10 hours of operation. Change pail as needed. See "Change Auto Lubricator TJC Pail" on page 229 for procedure.

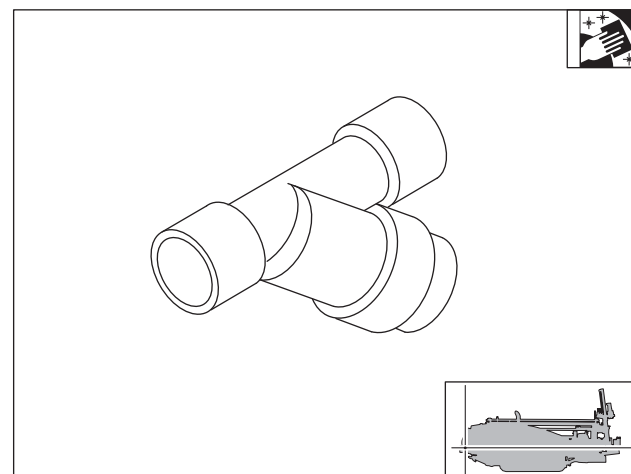
**NOTICE:** Ditch Witch® tool joint compound is specially formulated to work with Ditch Witch pipe lubrication system. Use of other tool joint compounds will clog system. See "Recommended Lubricants/Service Key" on page 197 for more information.



j22om042h.eps

## Clean Drilling Fluid Y-Strainer

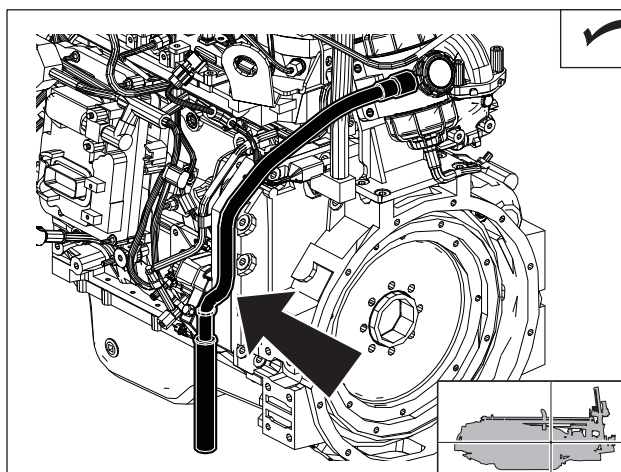
Clean drilling fluid y-strainer before startup and every 10 hours of operation. Ensure that strainer is free of debris.



j22om044h.eps

## Inspect Crankcase Breather Tube

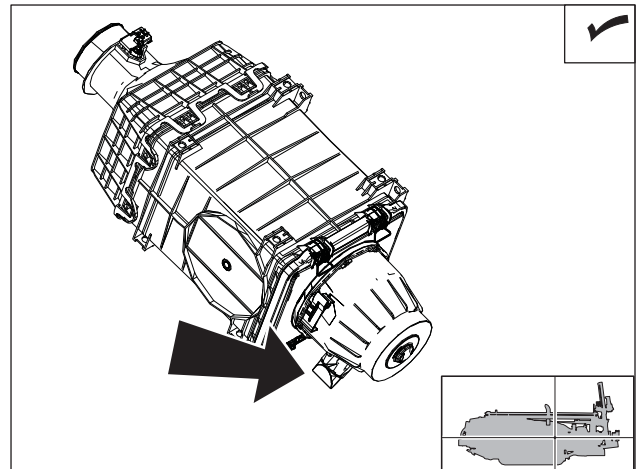
Inspect crankcase breather tube (shown) for debris before startup and every 10 hours of operation.



j50om034w.eps

## Empty Dust Ejector Valve

Check dust ejector valve (shown) before startup and every 10 hours of operation. Ensure that valve is not inverted, damaged, plugged, or cracked.



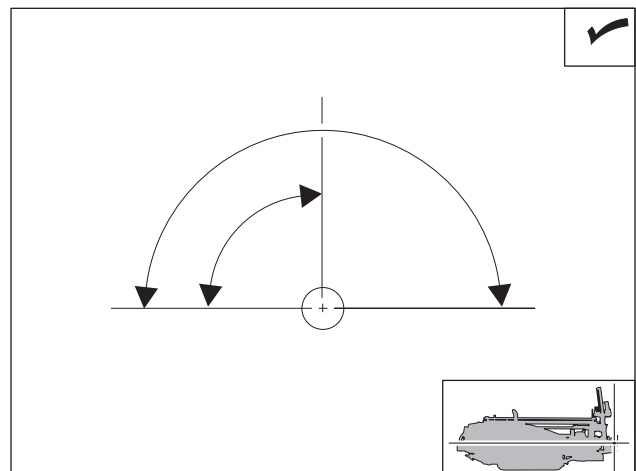
j50om033w.eps

## Check Inner Rotation Dither

Check movement of inner rod before startup and every 10 hours of operation. Inner rod should have between 90 and 180° of movement in each direction. If inner rod does not dither, use manual switch to finish bore and then repair dither (contact your Ditch Witch® dealer).

### To check:

1. Select AT mode.
2. Close front wrench.
3. Put carriage on rear home switch.
4. Put engine at high idle.
5. Move joystick forward or to left slightly.
6. Inner rod should start dithering.



j22om064h.eps



## 50 Hour

Location	Task	Notes
<b>DRILLING UNIT</b>	Change fluid pump oil	Initial service, NDO
	Check radiator	
	Change hydraulic filters	Initial service
	Check ground drive gearbox oil level	2 gearboxes, MPL
	Check rotation gearbox oil level	MPL
	Inspect thrust rollers	
	Drain water from hydraulic tank	
	Check anchor drive gearbox oil level	
	Check thrust drive gearbox oil level	
	Check hex stub	
<b>DOWNHOLE TOOL</b>	Rebuild AT Rockmaster housing	AT only; kit available

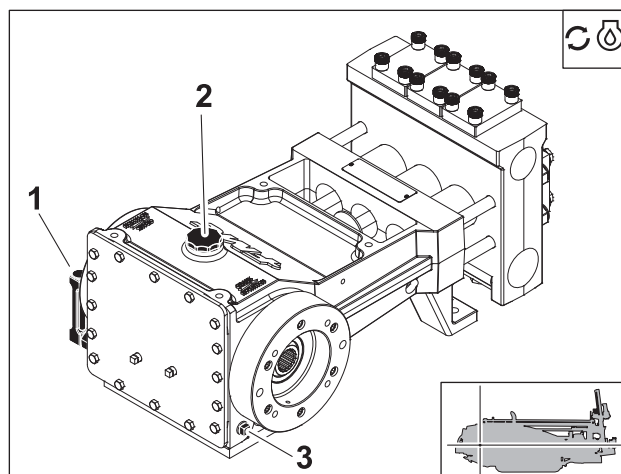
## Drilling Unit

### Change Fluid Pump Oil (Initial Service)

Change fluid pump oil at first 50 hours and every 2000 hours thereafter.

#### To change:

1. Drain at plug (3). Ensure that magnetic drain plug is cleaned of debris before reinstalling.
2. Add 2.8 qt (2.6 L) NDO at fill plug (2). Maintain fluid level at fill plug (2). Inspect oil level at sight glass (1).



j22om038h.jpg

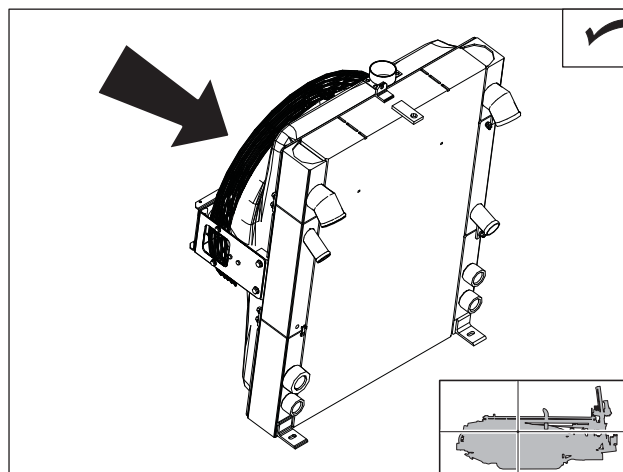
## Check Radiator

Check radiator for dirt, grass, and other debris every 50 hours. Check more often if operating in dusty or grassy conditions. Clean as needed.

### To clean:

- Clean fins with compressed air or spray wash.
- Open rear hood and spray through radiator toward engine.
- If grease and oil are present on radiator, spray with solvent and allow to soak overnight.

**IMPORTANT:** Be careful not to damage fins with high pressure air or water.



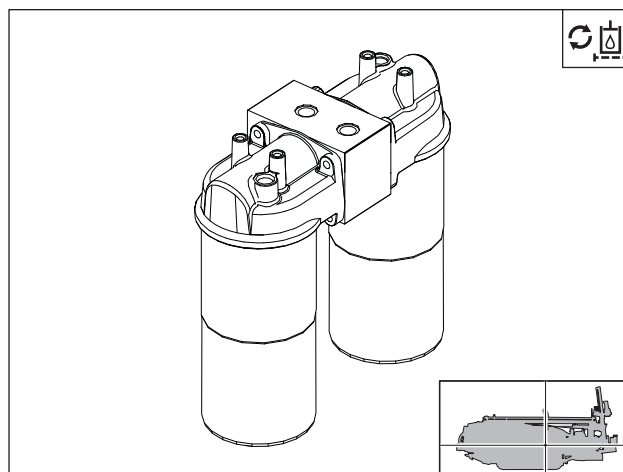
j50om017w.eps



## Change Hydraulic Filters (Initial Service)

Change hydraulic filter after first 50 hours. Replace filter every 500 hours thereafter. Change filter more often if indicated by filter indicator.

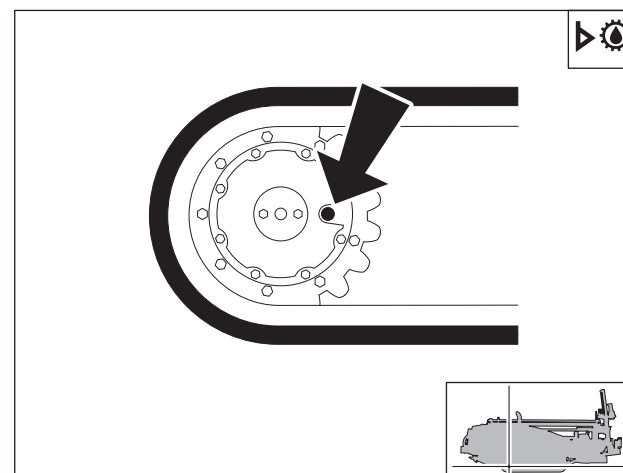
**IMPORTANT:** If hydraulic system must be opened for repair, install new filter (p/n 153-791) for first 50 hours of operation. If this filter becomes plugged in fewer than 20 hours, replace with new filter. After 50 hours of normal operation, replace with new filter (p/n 153-792).



j50om018w.eps

## Check Ground Drive Gearbox Oil Level

Check oil level in both ground drive gearboxes every 50 hours. Rotate plug (shown) until level with center of gearbox. Open plug. If oil does not come out, add MPL as needed. Never fill more than halfway.



j22om065h.eps



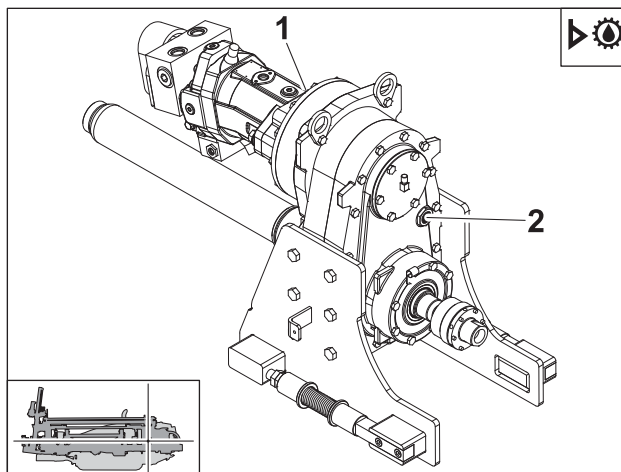
## Check Rotation Gearbox Oil Level

**IMPORTANT:** Drill frame must be level for accurate reading.

Check rotation gearbox oil level every 50 hours.

### Outer Rotation Gearbox:

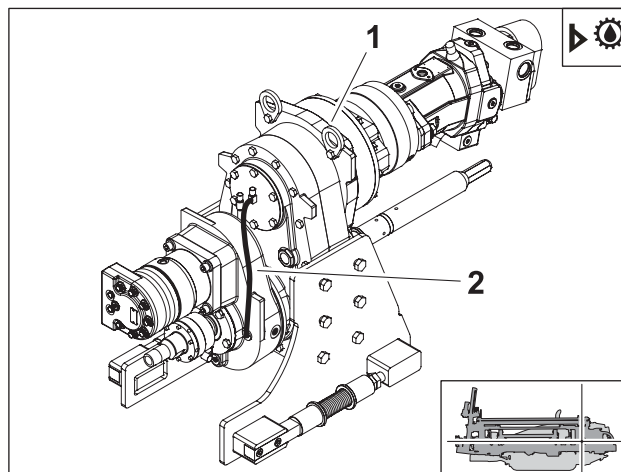
Add MPL through plug (1) to level of sight plug (2) as needed.



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### Inner Rotation Gearbox (AT only):

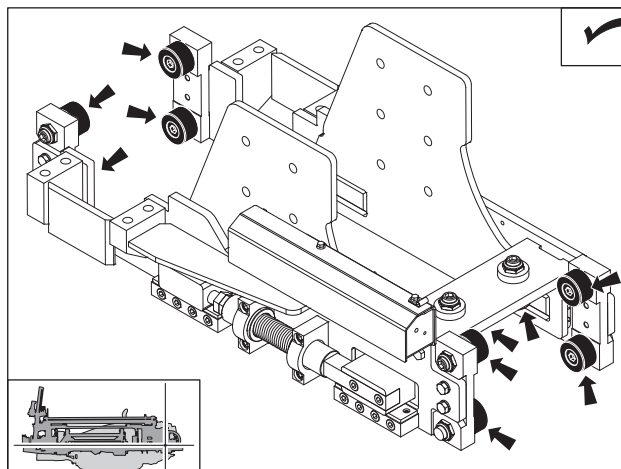
Add MPL through fill plug (1) until oil is at level indicated on sight tube (2).



j50om050w.eps

## Inspect Thrust Rollers

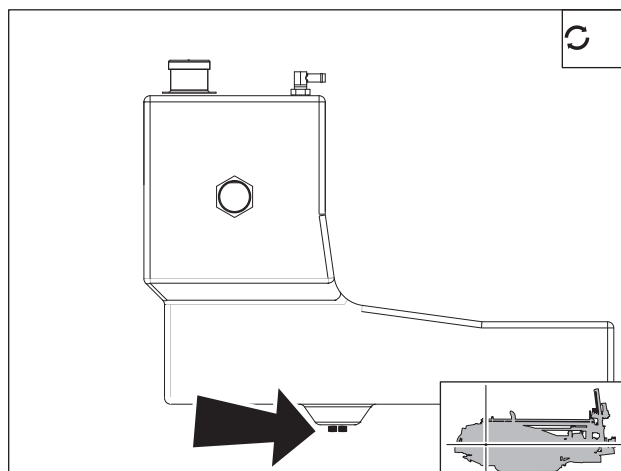
Inspect thrust rollers (at each end of carriage) every 50 hours. Clean or replace if they do not turn freely.



j22om080h.eps

## Drain Water from Hydraulic Tank

Drain water out of tank every 50 hours. To drain, turn plug slightly until water comes out. After all water has drained, tighten plug.

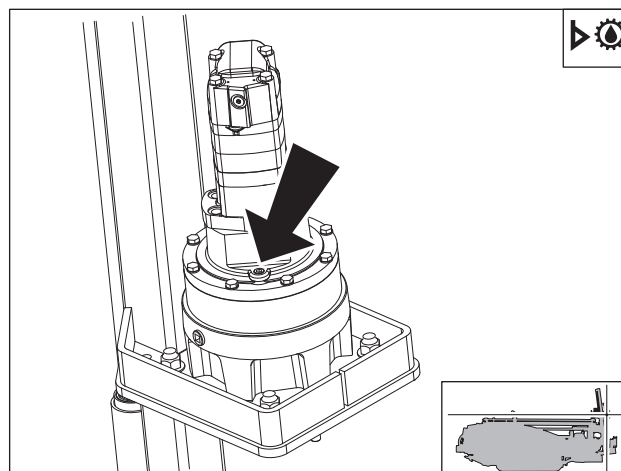


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## Check Anchor Driver Gearbox Oil Level

Check anchor driver gearboxes oil level at fill plug (shown) every 50 hours. Add MPL at fill as needed.

**IMPORTANT:** Gearbox must be level for accurate reading.

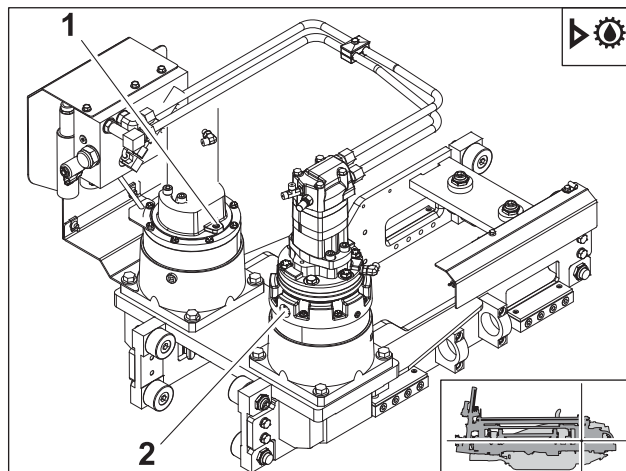


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**Check Thrust Drive Gearbox Oil Level**

Check thrust drive gearbox oil level at fill plug (1,2) every 50 hours. Add MPL at fill (1,2) as needed.



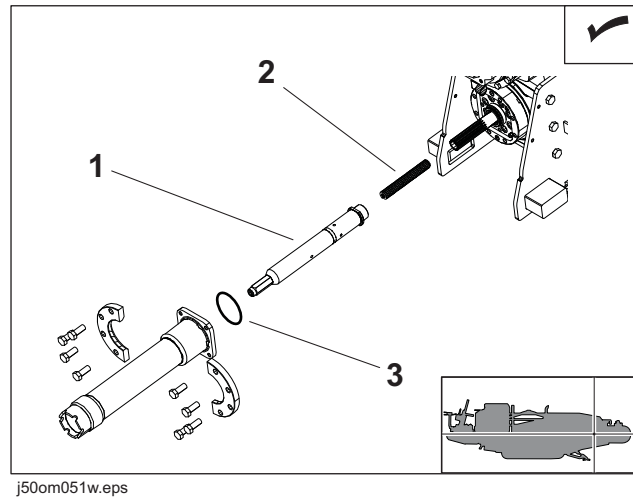
j22om083h.eps

## Check Hex Stub

Shine flashlight into spindle and check condition of hex stub (4) every 50 hours. Replace if rounded.

### To replace:

1. Remove SaverLok® connection. Do not remove indexing dowels from spindle.
2. Slide hex stub (4) and spring (3) off of drive shaft.
3. Check condition of hex stub and replace if needed.
4. Check o-ring (2) on inner water swivel (seal kit) and replace if needed.
5. Install new spring and hex stub.
6. Install saver sub. See "Change Inner Water Swivel (Seal Kit)" on page 231.



## Downhole Tool

### Rebuild Rockmaster Tool

Rebuild downhole tool every 50 hours as measured by inner rotation hourmeter. Use kits indicated by the chart below to rebuild downhole tool. Kits are available at your Ditch Witch® dealer.

Rebuild Kit	Rockmaster Tool
191-208	350-1254
	400-1314
	401-329
	401-159
190-2084	400-1200

## 200 Hour

Location	Task	Notes
<b>DOWNHOLE TOOL</b>	Replace drive shaft on AT Rockmaster housing (excluding 400-1200)	

### Replace Drive Shaft

Replace drive shaft on AT Rockmaster housing (excluding 400-1200) every 200 hours as measured by inner rotation hourmeter when rebuilding AT Rockmaster tool. See your Ditch Witch® dealer for parts.

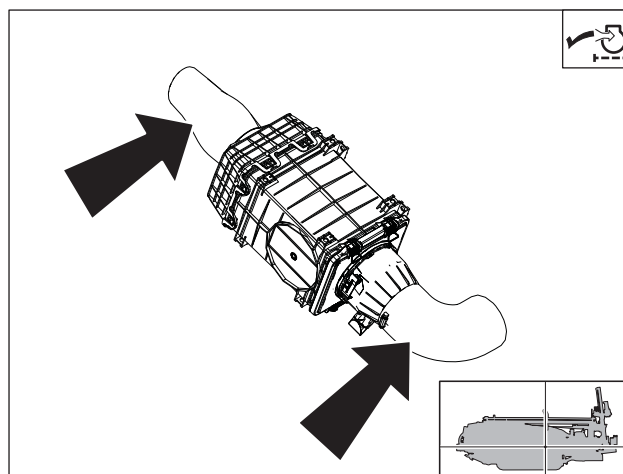
## 250 Hour

Location	Task	Notes
<b>DRILLING UNIT</b>	Inspect air intake system	
	Change rotation gearbox oil	MPL

### Drilling Unit

#### Inspect Air Intake System

Inspect intake piping for cracked hoses, loose clamps, or punctures. Tighten or replace parts as necessary.



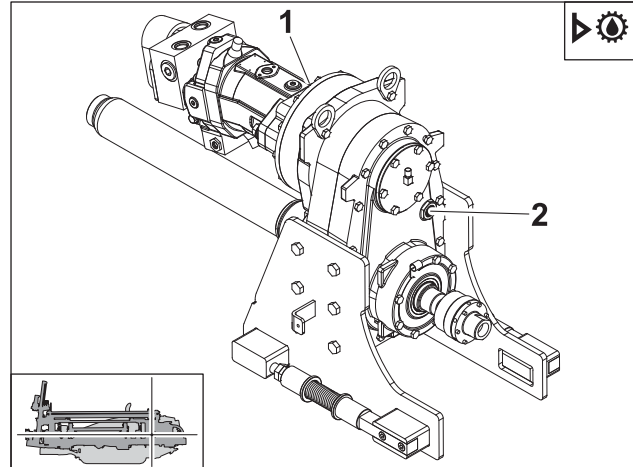
j50om019w.eps

## Change Rotation Gearbox Oil

**IMPORTANT:** Gearbox must be level for accurate reading.

### JT Units:

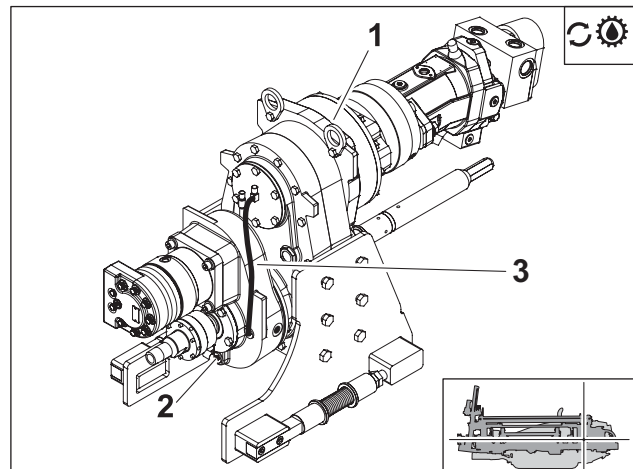
Drain oil at gearbox oil drain (3) every 1000 hours. Replace drain plug. Add MPL at fill (1). Check level at sight glass (2). Replace fill plug.



j22om074h.eps

### AT Units:

Drain oil at gearbox oil drain (2) every 1000 hours. Replace drain plug. Add MPL through fill plug (1) until oil is at level indicated on sight tube (3).



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## 500 Hour

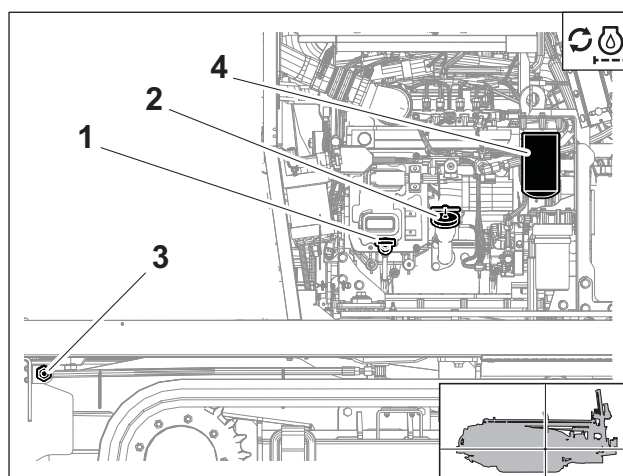
Location	Task	Notes
<b>DRILLING UNIT</b>	Change engine oil and filter	DEO
	Change hydraulic filters	Normal conditions
	Change fuel filters	
	Inspect radiator cap	

### Drilling Unit

#### Change Engine Oil and Filter

**IMPORTANT:** See "Recommended Lubricants/Service Key" on page 197.

Change engine oil and filter every 500 hours. Drain oil (3), change filter (4), and add 11.5 qt (10.9 L) of DEO at fill (1). Run engine and check oil level at dipstick (2). Add oil to bring level to highest line on dipstick.

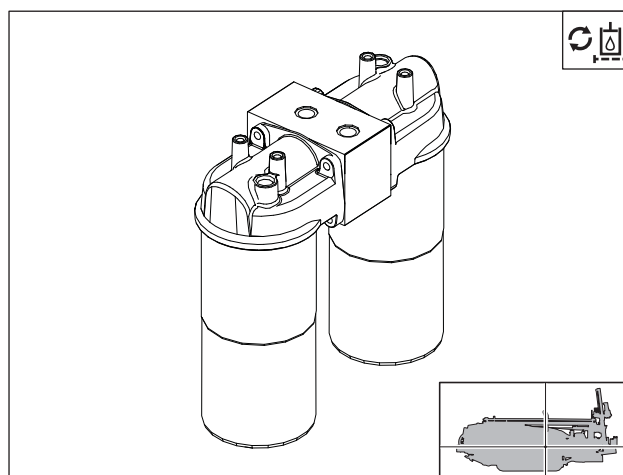


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#### Change Hydraulic Filters (Normal Conditions)

Change hydraulic filter every 500 hours. Change filter more often if indicated by filter indicator.

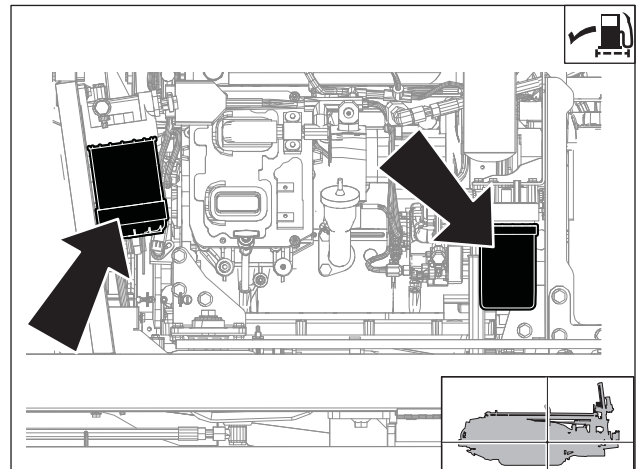
**IMPORTANT:** If hydraulic system must be opened for repair, install new filter (p/n 153-791) for first 50 hours of operation. If this filter becomes plugged in fewer than 20 hours, replace with new filter. After 50 hours of normal operation, replace with new filter (p/n 153-792).



j50om018w.eps

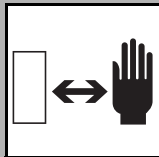
## Change Fuel Filters

Replace fuel filters every 500 hours.



j50om021w.eps

## Inspect Radiator Cap

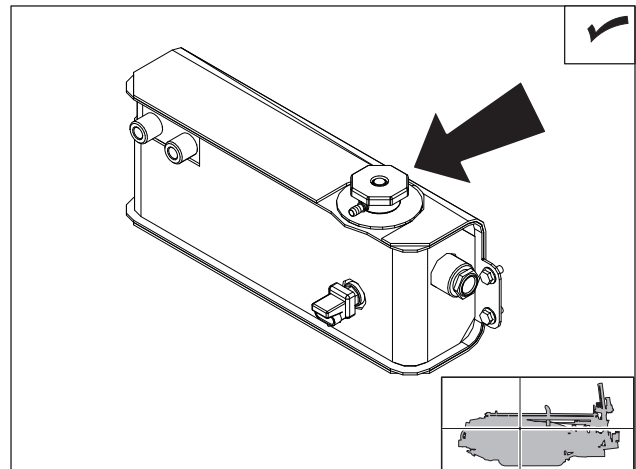


**CAUTION**  
Hot parts may cause burns. Do not touch until cool or wear

gloves. 275-355 (2-P), 273-423 (2-P)

**To help avoid injury:** Wait for machine to cool before inspecting radiator cap.

Inspect radiator cap (shown) every 500 hours. Ensure rubber seal is not damaged.



j50om038w.eps





## 1000 Hour

Location	Task	Notes
<b>DRILLING UNIT</b>	Change hydraulic fluid and filters	THF
	Change ground drive gearbox oil	2 gearboxes, MPL
	Change spindle brake oil	THF
	Change thrust drive gearbox oil	2 gearboxes, MPL
	Change anchor driver gearbox oil	2 gearboxes, MPL
	Change engine drive belt	
	Replace diesel exhaust fluid (DEF) tank filter	

### Drilling Unit

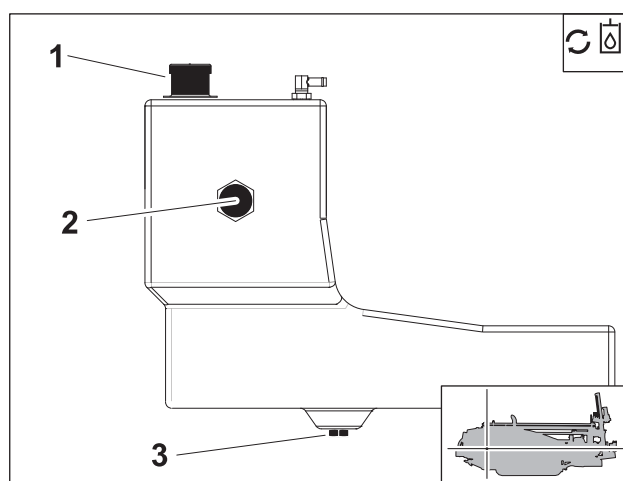
#### Change Hydraulic Fluid and Filters

Change hydraulic fluid and filters every 1000 hours.

##### To change:

1. Drain hydraulic oil at drain (3).
2. Change hydraulic filters. See "Change Hydraulic Filters (Normal Conditions)" on page 218.
3. Add THF at fill (1) until level is at halfway point on sight glass (2).

**IMPORTANT:** Change oil and filter every 500 hours if jobsite temperature exceeds 100°F (38°C) more than 50% of the time.



j22om035h.eps

## Change Ground Drive Gearbox Oil

Change oil in both ground drive gearboxes every 1000 hours.

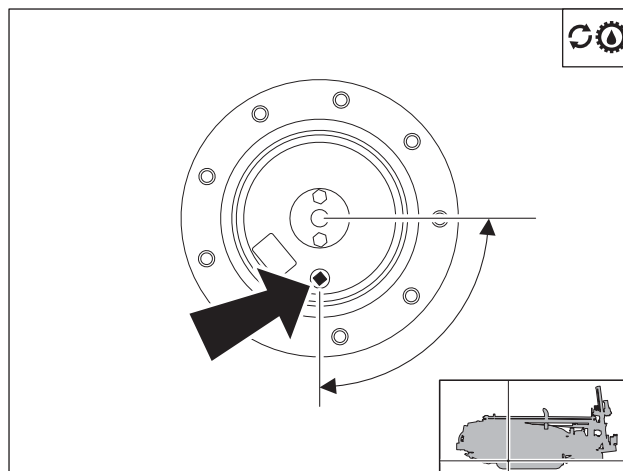
### To change:

1. Drain oil at plug (shown).
2. Rotate gearbox 90° and add MPL at fill plug.

#### IMPORTANT:

- Drill frame must be parked on level surface for accurate reading.
- Use helper to assist in positioning gearbox plugs for checking and adding oil.
- Do not fill more than halfway.

3. Replace fill plug.



j50om027w.eps



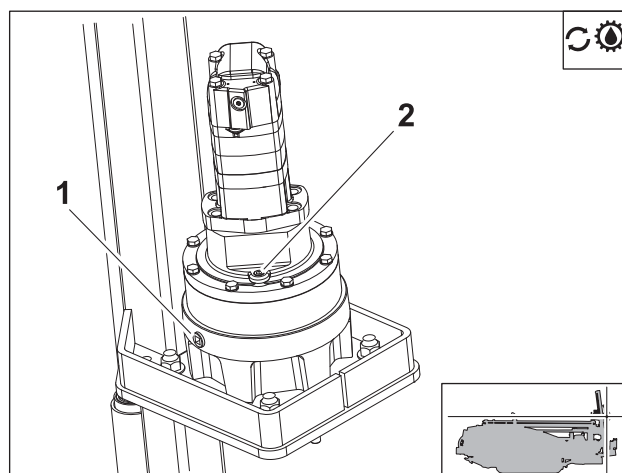
## Change Anchor Gearbox Oil

Change anchor gearbox oil every 1000 hours.  
Capacity is 26 oz (0.77 L) MPL per gearbox.

### To Change:

1. Ensure that gearbox is level.
2. Drain oil at gearbox oil drain (1). Replace drain plug.
3. Fill gearbox with MPL at fill plug (2).

**IMPORTANT:** Gearbox must be level for accurate reading.



j22om086h.eps

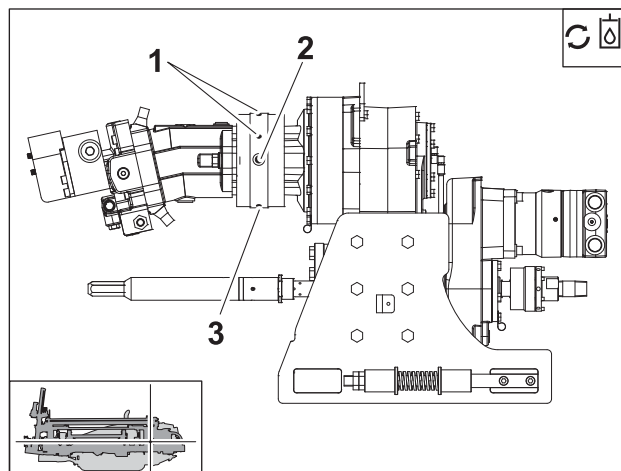
## Change Spindle Brake Oil

**IMPORTANT:** Gearbox must be level for accurate reading.

Change spindle brake oil every 1000 hours.  
Capacity is 5 oz (148 mL) of THF.

### To change:

1. Ensure drill frame is level.
2. Remove bottom plug on brake housing (3).
3. After all oil drains, replace bottom plug and remove either top plug (1) and side fill level plug (2).
4. Add THF at plug (1).
5. Install both plugs (1,2).



j22om071h.eps

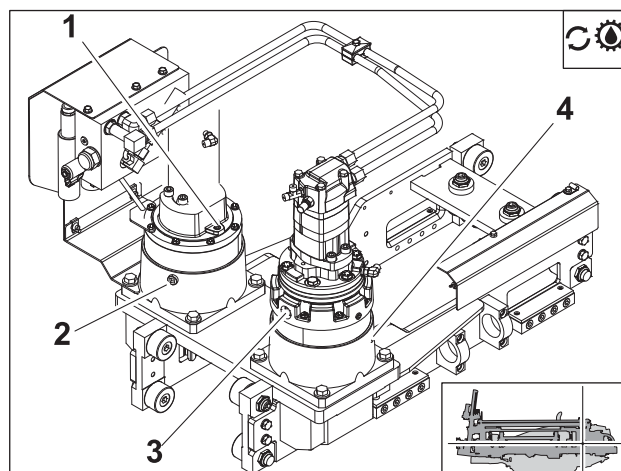
## Change Thrust Drive Gearbox Oil

Change thrust drive gearbox oil every 1000 hours.  
Capacity is 26 oz (0.77 L) MPL per gearbox.

### To change:

1. Ensure that drill frame is level.
2. Drain oil at gearbox oil drain (2, 4).
3. Fill each gearbox with MPL at fill plugs (1, 3).

**IMPORTANT:** Gearbox must be level for accurate reading.



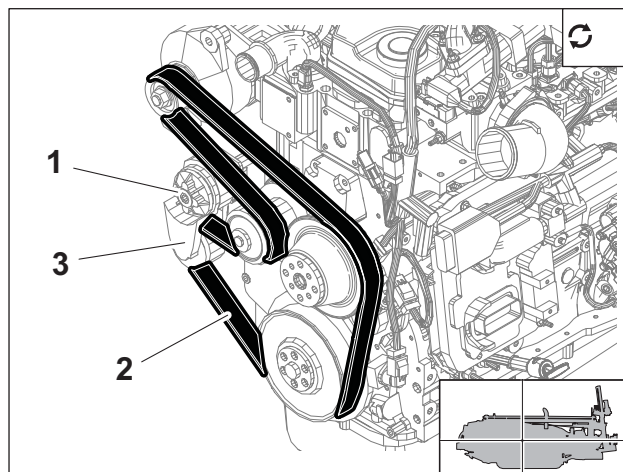
j22om084h.eps

## Change Engine Drive Belt

Change engine drive belt every 1000 hours.

### JT Units:

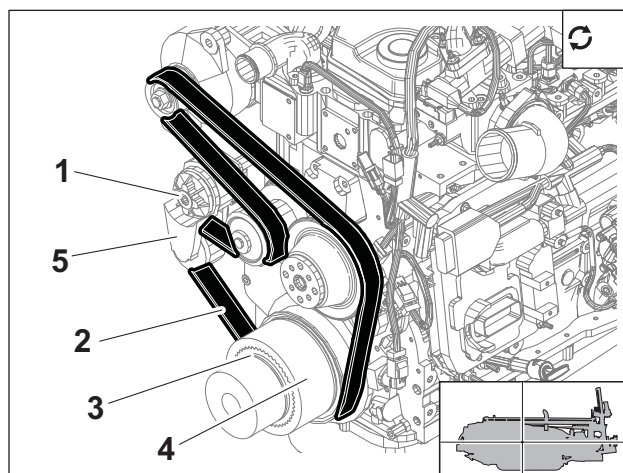
1. Turn off engine and remove key.
2. Use a 1/2" drive ratchet at pulley (1) to remove tension.
3. Remove belt (2).
4. Inspect engine belt tensioner (3) for damage and debris.
5. Install new belt.



j50om023w.eps

### All Terrain Units:

1. Turn off engine and remove key.
2. Remove snap ring (3) from groove and slide pump coupler collar (4) back.
3. Use a 1/2" drive ratchet at pulley (1) to remove tension.
4. Remove belt (2).
5. Inspect engine belt tensioner (5) for damage and debris.
6. Install new belt.
7. Slide pump coupler collar back into position and reinstall snap ring.



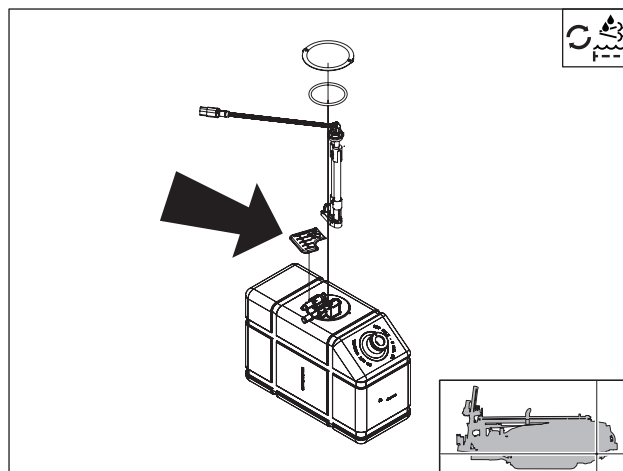
j50om024w.eps



## Change Diesel Exhaust Fluid (DEF) Tank Filter

Change DEF filter (shown) every 1000 hours. Contact your Ditch Witch® dealer for more detailed information.

1. Remove multifunction head unit from DEF tank. Take care not to damage unit during removal.
2. Remove retention screw and discard.
3. Pull filter off suction tube and discard.
4. Position new filter suction tube housing onto the bottom of the suction tube and press flush against bottom of heater tube fin. Ensure filter retention screw aligns with retention screw housing.
5. Install new retention screw.
6. Install multifunction head unit into DEF tank. Take care not to damage unit during installation.



j50om047w.eps

## 2000 Hour

Location	Task	Notes
DRILLING UNIT	Change engine coolant	DEAC
	Change fluid pump oil	NDO
	Replace crankcase breather filter	

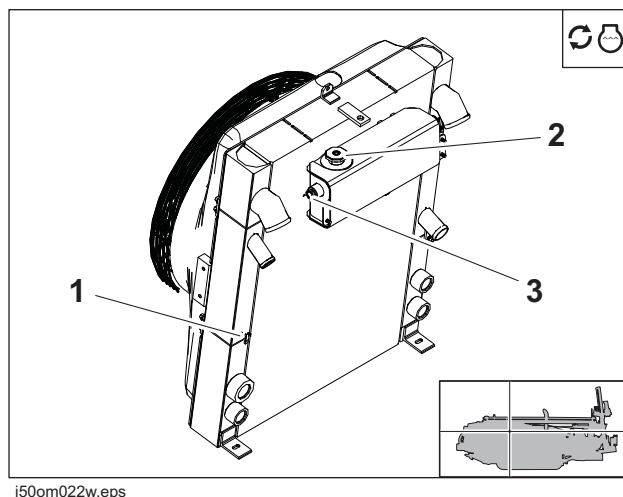
### Drilling Unit

#### Change Engine Coolant

Drain cooling system at drain (1) every two years or 2000 hours. Add approved coolant according to instructions below. Refill capacity is 24 qt (22.7 L).

**NOTICE:**

- The use of non-approved coolant may lead to engine damage or premature engine failure and will void engine warranty.
- See "Approved Coolant" on page 198 for list of requirements.
- Use only distilled water for mixing coolants. Do not use tap water.



j50om022w.eps

**To fill:**

1. Add coolant at radiator fill (2) at a rate of 3 gpm (11.4 L/min) or less until full.
2. Run engine with thermostat open (>195°F/90°C engine temperature) for several minutes.
3. Stop engine and let it cool.
4. Maintain coolant level at halfway point on sight glass (3).

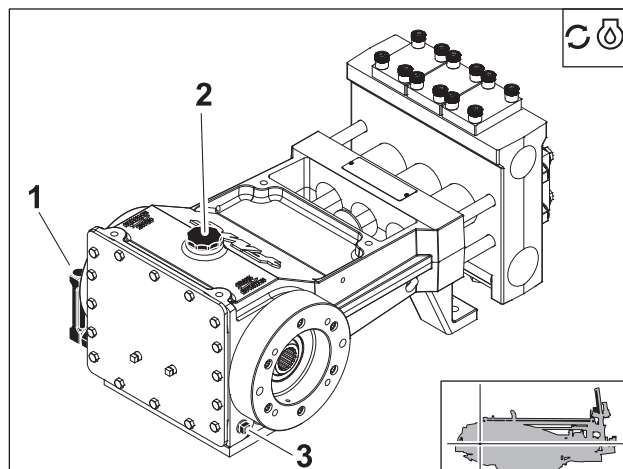


## Change Fluid Pump Oil

Change fluid pump oil every 2000 hours.

### To change:

1. Drain at plug (3). Ensure that magnetic drain plug is cleaned of debris before reinstalling.
2. Add 2.8 qt (2.6 L) NDO at fill plug (2). Maintain fluid level at sight glass (1). Inspect oil level at sight glass (1).



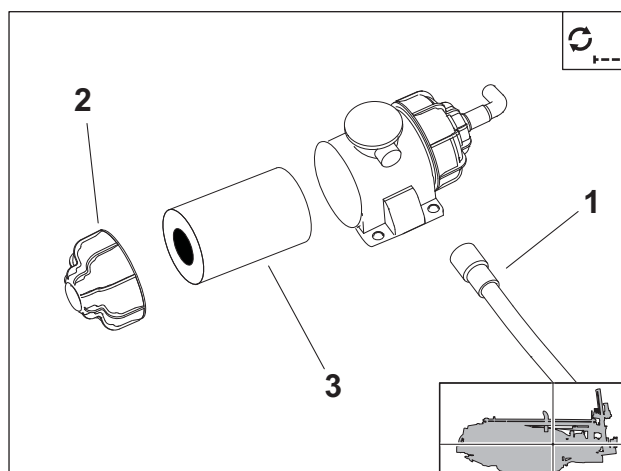
j22om038h.jpg

## Replace Crankcase Breather Filter

Replace crankcase breather filter every 2000 hours.

### To replace:

1. Disconnect crankcase ventilation hose (1).
2. Turn breather housing cover (2) counterclockwise.
3. Remove filter element (3).
4. Install the new filter element either end up in the crankcase ventilation breather housing.
5. Install breather housing cover and turn clockwise.
6. Install crankcase ventilation hose.



j50om035w.eps

## 4500 Hour

### Replace Diesel Exhaust Fluid (DEF) Pump Filter

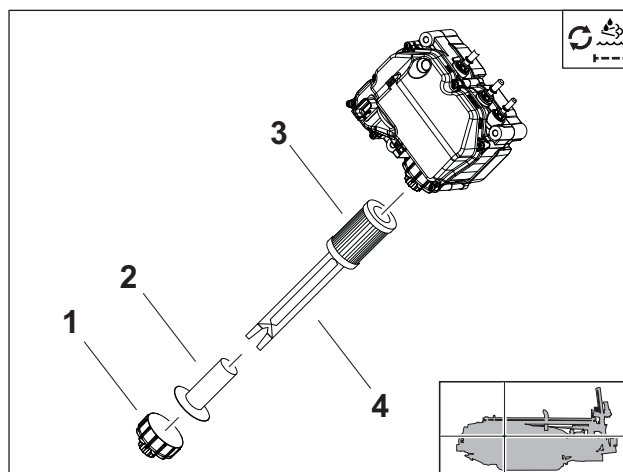
Replace diesel exhaust fluid (DEF) pump filter every 4500 hours or every 3 years.

#### To remove:

1. Unscrew DEF filter cap (1) and inspect threads for damage. Replace if needed.
2. Remove the DEF filter equalizing element (2).
3. Remove DEF dosing unit filter element (3) using disposable service tool (4).

**IMPORTANT:** A disposable service tool is included with the filter to aid in filter removal.

- Use the color of the plastic on the filter to determine which end of the tool to use.
- When inserting the tool, a “click” sound will indicate proper engagement with the filter.

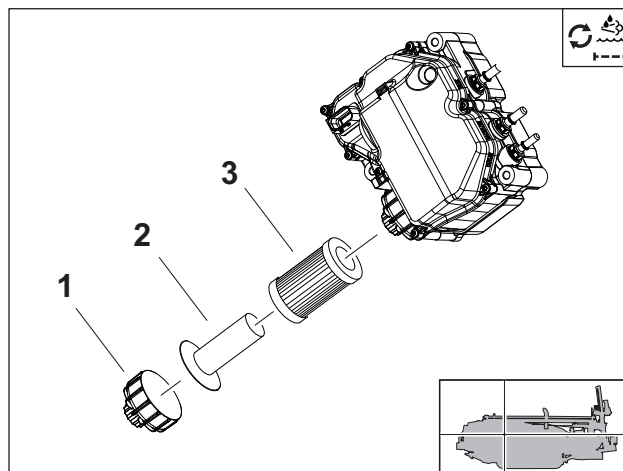


j50om037w.eps



#### To install:

1. Slide DEF filter equalizing element (2) into the DEF filter cartridge (3).
2. Insert filter equalizing element and filter cartridge assembly into the DEF dosing unit.
3. Install cap (1) and tighten to 177 in•lb (20 N•m).



j50om036w.eps



## As Needed

Location	Task	Notes
<b>DRILLING UNIT</b>	Change pipe auto lubricator pail	TJC
	Change hydraulic filter	Anytime system is opened
	Check pipeloader inserts	
	Check pipe guide inserts	
	Check fluid pump ball valve	
	Check track support slide pads	
	Check wrench jaw inserts	
	Change air filter	
	Replace SaverLok <sup>®</sup> body	
	Replace carriage wear bars	
	Check pipeloader chute opening	
	Clean crankcase breather tube	
	Change inner water swivel (seal kit)	
	Change wireless ground drive controller batteries	
	Check batteries	
	Charge batteries	

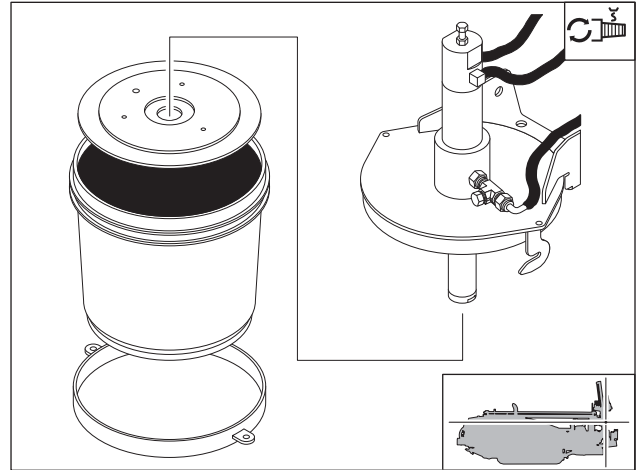
## Drilling Unit

### Change Auto Lubricator TJC Pail

Check pipe auto lubricator TJC level and change pail as needed.

#### To change pail:

1. Remove wingnuts and bolts attaching base ring to pail cover.
2. Rotate base ring slightly to clear hooks on cover and remove pail from cover.
3. Remove follower plate from empty pail and install into new pail. Press firmly on follower plate until TJC comes up in center opening.
4. Remove base ring from empty pail and install onto new pail.
5. Install pail into place over pump dip tube. Use hooks on cover to support base ring.
6. Install bolts and wingnuts.
7. Remove cap from discharge tee on pump. Operate pump until discharged TJC is free of air pockets. Replace cap.



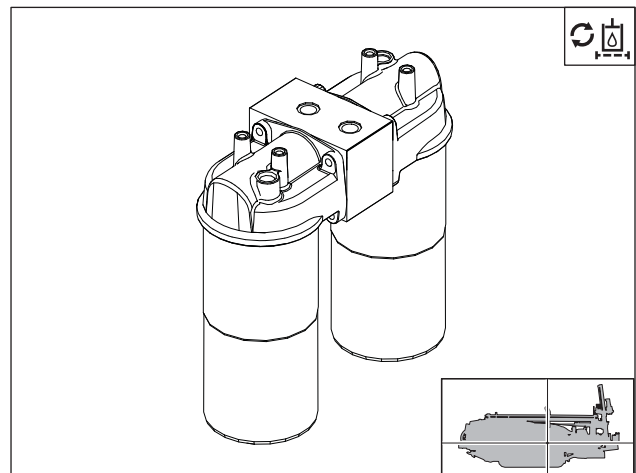
j22om043h.eps



**NOTICE:** Use only genuine Ditch Witch® tool joint compound to maintain warranty. See “Recommended Lubricants/Service Key” on page 197 for more information.

### Change Hydraulic Filter (Anytime System Opened)

Change hydraulic filter anytime system is opened for repair. Change filter and add THF as needed at hydraulic fluid fill.



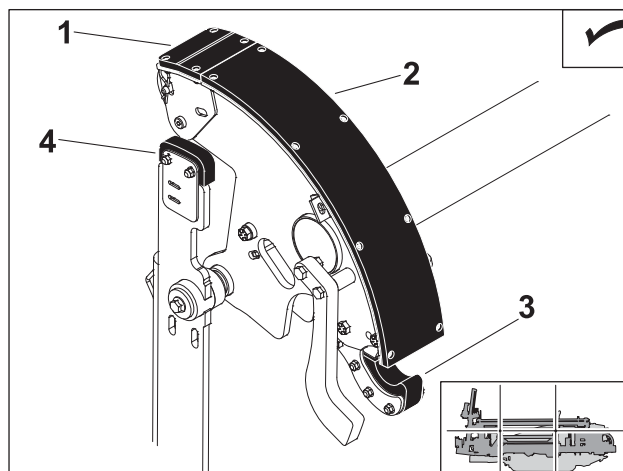
j50om018w.eps

## Check Pipeloader Inserts

Check pipeloader inserts at indicated areas for wear. Flip gripper inserts for longer wear, or replace as needed.

1. Wear pad
2. Shuttle wear pad
3. Shuttle gripper pad
4. Catch arm wear pad

**IMPORTANT:** Ensure bolts are tightened evenly to enable inserts to slide freely and wear evenly.



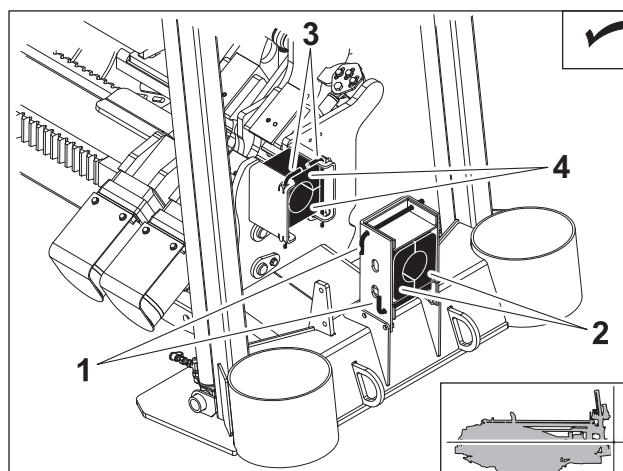
j22om047h.eps

## Check Front Pipe Guide Inserts

Check front pipe guide inserts (2) for wear. Rotate inserts for longer wear, or replace as needed.

### To replace:

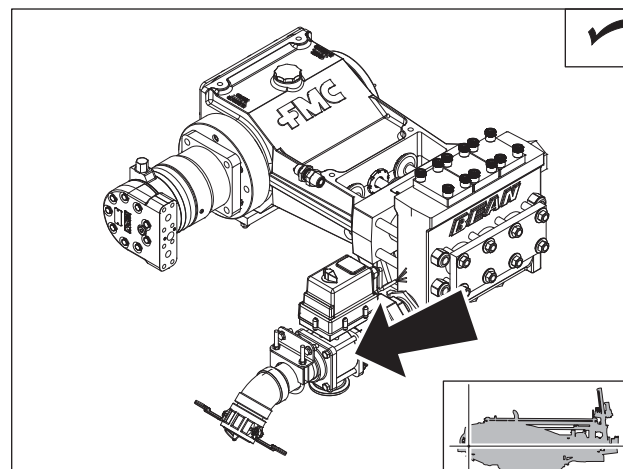
1. Remove lynch pins (1) and open pipe guide.
2. Remove guide inserts (2).
3. Remove lynch pins (3) and open pipe guide.
4. Remove guide inserts (4).
5. Replace in reverse order.



j50om030w.eps

## Check Fluid Pump Ball Valve

Check ball valve for leaks. Tighten stem packing as needed.



j22om049h.eps

## Check Track Support Slide Pads

Check track support slide pads. Replace as needed.

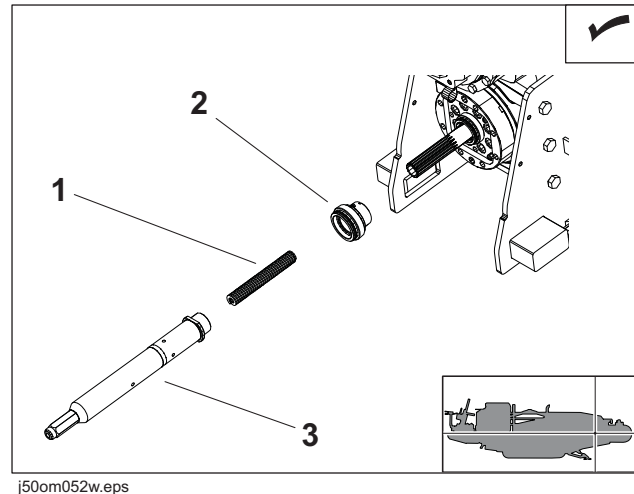
## Change Inner Water Swivel (Seal Kit)

Replace inner water swivel (seal kit) as needed.

### To replace:

1. Remove saver sub. Do not remove indexing dowels from spindle.
2. Remove hex stub (3) and spring (1) from drive shaft.
3. Remove main body (2).

**IMPORTANT:** Use care when handling main body to avoid seal contamination. Do not allow grease to touch inner seals during installation.



j50om052w.eps

4. Slide new main body (2) onto drive shaft.
5. Lightly coat seal with SAE 30 engine oil and install onto main body.

**NOTICE:** Do not run seals without lubrication. Damage will occur.

6. Install hex stub (3) and spring (1).
7. Install saver sub. See page 234.



## Change Air Filter

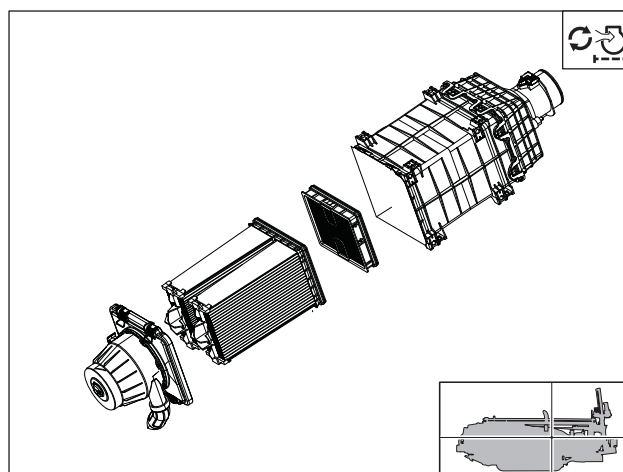
Change air filter when indicated on display.

**NOTICE:** 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 filter elements.
- Tapping filter elements to loosen dirt may damage the elements.

### To change air filter:

1. Disengage clasps and remove cover.
2. Remove primary element and secondary element.
3. Wipe inside of housing and wash cover and dust ejector slit.
4. Install new element(s).
5. Install cover and engage clasps.
6. Reset air filter service indicator.



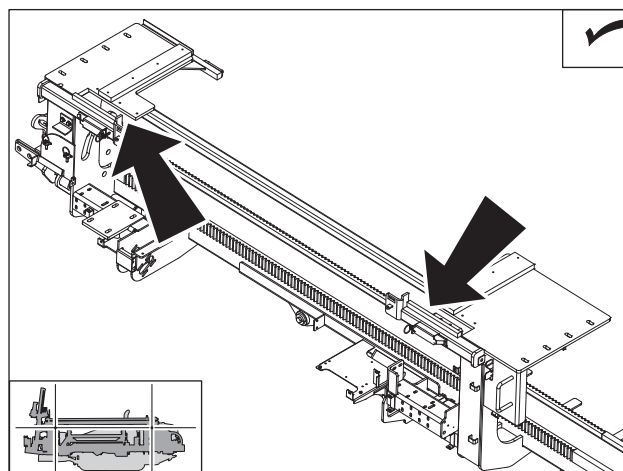
j50om025w.eps

## Check Pipeloader Chute Opening

Check chute openings and adjust per dimension as needed.

1. JT chute opening (shown) = 3.35" (8.5 cm).
2. AT chute opening (shown) = 3.60" (9.1 cm).

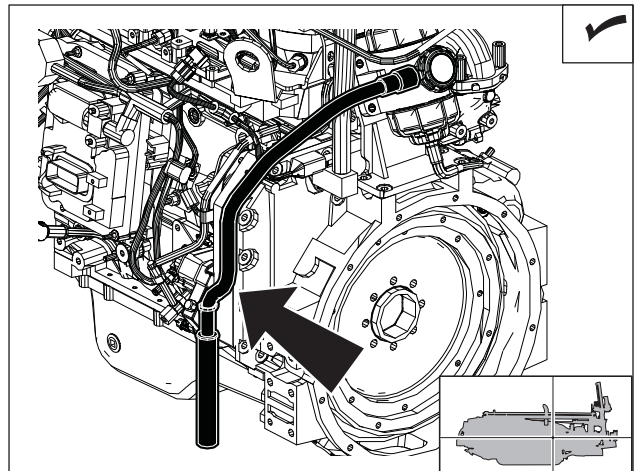
Apply Loctite® 242 to bolts.



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## **Clean Crankcase Breather Tube**

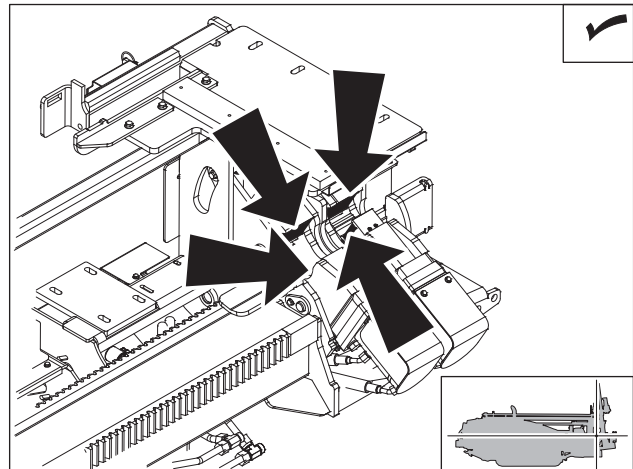
Clean crankcase breather tube with detergent and warm water as needed.



j50om034w.eps

## **Check Wrench Jaw Inserts**

Check wrench jaw inserts for wear and replace as needed.



j22om088h.eps



## Replace SaverLok<sup>®</sup> Body

Replace SaverLok body (2) as needed.

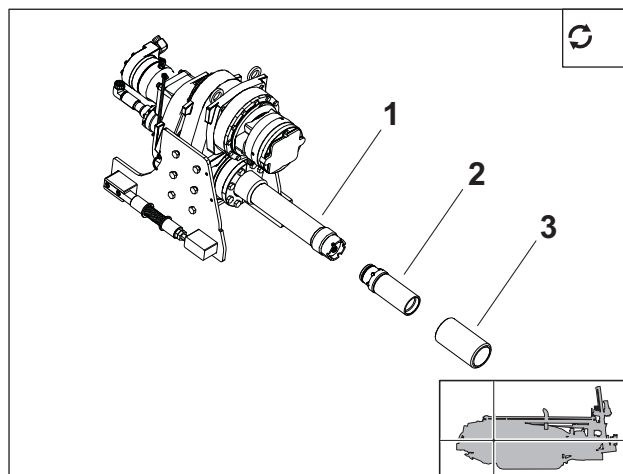
### To remove:

1. Clean front wrench of all pipe and tooling.
2. Close front wrench.
3. Position the carriage so that the SaverLok collar (3) can be clamped into the rear wrench.

**NOTICE:** Clamping front wrench on SaverLok nose will damage the threads and impede disassembly.

4. Clamp rear wrench on SaverLok collar.

**IMPORTANT:** Unit may not build enough torque to break out the SaverLok body unless both wrenches are closed.

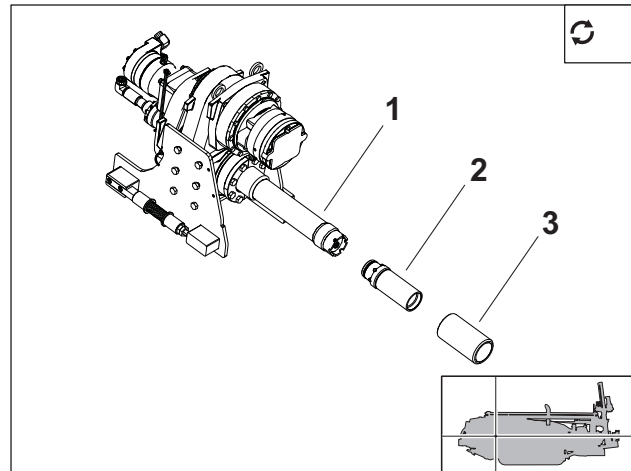


j50om042w.eps

5. Rotate spindle counterclockwise to unthread collar. Remove collar from system and set aside for later use.
6. Remove SaverLok body from SaverLok connection (1).
  - If parts are clean and dry, pull SaverLok body free of SaverLok connection by hand.
  - If the parts are not clean and dry, reposition carriage to clamp SaverLok body in rear wrench and thrust carriage back to pull SaverLok body free from connection.
7. Turn off engine.

**To install:**

1. Inspect SaverLok<sup>®</sup> connection (1) for damage. Coat threads with clean TJC.
2. Coat SaverLok shoulder (2) and SaverLok collar (3) threads and shoulder with clean TJC.
3. Apply grease or lubricant to the SaverLok o-ring and insert SaverLok body into SaverLok connection. The connection will not lock fully into place.
4. Thread SaverLok body into connection until o-ring is fully engaged using one of the following methods:
  - Slide SaverLok collar over SaverLok body and engage threads by hand. Once the SaverLok collar is hand tight (bottomed out), remove collar.
  - Tap the SaverLok nose with a rubber mallet until the o-ring is fully engaged.
5. Position SaverLok body by hand for proper engagement of pins and grooves.
6. Slide SaverLok collar over SaverLok body and hand-tighten the threads (typically 3-4 turns).
7. Start unit and position carriage so that collar can be clamped in the rear wrenches.
8. Clamp wrench on collar and tighten SaverLok assembly to a rotation pressure gauge reading between 4350-5800 psi (300-400 bar). This is equivalent to 3000-4000 ft•lb (2212-2950 N•m) of torque.
9. Immediately loosen the collar and repeat the tighten/loosen process five times to break in the contact surfaces.
10. Tighten SaverLok assembly to a rotation pressure gauge reading between 4350-5800 psi (300-400 bar) to finish the installation.

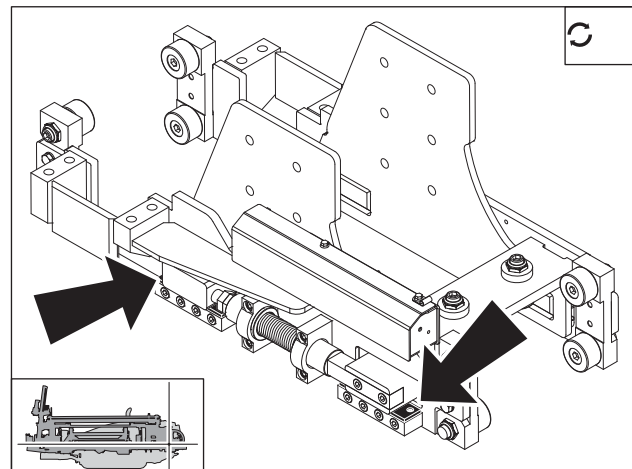


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**Replace Carriage Wear Bars**

Check carriage wear bars for wear. Replace as needed.

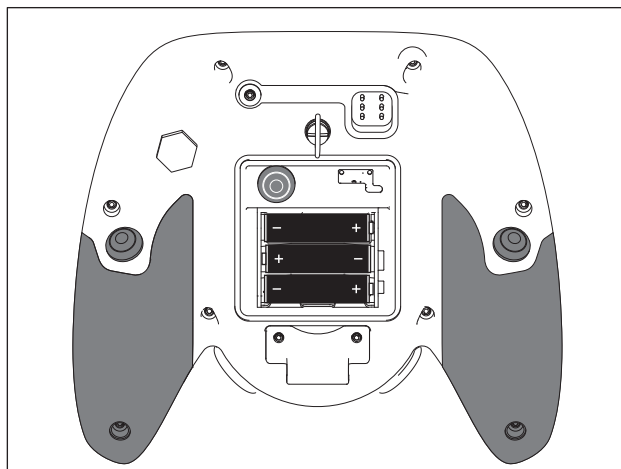


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## Change Wireless Ground Drive Controller Batteries

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



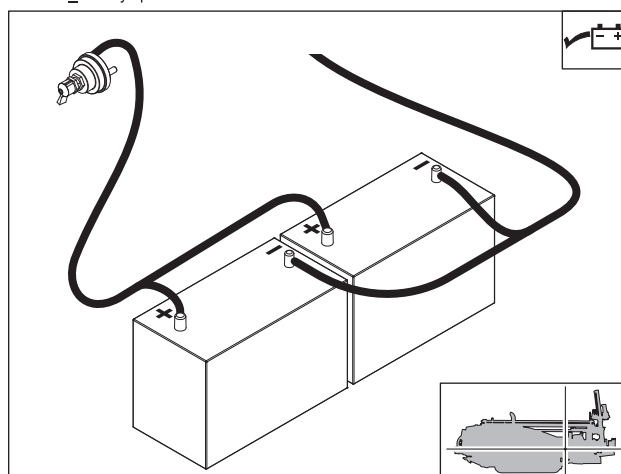
Remote\_Battery.eps

## Check Battery

Check batteries as needed. Keep batteries clean and terminals free of corrosion.

### To clean:

1. Turn battery disconnect switch to the off position.
2. Ensure that no ignition sources are near batteries.
3. Loosen and remove battery cable clamps carefully, **negative (-)** cable first.
4. Clean cable clamps and terminals with wire brush or battery cleaning tool to remove dull glaze.
5. Check for signs of internal corrosion in cables.
6. Apply MPG to terminals after cleaning to reduce corrosion.
7. Connect battery cable clamps, **positive (+)** cable first.
8. Tighten any loose connections.
9. Ensure that battery tiedowns are secure.
10. Turn battery disconnect switch to the on position.



j22om045h.eps



### **WARNING**

Explosion possible. Serious injury or equipment damage could occur. Follow directions carefully.

**To help avoid injury:** Do not create sparks and do not short across battery terminals for any reason.

## Charge Battery



**⚠ WARNING**

Explosion possible. Serious injury or equipment damage could occur. Follow directions carefully.

### To help avoid injury:

- Use a single 12V maximum source for charging. Do not connect to rapid chargers or dual batteries.
- Use caution and wear personal protective equipment such as safety eyewear, when charging or cleaning battery.
- Keep sparks, flames, and any ignition source away from batteries at all times. Internal contents are extremely hazardous. Leaking fluid is corrosive. Battery may be explosive at higher temperatures.
- NEVER lean over battery when making connections.
- Do not allow vehicles to touch when charging.
- Do not attempt to charge a battery that is leaking, bulging, heavily corroded, frozen, or otherwise damaged.
- NEVER short-circuit battery terminals for any reason or strike battery posts or cable terminals.
- Refer to MSDS for additional information regarding this battery.



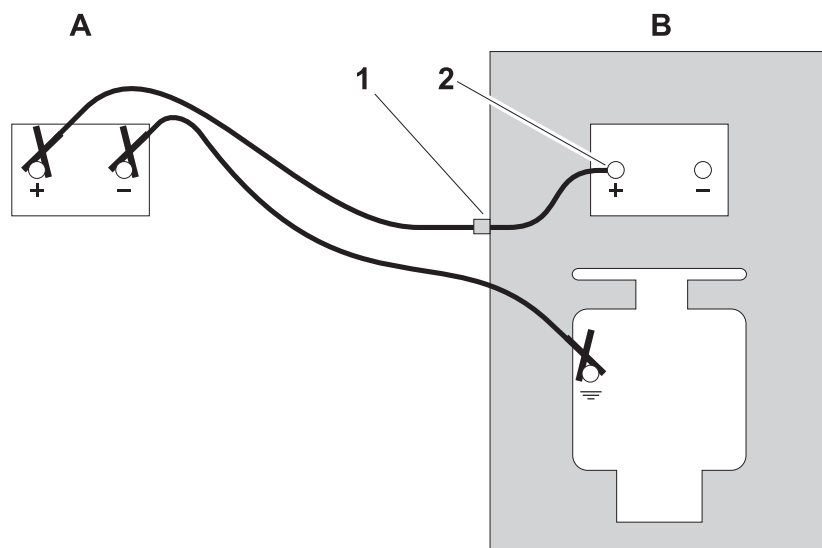
### Before You Start

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). Cheap cables may not allow enough current flow to charge a dead/discharged battery.

Read all steps thoroughly and review illustration before performing procedure.

**Charging Procedure (Engine Off)**

1. Park service vehicle close to disabled equipment but do not allow vehicles to touch. Engage parking brake in both vehicles.
2. Turn the ignition switch to the OFF position in both vehicles, and turn off all electrical loads. Disconnect the machine controller.



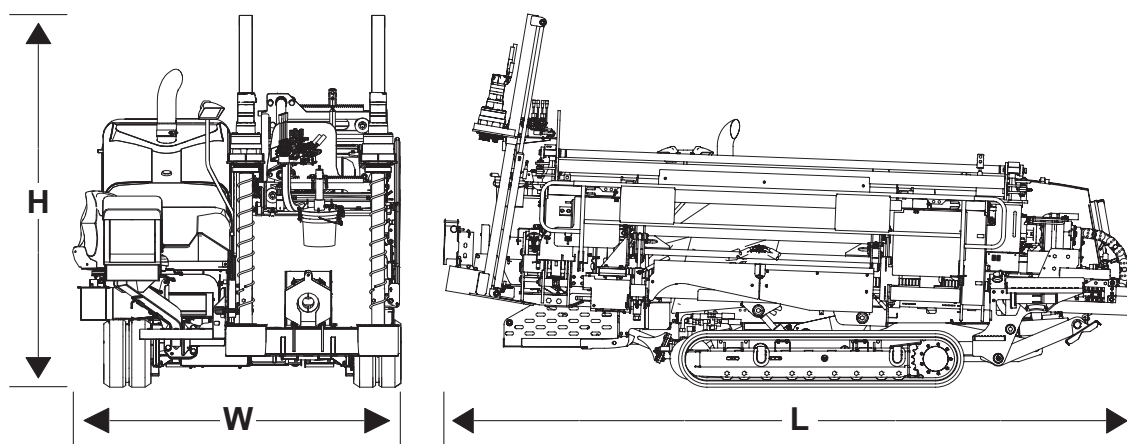
3. Inspect battery in disabled vehicle (B) for signs of cracking, bulging, leaking, or other damage. Connect red positive (+) jumper cable clamp to positive (+) post (2) of battery in disabled vehicle first.

**IMPORTANT:** Some equipment may have a positive jumper cable terminal (1) located externally. If so equipped, connect red positive (+) jumper cable clamp to terminal.

4. Connect the other red positive (+) jumper cable clamp to positive (+) post of battery (A) in the service vehicle.
5. Connect black negative (-) cable clamp to negative (-) post of battery (A) in service vehicle.
6. Connect the other black negative (-) cable clamp to the engine or frame ground on the disabled vehicle, at least 12" (305 mm) from the failed battery, as shown.
7. Operate service vehicle engine at 1500-2000 rpm for a few minutes to build an electrical charge in the failed battery.
8. Stop engine in service vehicle.
9. Remove jumper cables from the service vehicle, black negative (-) clamp first. Do not allow clamps to touch.
10. Remove black negative (-) cable clamp from the disabled engine or frame ground first.
11. Remove red positive (+) cable clamp from the disabled vehicle positive (+) battery post last.
12. Reconnect machine controller and try to start disabled vehicle.

If the disabled vehicle did not start, check for loose or corroded battery cable connections. Poor connections will prevent current from charging the failed battery. Clean terminals and posts if necessary and repeat steps above.

# Specifications



j50m040w.eps

Dimensions		U.S.	Metric
L, overall machine length			
	driving (per SAE J2022)	220 in	5.59 m
	transport (per SAE J2022)	221 in	5.61 m
W, overall machine width			
	base width (per SAE J2022)	80 in	2.03 m
	width with cab (per SAE J2022)	89 in	2.26 m
	width with cab, support removed (per SAE J2022)	88 in	2.23 m
H, overall machine height			
	driving (per SAE J2022)	119 in	3.02 m
	JT/AT large box, transport (per SAE J2022)	94 in	2.39 m
	JT/AT small box, transport (per SAE J2022)	92 in	2.34 m
Operating mass			
	JT base unit, no pipe (per SAE J2022)	17,080 lb	7747 kg
	AT base unit, no pipe (per SAE J2022)	17,660 lb	8010 kg
	Add cab option, heat and air (per SAE J2022)	900 lb	410 kg
Entry angle (per SAE J2022)		10-16°	10-16°
Angle of approach		19°	19°
Angle of approach (with cab)		15°	15°

Dimensions	U.S.	Metric
Angle of departure	18°	18°
Ground bearing pressure, JT, pipe, w/cab (per ISO 16754)	11.15 psi	0.78 kg/cm <sup>2</sup>
Ground bearing pressure, AT, pipe, w/cab (per ISO 16754)	11.43 psi	0.80 kg/cm <sup>2</sup>
Ground clearance (per ISO 16754)	5.7 in	144 mm

Power Pipe <sup>®</sup> HD	U.S.	Metric
Length (per SAE J2022), nominal	118 in	3.00 m
Joint diameter (per SAE J2022)	2.75 in	70 mm
Tubing diameter (per SAE J2022)	2.38 in	60 mm
Minimum bend radius (per SAE J2022)	123 ft	37.5 m
Weight, lined (per SAE J2022)	88 lb	40 kg
Weight of lined drill pipe and JT30 large box (48 pipe)	5204 lb	2361 kg
Weight of lined drill pipe and JT30 small box (24 pipe)	2897 lb	1314 kg
Weight of lined drill pipe and JT30AT large box (48 pipe)	5323 lb	2415 kg
Weight of lined drill pipe and JT30AT small box (24 pipe)	2959 lb	1342 kg
Weight, unlined (per SAE J2022)	79 lb	36 kg
Weight of unlined drill pipe and JT30 large box (48 pipe)	4772 lb	2165 kg
Weight of unlined drill pipe and JT30 small box (24 pipe)	2681 lb	1216 kg
Weight of unlined drill pipe and JT30AT large box (48 pipe)	4891 lb	2219 kg
Weight of unlined drill pipe and JT30AT small box (24 pipe)	2743 lb	1244 kg

Power Pipe <sup>®</sup> Forged	U.S.	Metric
Length (per SAE J2022), nominal	120 in	3.05 m
Joint diameter (per SAE J2022)	2.63 in	66.7 mm
Tubing diameter (per SAE J2022)	2.38 in	60 mm
Minimum bend radius (per SAE J2022)	108.2 ft	33 m
Weight (per SAE J2022)	73 lb	33 kg
Weight of drill pipe and JT30 large box (48 pipe)	4484 lb	2034 kg
Weight of drill pipe and JT30 small box (24 pipe)	2537 lb	2034 kg
Weight of drill pipe and JT30AT large box (48 pipe)	4603 lb	2088 kg

<b>Power Pipe® Forged</b>	<b>U.S.</b>	<b>Metric</b>
Weight of drill pipe and JT30AT small box (24 pipe)	2599 lb	1179 kg
<b>All Terrain Pipe</b>	<b>U.S.</b>	<b>Metric</b>
Length (per SAE J2022), nominal	112 in	2.84 m
Joint diameter (per SAE J2022)	3.25 in	83 mm
Tubing diameter (per SAE J2022)	2.23 in	57 mm
Minimum bend radius (per SAE J2022)	145 ft	44 m
Weight (per SAE J2022), with inner rod	100 lb	45 kg
Weight of drill pipe and large box (35 pipe)	4599 lb	2086 kg
Weight of drill pipe and small box (20 pipe)	2847 lb	1291 kg
<b>All Terrain Flush Pipe</b>	<b>U.S.</b>	<b>Metric</b>
Length (per SAE J2022), nominal	112 in	2.84 m
Joint diameter (per SAE J2022)	3.25 in	83 mm
Tubing diameter (per SAE J2022)	2.94 in	64 mm
Minimum bend radius (per SAE J2022)	153 ft	47 m
Weight (per SAE J2022), with inner rod	120 lb	54 kg
Weight of drill pipe and large box (35 pipe)	5299 lb	2404 kg
Weight of drill pipe and small box (20 pipe)	3247 lb	1473 kg
<b>Operational</b>	<b>U.S.</b>	<b>Metric</b>
Maximum spindle speed (per SAE J2022)	225 rpm	225 rpm
Maximum spindle speed (per SAE J2022) (AT inner spindle)	400 rpm	400 rpm
Maximum spindle torque	4000 ft•lb	5420 N•m
Maximum spindle torque (AT inner spindle)	800 ft•lb	1080 N•m
Carriage thrust travel speed (per SAE J2022)	120 fpm	37 m/min
Carriage pullback travel speed (per SAE J2022)	120 fpm	37 m/min
Thrust force (per SAE J2022)	24,800 lb	110 kN
Thrust force (All Terrain mode) (per SAE J2022)	24,800 lb	110 kN
Pullback force (per SAE J2022)	30,000 lb	133 kN
Bore diameter	4.5 in	114 mm
Bore diameter (All Terrain w/ Rockmaster 822)	4.75 in	121 mm



Operational	U.S.	Metric
Bore diameter (All Terrain w/ Rockmaster 86)	5.50 in	140 mm
Backream diameter	soil dependent	
Ground travel speed, forward (per SAE J2022)	2.4 mph	3.9 km/h
Ground travel speed, reverse (per SAE J2022)	2.4 mph	3.9 km/h

Power	U.S.	Metric	
Engine: Cummins QSB4.5, EPA Tier 4, EU Stage IV			
Fuel: diesel			
Cooling medium: liquid			
Injection: direct			
Aspiration: turbocharged and charge air cooled			
Cylinders: 4			
Displacement	275 in <sup>3</sup>	4.5 L	
Bore	4.21 in	107 mm	
Stroke	4.88 in	124 mm	
Power			
	manufacturer's gross power rating (per SAE J1995)	160 hp	119 kW
	estimated net power rating (per SAE J1349)	152 hp	113 kW
	rated speed	2300 rpm	2300 rpm
	peak gross power @ 2200 rpm	163 hp	122 kW

Drilling Fluid System (Onboard)	U.S.	Metric
Maximum drilling fluid pressure (per SAE J2022)	1500 psi	103 bar
Maximum drilling fluid flow (per SAE J2022)	50 gpm	189 L/min

Fluid Capacities	U.S.	Metric
Hydraulic reservoir	27 gal	102 L
Fuel tank *	48 gal	182 L
Engine oil, including filter	13.7 qt	13 L
Cooling system	24 qt	22.7 L
Antifreeze tank	8 gal	30 L
Diesel exhaust fluid tank	5 gal	18.9 L

Fluid Capacities	U.S.	Metric
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\* Under normal operating conditions, a full tank of fuel will last 10 hours.

### Battery (2 used)

SAE reserve capacity 195 min, 12V, negative ground, SAE cold crank @ 0°F (-18°C), 950 amps.

### Noise Levels

Operator ear sound pressure level is < or = 86 dBA sound pressure per ISO 6396

Operator ear sound pressure level (with cab) is < or = 83 dBA sound pressure per ISO 6396

Exterior sound power level is < or = 100 dBA per ISO 6395

### Vibration Levels

Average vibration transmitted to the operator's hand and whole body during normal operation does not exceed 2.5 and 0.5 m/sec<sup>2</sup> respectively.

Specifications are called out according to SAE recommended practices where indicated. Specifications are general and subject to change without notice. If exact measurements are required, equipment should be weighed and measured. Due to selected options, delivered equipment may not necessarily match that shown.







# Support

## 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. Use of another manufacturer's parts may void warranty consideration.

## Resources

### Publications

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



### Ditch Witch Training

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

# 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 Charles Machine Works, Inc. (CMW) 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, 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.

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 CMW or its authorized dealer. CMW will provide the location of its inspection facilities or its nearest authorized dealer upon inquiry. CMW reserves the right to supply remanufactured replacement parts under this warranty as it deems appropriate.

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

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 CMW's Product Support department, P.O. Box 66, Perry, OK 73077-0066, or contact your local dealer.

**A Note To  
Ditch Witch  
Equipment Owners:**

If your equipment was purchased through a Ditch Witch dealer, there is no need to read further.

However, if you purchased from any other source, please fill out the form on the reverse side and return it to us.

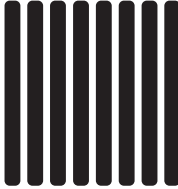
This will enable you to receive updates on this equipment as well as information on new products of interest.

Thanks for using Ditch Witch equipment.

(Please Fold Along This Line And Seal At Bottom With Tape)



NO POSTAGE  
NECESSARY  
IF MAILED  
IN THE  
UNITED STATES



**BUSINESS REPLY MAIL**

FIRST CLASS PERMIT NO 23 PERRY OKLAHOMA

POSTAGE WILL BE PAID BY

**The Charles Machine Works, Inc.  
P.O. Box 66  
Perry, Oklahoma 73077-9989**



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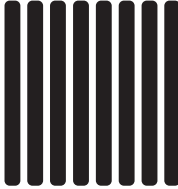
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# Ditch Witch® Registration Card

Please Type or Print All Information

Purchaser's Company Name		
Attention		
Street Address or P.O. Box		
City	County	
State	Zip	Nation
(       )		
Phone Number With Area Code		
Model	Serial Number	
Attachments/Accessories	Serial Numbers	
Attachments/Accessories	Serial Numbers	
Attachments/Accessories	Serial Numbers	
Name of Ditch Witch Dealership		
Your Signature		

# Ditch Witch® Registration Card

Please Type or Print All Information

Purchaser's Company Name		
Attention		
Street Address or P.O. Box		
City	County	
State	Zip	Nation
(       )		
Phone Number With Area Code		
Model	Serial Number	
Attachments/Accessories	Serial Numbers	
Attachments/Accessories	Serial Numbers	
Attachments/Accessories	Serial Numbers	
Name of Ditch Witch Dealership		
Your Signature		

## Service Record

[illegible]

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# Appendix



## Chapter Contents

### Engine Diagnostic Codes



J1939_SPN	J1939_FMI	Cummins' Fault Code	Circuit	Cummins Detailed Description	JT25/JT30	JT60/JT100
27	4	2272	EGR Valve Position Circuit	Voltage below normal, or shorted to low source	X	X
81	16	2754	Engine Diesel Particulate Filter Intake Pressure	Data Valid But Above Normal Operating Range , Moderately Severe Level		X
84	2	241	Wheel	Based Vehicle Speed , Data erratic, intermittent or incorrect	X	X
84	10	242	Wheel	Based Vehicle Speed Sensor Circuit tampering has been detected , Abnormal rate of change		X
84	19	3525	Wheel	Based Vehicle Speed , Received Network Data In Error		X
91	0	148	Accelerator Pedal or Lever Position Sensor 1	Data valid but above normal operational range , Most Severe Level	X	X
91	1	147	Accelerator Pedal or Lever Position 1 Sensor Circuit Frequency	Data valid but below normal operating Range	X	X
91	2	1242	Accelerator Pedal or Lever Position Sensor 1	Data erratic, intermittent or incorrect	X	X
91	3	131	Accelerator Pedal or Lever Position Sensor 1 Circuit	Voltage above normal, or shorted to high source	X	X
91	4	132	Accelerator Pedal or Lever Position Sensor 1 Circuit	Voltage below normal, or shorted to low source	X	X
91	9	3326	SAE J1939 Multiplexed Accelerator Pedal or Lever Sensor System	Abnormal update rate	X	X
91	19	1515	SAE J1939 Multiplexed Accelerator Pedal or Lever Sensor System	Received Network Data In Error	X	X
94	3	546	Fuel Delivery Pressure Sensor Circuit	Voltage above normal, or shorted to high source	X	X
94	4	547	Fuel Delivery Pressure Sensor Circuit	Voltage below normal, or shorted to low source	X	X
95	16	2372	Fuel Filter Differential Pressure	Data Valid But Above Normal Operating Range , Moderately Severe Level	X	X
97	3	428	Water in Fuel Indicator Sensor Circuit	Voltage above normal, or shorted to high source	X	X
97	4	429	Water in Fuel Indicator Sensor Circuit	Voltage below normal, or shorted to low source	X	X
97	15	418	Water in Fuel Indicator	Data Valid But Above Normal Operating Range , Least Severe Level	X	X
97	16	1852	Water in Fuel Indicator	Data Valid But Above Normal Operating Range , Moderately Severe Level	X	X
100	1	415	Engine Oil Rifle Pressure	Data valid but below normal operational range , Most Severe Level	X	X
100	2	435	Engine Oil Rifle Pressure	Data erratic, intermittent or incorrect	X	X
100	3	135	Engine Oil Rifle Pressure 1 Sensor Circuit	Voltage above normal, or shorted to high source	X	X
100	4	141	Engine Oil Rifle Pressure 1 Sensor Circuit	Voltage below normal, or shorted to low source	X	X
100	18	143	Engine Oil Rifle Pressure	Data Valid But Below Normal Operating Range , Moderately Severe Level	X	X
101	0	556	Crankcase Pressure	Data valid but above normal operational range , Most Severe Level	X	X
101	2	1942	Crankcase Pressure	Data erratic, intermittent or incorrect	X	X
101	3	1843	Crankcase Pressure Circuit	Voltage above normal, or shorted to high source	X	X
101	4	1844	Crankcase Pressure Circuit	Voltage below normal, or shorted to low source	X	X
101	15	1974	Crankcase Pressure	Data Valid But Above Normal Operating Range , Least Severe Level	X	X
101	16	555	Crankcase Pressure	Data Valid But Above Normal Operating Range , Moderately Severe Level	X	X
102	3	122	Intake Manifold 1 Pressure Sensor Circuit	Voltage above normal, or shorted to high source	X	X
102	4	123	Intake Manifold 1 Pressure Sensor Circuit	Voltage below normal, or shorted to low source	X	X
102	16	124	Intake Manifold 1 Pressure	Data Valid But Above Normal Operating Range , Moderately Severe Level		X
103	15	2288	Turbocharger 1 Speed	Data Valid But Above Normal Operating Range , Least Severe Level	X	X
103	16	595	Turbocharger 1 Speed	Data Valid But Above Normal Operating Range , Moderately Severe Level	X	X
103	18	687	Turbocharger 1 Speed	Data Valid But Below Normal Operating Range , Moderately Severe Level	X	X
105	0	155	Intake Manifold 1 Temperature	Data valid but above normal operational range , Most Severe Level	X	X
105	3	153	Intake Manifold 1 Temperature Sensor Circuit	Voltage above normal, or shorted to high source	X	X
105	4	154	Intake Manifold 1 Temperature Sensor Circuit	Voltage below normal, or shorted to low source	X	X
105	15	2964	Intake Manifold 1 Temperature	Data Valid But Above Normal Operating Range , Least Severe Level	X	X
105	16	488	Intake Manifold 1 Temperature	Data Valid But Above Normal Operating Range , Moderately Severe Level	X	X
107	15	5576	Engine Air Filter Differential Pressure	Data Valid But Above Normal Operating Range , Least Severe Level	X	X
107	16	3341	Engine Air Filter Differential Pressure	Data Valid But Above Normal Operating Range , Moderately Severe Level	X	X
108	3	221	Barometric Pressure Sensor Circuit	Voltage above normal, or shorted to high source		X
108	4	222	Barometric Pressure Sensor Circuit	Voltage above normal, or shorted to low source		X
110	0	151	Engine Coolant Temperature	Data valid but above normal operational range , Most Severe Level	X	X
110	3	144	Engine Coolant Temperature 1 Sensor Circuit	Voltage above normal, or shorted to high source	X	X
110	4	145	Engine Coolant Temperature 1 Sensor Circuit	Voltage below normal, or shorted to low source	X	X
110	16	146	Engine Coolant Temperature	Data Valid But Above Normal Operating Range , Moderately Severe Level	X	X
110	31	2646	Engine Coolant Temperature	Condition Exists	X	X
110	31	2659	Engine Coolant Temperature	Condition Exists	X	X
111	1	235	Coolant Level	Data valid but below normal operational range , Most Severe Level	X	X
111	3	195	Coolant Level Sensor 1 Circuit	Voltage above normal, or shorted to high source	X	X

J1939_SPN	J1939_FMI	Cummins' Fault Code	Circuit	Cummins Detailed Description	JT25/JT30	JT60/JT100
111	4	196	Coolant Level Sensor 1 Circuit	Voltage below normal, or shorted to low source	X	X
111	9	3613	SAE J1939 Multiplexing PGN Timeout Error	Abnormal update rate		X
111	17	2448	Coolant Level	Data Valid But Below Normal Operating Range , Least Severe Level	X	X
111	18	197	Coolant Level	Data Valid But Below Normal Operating Range , Moderately Severe Level	X	X
111	19	3614	Coolant Level Sensor	Received Network Data in Error		X
157	0	449	Injector Metering Rail 1 Pressure	Data valid but above normal operational range , Most Severe Level	X	X
157	3	451	Injector Metering Rail 1 Pressure Sensor Circuit	Voltage above normal, or shorted to high source	X	X
157	4	452	Injector Metering Rail 1 Pressure Sensor Circuit	Voltage below normal, or shorted to low source	X	X
157	16	553	Injector Metering Rail 1 Pressure	Data Valid But Above Normal Operating Range , Moderately Severe Level	X	X
157	18	559	Injector Metering Rail 1 Pressure	Data Valid But Below Normal Operating Range , Moderately Severe Level	X	X
168	16	442	Battery 1 Voltage	Data Valid But Above Normal Operating Range , Moderately Severe Level	X	X
168	17	3724	Battery 1 Voltage	Data Valid But Below Normal Operating Range , Least Severe Level	X	X
168	18	441	Battery 1 Voltage	Data Valid But Below Normal Operating Range , Moderately Severe Level	X	X
171	3	249	Ambient Air Temperature Sensor 1 Circuit	Voltage above normal, or shorted to high source		X
171	4	256	Ambient Air Temperature Sensor 1 Circuit	Voltage below normal, or shorted to low source		X
171	9	3531	Ambient Air Temperature	Abnormal update rate		X
190	0	234	Engine Crankshaft Speed/Position	Data valid but above normal operational range , Most Severe Level	X	X
190	2	689	Engine Crankshaft Speed/Position	Data erratic, intermittent or incorrect	X	X
190	2	2321	Engine Crankshaft Speed/Position	Data erratic, intermittent or incorrect	X	X
190	16	2468	Engine Crankshaft Speed/Position	Data Valid But Above Normal Operating Range , Moderately Severe Level	X	X
191	9	3328	Transmission Output Shaft Speed	Abnormal update rate		X
191	16	349	Transmission Output Shaft Speed	Data Valid But Above Normal Operating Range , Moderately Severe Level		X
191	18	489	Transmission Output Shaft Speed	Data Valid But Below Normal Operating Range , Moderately Severe Level		X
191	19	3418	Transmission Output Shaft Speed	Received Network Data In Error		X
237	13	4517	Vehicle Identification Number	Out of Calibration	X	X
411	2	1866	Exhaust Gas Recirculation Differential Pressure	Data erratic, intermittent or incorrect	X	X
411	3	2273	Exhaust Gas Recirculation Differential Pressure Sensor Circuit	Voltage above normal, or shorted to high source	X	X
411	4	2274	Exhaust Gas Recirculation Differential Pressure Sensor Circuit	Voltage below normal, or shorted to low source	X	X
412	3	2375	Exhaust Gas Recirculation Temperature Sensor Circuit	Voltage above normal, or shorted to high source	X	X
412	4	2376	Exhaust Gas Recirculation Temperature Sensor Circuit	Voltage below normal, or shorted to low source	X	X
412	15	2961	Exhaust Gas Recirculation Temperature	Data Valid But Above Normal Operating Range , Least Severe Level	X	X
412	16	2962	Exhaust Gas Recirculation Temperature	Data Valid But Above Normal Operating Range , Moderately Severe Level	X	X
441	3	293	Auxiliary Temperature Sensor Input 1 Circuit	Voltage above normal, or shorted to high source		X
441	4	294	Auxiliary Temperature Sensor Input 1 Circuit	Voltage below normal, or shorted to low source		X
441	14	292	Auxiliary Temperature Sensor Input 1	Special Instructions		X
442	3	3765	Auxiliary Temperature Sensor Input 2 Circuit	Voltage above normal, or shorted to high source		X
442	4	3766	Auxiliary Temperature Sensor Input 2 Circuit	Voltage below normal, or shorted to low source		X
558	2	431	Accelerator Pedal or Lever Idle Validation Switch	Data erratic, intermittent or incorrect	X	X
558	13	432	Accelerator Pedal or Lever Idle Validation Switch Circuit	Out of Calibration	X	X
558	19	3527	Accelerator Pedal or Lever Idle Validation Switch	Received Network Data In Error	X	X
563	9	3488	Anti	Lock Braking (ABS) Controller , Abnormal update rate	X	X
563	31	4215	Anti	Lock Braking (ABS) Active , Condition Exists	X	X
611	2	523	Auxiliary Intermediate (PTO) Speed Switch Validation	Data erratic, intermittent or incorrect		X
612	2	115	Engine Magnetic Speed/Position Lost Both of Two Signals	Data erratic, intermittent or incorrect	X	X
625	9	291	Proprietary Datalink Error (OEM/Vehicle Datalink)	Abnormal update rate	X	X
629	12	111	Engine Control Module Critical Internal Failure	Bad intelligent device or component	X	X
629	12	343	Engine Control Module Warning Internal Hardware Failure	Bad intelligent device or component	X	X
630	12	3697	Engine Control Module Calibration Memory	Bad intelligent device or component	X	X
633	31	2311	Electronic Fuel Injection Control Valve Circuit	Condition Exists	X	X
639	9	285	SAE J1939 Multiplexing PGN Timeout Error	Abnormal update rate	X	X
639	13	286	SAE J1939 Multiplexing Configuration Error	Out of Calibration	X	X
640	14	599	Auxiliary Commanded Dual Output Shutdown	Special Instructions		X
641	7	2387	VGT Actuator Driver Circuit (Motor)	Mechanical system not responding or out of adjustment	X	X
641	9	2636	VGT Actuator Driver Circuit	Abnormal update rate	X	X
641	11	2198	VGT Actuator Driver Circuit	Root Cause Not Known	X	X
641	12	2634	VGT Actuator Controller	Bad intelligent device or component	X	X
641	13	1898	VGT Actuator Controller	Out of Calibration	X	X
641	13	2449	VGT Actuator Controller	Out of Calibration	X	X
641	15	1962	VGT Actuator Driver Over Temperature (Calculated)	Data Valid But Above Normal Operating Range , Least Severe Level	X	X

J1939_SPN	J1939_FMI	Cummins' Fault Code	Circuit	Cummins Detailed Description	JT25/JT30	JT60/JT100
641	31	2635	VTG Actuator Driver Circuit	Condition Exists	X	X
644	2	237	External Speed Command Input (Multiple Unit Synchronization)	Data erratic, intermittent or incorrect	X	
647	3	2377	Fan Control Circuit	Voltage above normal, or shorted to high source	X	X
647	4	245	Fan Control Circuit	Voltage below normal, or shorted to low source	X	X
651	5	322	Injector Solenoid Driver Cylinder 1 Circuit	Current below normal or open circuit	X	X
652	5	331	Injector Solenoid Driver Cylinder 2 Circuit	Current below normal or open circuit	X	X
652	7	1141	Injector Solenoid Driver Cylinder 2	Mechanical system not responding or out of adjustment	X	X
653	5	324	Injector Solenoid Driver Cylinder 3 Circuit	Current below normal or open circuit	X	X
653	7	1142	Injector Solenoid Driver Cylinder 3	Mechanical system not responding or out of adjustment	X	X
654	5	332	Injector Solenoid Driver Cylinder 4 Circuit	Current below normal or open circuit	X	X
654	7	1143	Injector Solenoid Driver Cylinder 4	Mechanical system not responding or out of adjustment	X	X
655	5	323	Injector Solenoid Driver Cylinder 5 Circuit	Current below normal or open circuit	X	X
655	7	1144	Injector Solenoid Driver Cylinder 5	Mechanical system not responding or out of adjustment		X
656	5	325	Injector Solenoid Driver Cylinder 6 Circuit	Current below normal or open circuit	X	X
656	7	1145	Injector Solenoid Driver Cylinder 6	Mechanical system not responding or out of adjustment		X
677	3	584	Starter Relay Driver Circuit	Voltage above normal, or shorted to high source	X	X
677	4	585	Starter Relay Driver Circuit	Voltage below normal, or shorted to low source	X	X
697	3	2557	Auxiliary PWM Driver 1 Circuit	Voltage above normal, or shorted to high source	X	X
697	4	2558	Auxiliary PWM Driver 1 Circuit	Voltage below normal, or shorted to low source	X	X
701	14	4734	Auxiliary Input/Output 1	Special Instructions	X	X
702	3	527	Auxiliary Input/Output 2 Circuit	Voltage above normal, or shorted to high source		X
703	3	529	Auxiliary Input/Output 3 Circuit	Voltage above normal, or shorted to high source		X
723	2	778	Engine Camshaft Speed / Position Sensor	Data erratic, intermittent or incorrect	X	X
723	2	2322	Engine Camshaft Speed / Position Sensor	Data erratic, intermittent or incorrect	X	X
723	7	731	Engine Speed / Position Camshaft and Crankshaft Misalignment	Mechanical system not responding or out of adjustment	X	X
729	3	2555	Engine Intake Air Heater 1 Circuit	Voltage above normal, or shorted to high source	X	X
729	4	2556	Engine Intake Air Heater 1 Circuit	Voltage below normal, or shorted to low source	X	X
748	9	3641	Transmission Output Retarder	Abnormal update rate	X	X
974	3	133	Remote Accelerator Pedal or Lever Position Sensor 1 Circuit	Voltage above normal, or shorted to high source	X	X
974	4	134	Remote Accelerator Pedal or Lever Position Sensor 1 Circuit	Voltage below normal, or shorted to low source	X	X
974	19	288	SAE J1939 Multiplexing Remote Accelerator Pedal or Lever Position Sensor System	Received Network Data In Error	X	X
1073	3	2367	Engine Brake Actuator Driver Output 2 Circuit	Voltage above normal, or shorted to high source		X
1073	4	2363	Engine Brake Actuator Driver Output 2 Circuit	Voltage below normal, or shorted to low source		X
1081	9	3555	Engine Wait to Start Lamp	Abnormal update rate	X	X
1172	3	691	Turbocharger 1 Compressor Intake Temperature Circuit	Voltage above normal, or shorted to high source	X	X
1172	4	692	Turbocharger 1 Compressor Intake Temperature Circuit	Voltage below normal, or shorted to low source	X	X
1176	2	743	Turbocharger 1 Compressor Intake Pressure	Data erratic, intermittent or incorrect	X	X
1176	3	741	Turbocharger 1 Compressor Intake Pressure Circuit	Voltage above normal, or shorted to high source	X	X
1176	4	742	Turbocharger 1 Compressor Intake Pressure Circuit	Voltage below normal, or shorted to low source	X	X
1194	13	3298	Anti theft Encryption Seed , Out of Calibration		X	X
1209	2	2554	Exhaust Gas Pressure 1	Data erratic, intermittent or incorrect	X	X
1209	3	2373	Exhaust Gas Pressure Sensor 1 Circuit	Voltage above normal, or shorted to high source	X	X
1209	4	2374	Exhaust Gas Pressure Sensor 1 Circuit	Voltage below normal, or shorted to low source	X	X
1231	2	3329	J1939 Network #2	Data erratic, intermittent or incorrect	X	X
1235	2	3331	J1939 Network #3	Data erratic, intermittent or incorrect	X	X
1267	3	338	Idle Shutdown Vehicle Accessories Relay Driver Circuit	Voltage above normal, or shorted to high source		X
1267	4	339	Idle Shutdown Vehicle Accessories Relay Driver Circuit	Voltage below normal, or shorted to low source		X
1323	31	1654	Engine Misfire Cylinder 1	Condition Exists	X	X
1324	31	1655	Engine Misfire Cylinder 2	Condition Exists	X	X
1325	31	1656	Engine Misfire Cylinder 3	Condition Exists	X	X
1326	31	1657	Engine Misfire Cylinder 4	Condition Exists	X	X
1327	31	1658	Engine Misfire Cylinder 5	Condition Exists		X
1328	31	1659	Engine Misfire Cylinder 6	Condition Exists		X
1347	3	272	Engine Fuel Pump Pressurizing Assembly 1 Circuit	Voltage above normal, or shorted to high source	X	X
1347	4	271	Engine Fuel Pump Pressurizing Assembly 1 Circuit	Voltage below normal, or shorted to low source	X	X
1347	7	281	Engine Fuel Pump Pressurizing Assembly 1	Mechanical system not responding or out of adjustment	X	X
1349	3	483	Injector Metering Rail 2 Pressure Sensor Circuit	Voltage above normal, or shorted to high source	X	X
1377	2	497	Multiple Unit Synchronization Switch	Data erratic, intermittent or incorrect		X
1378	31	649	Engine Oil Change Interval	Condition Exists	X	X
1387	3	1539	Auxiliary Pressure Sensor Input 1 Circuit	Voltage above normal, or shorted to high source		X
1387	4	1621	Auxiliary Pressure Sensor Input 1 Circuit	Voltage below normal, or shorted to low source		X
1388	3	297	Auxiliary Pressure Sensor Input 2 Circuit	Voltage above normal, or shorted to high source		X
1388	4	298	Auxiliary Pressure Sensor Input 2 Circuit	Voltage below normal, or shorted to low source		X
1388	14	296	Auxiliary Pressure Sensor Input 2	Special Instructions		X
1569	31	3714	Engine Protection Torque Derate	Condition Exists	X	X
1623	9	3186	Tachograph Output Shaft Speed	Abnormal update rate		X
1623	13	5248	Tachograph Output Shaft Speed	Out of Calibration		X
1623	19	3213	Tachograph Output Shaft Speed	Received Network Data In Error		X
1632	14	2998	Engine Torque Limit Feature	Special Instructions		X

J1939_SPN	J1939_FMI	Cummins' Fault Code	Circuit	Cummins Detailed Description	JT25/JT30	JT60/JT100
1639	0	4789	Fan Speed	Data Valid but Above Normal Operational Range , Most Severe Level	X	X
1639	1	4791	Fan Speed	Data Valid but Below Normal Operational Range , Most Severe Level	X	X
1668	2	4437	J1939 Network #4	Data erratic, intermittent or incorrect	X	X
1675	31	3737	Engine Starter Mode Overcrank Protection	Condition Exists	X	X
1761	1	1673	Aftertreatment 1 Diesel Exhaust Fluid Tank Level	Data valid but below normal operational range , Most Severe Level	X	X
1761	3	1669	Aftertreatment 1 Diesel Exhaust Fluid Tank Level Sensor Circuit	Voltage above normal, or shorted to high source	X	X
1761	4	1668	Aftertreatment 1 Diesel Exhaust Fluid Tank Level Sensor Circuit	Voltage below normal, or shorted to low source	X	X
1761	10	4769	Aftertreatment 1 Diesel Exhaust Fluid Tank Level Sensor	Abnormal Rate of Change	X	X
1761	11	4739	Aftertreatment 1 Diesel Exhaust Fluid Tank Level Sensor	Root Cause Not Known	X	X
1761	13	4732	Aftertreatment 1 Diesel Exhaust Fluid Tank Level Sensor	Out of Calibration		X
1761	17	3497	Aftertreatment 1 Diesel Exhaust Fluid Tank Level	Data Valid But Below Normal Operating Range , Least Severe Level	X	X
1761	18	3498	Aftertreatment 1 Diesel Exhaust Fluid Tank Level	Data Valid But Below Normal Operating Range , Moderately Severe Level	X	X
2623	3	1239	Accelerator Pedal or Lever Position Sensor 2 Circuit	Voltage above normal, or shorted to high source	X	X
2623	4	1241	Accelerator Pedal or Lever Position Sensor 2 Circuit	Voltage below normal, or shorted to low source	X	X
2630	3	2571	Engine Charge Air Cooler Outlet Temperature	Voltage above normal, or shorted to high source		X
2630	4	2572	Engine Charge Air Cooler Outlet Temperature	Voltage below normal, or shorted to low source		X
2789	15	2346	Turbocharger Turbine Intake Temperature	Data Valid But Above Normal Operating Range , Least Severe	X	X
2791	5	2349	EGR Valve Control Circuit	Current below normal or open circuit	X	X
2791	6	2353	EGR Valve Control Circuit	Current above normal or grounded circuit	X	X
2791	7	2357	EGR Valve Control Circuit	Mechanical system not responding or out of adjustment	X	X
2791	13	1896	EGR Valve Controller	Out of Calibration	X	X
2791	15	1961	EGR Valve Control Circuit Over Temperature	Data Valid But Above Normal Operating Range , Least Severe Level	X	X
3031	2	1679	Aftertreatment 1 Diesel Exhaust Fluid Tank Temperature	Data erratic, intermittent or incorrect	X	X
3031	3	1678	Aftertreatment 1 Diesel Exhaust Fluid Tank Temperature Sensor	Voltage above normal, or shorted to high source	X	X
3031	4	1677	Aftertreatment 1 Diesel Exhaust Fluid Tank Temperature Sensor	Voltage below normal, or shorted to low source	X	X
3031	9	4572	Aftertreatment 1 Diesel Exhaust Fluid Tank Temperature	Abnormal Update Rate	X	X
3031	11	4737	Aftertreatment 1 Diesel Exhaust Fluid Tank Temperature	Root Cause Not Known		X
3031	13	4731	Aftertreatment 1 Diesel Exhaust Fluid Tank Temperature Sensor	Out of Calibration		X
3216	2	3228	Aftertreatment 1 Intake NOx Sensor	Data erratic, intermittent or incorrect	X	X
3216	4	1885	Aftertreatment 1 Intake NOx Sensor Circuit	Voltage below normal, or shorted to low source	X	X
3216	9	3232	Aftertreatment 1 Intake NOx Sensor	Abnormal update rate	X	X
3216	10	3725	Aftertreatment 1 Intake NOx Sensor	Abnormal rate of change	X	X
3216	13	3718	Aftertreatment 1 Intake NOx	Out of Calibration	X	X
3216	16	3726	Aftertreatment 1 Intake NOx	Data Valid But Above Normal Operating Range , Moderately Severe Level	X	X
3216	20	3748	Aftertreatment 1 Intake NOx Sensor	Data not Rational , Drifted High	X	X
3218	2	3682	Aftertreatment 1 Intake NOx Sensor Power Supply	Data erratic, intermittent or incorrect	X	X
3226	2	1694	Aftertreatment 1 Outlet NOx Sensor	Data erratic, intermittent or incorrect	X	X
3226	4	1887	Aftertreatment 1 Outlet NOx Sensor Circuit	Voltage below normal, or shorted to low source	X	X
3226	9	2771	Aftertreatment 1 Outlet NOx Sensor	Abnormal update rate	X	X
3226	10	3545	Aftertreatment 1 Outlet NOx Sensor	Abnormal rate of change	X	X
3226	13	3717	Aftertreatment 1 Outlet NOx Sensor	Out of Calibration	X	X
3226	20	3749	Aftertreatment 1 Outlet NOx Sensor	Data not Rational , Drifted High	X	X
3228	2	3681	Aftertreatment 1 Outlet NOx Sensor Power Supply	Data erratic, intermittent or incorrect	X	X
3246	3	3319	Aftertreatment 1 Diesel Particulate Filter Outlet Temperature Sensor Circuit	Voltage above normal, or shorted to high source	X	X
3361	2	2976	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Temperature	Data erratic, intermittent or incorrect	X	X
3361	3	3558	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit	Voltage above normal, or shorted to high source	X	X
3361	4	3559	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit	Voltage below normal, or shorted to low source	X	X
3362	31	1682	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Input Lines	Condition Exists	X	X
3363	3	1683	Aftertreatment 1 Diesel Exhaust Fluid Tank Heater	Voltage above normal, or shorted to high source	X	X
3363	4	1684	Aftertreatment 1 Diesel Exhaust Fluid Tank Heater	Voltage below normal, or shorted to low source	X	X
3363	7	3242	Aftertreatment 1 Diesel Exhaust Fluid Tank Heater	Mechanical system not responding or out of adjustment	X	X
3363	16	1713	Aftertreatment 1 Diesel Exhaust Fluid Tank Heater	Data Valid But Above Normal Operating Range , Moderately Severe Level	X	X
3363	18	1712	Aftertreatment 1 Diesel Exhaust Fluid Tank Heater	Data Valid But Below Normal Operating Range , Moderately Severe Level	X	X
3364	2	3878	Aftertreatment Diesel Exhaust Fluid Quality	Data erratic, intermittent or incorrect	X	X

J1939_SPN	J1939_FMI	Cummins' Fault Code	Circuit	Cummins Detailed Description	JT25/JT30	JT60/JT100
3364	3	1686	Aftertreatment Diesel Exhaust Fluid Quality Sensor Circuit	Voltage above normal, or shorted to high source	X	X
3364	4	1685	Aftertreatment Diesel Exhaust Fluid Quality Sensor Circuit	Voltage below normal, or shorted to low source	X	X
3364	5	4741	Aftertreatment Diesel Exhaust Fluid Quality Sensor Circuit	Current below normal or open circuit	X	X
3364	6	4742	Aftertreatment Diesel Exhaust Fluid Quality Sensor Circuit	Current above normal or grounded circuit	X	X
3364	7	3876	Aftertreatment Diesel Exhaust Fluid Quality Sensor	Mechanical system not responding or out of adjustment	X	X
3364	9	3868	Aftertreatment Diesel Exhaust Fluid Quality	Abnormal update rate	X	X
3364	10	4277	Aftertreatment Diesel Exhaust Fluid Quality	Abnormal Rate of Change	X	X
3364	11	1715	Aftertreatment Diesel Exhaust Fluid Quality	Root Cause Not Known	X	X
3364	12	3877	Aftertreatment Diesel Exhaust Fluid Quality Sensor	Bad intelligent device or component		X
3364	13	1714	Aftertreatment Diesel Exhaust Fluid Quality	Out of Calibration	X	X
3364	15	4842	Aftertreatment Diesel Exhaust Fluid Quality	Data Valid But Above Normal Operating Range , Least Severe Level	X	X
3364	18	3867	Aftertreatment Diesel Exhaust Fluid Quality	Data Valid But Below Normal Operating Range , Moderate Severe Level	X	X
3364	19	4241	Aftertreatment Diesel Exhaust Fluid Quality	Received Network Data In Error	X	X
3509	3	386	Sensor Supply 1 Circuit	Voltage above normal, or shorted to high source	X	X
3509	4	352	Sensor Supply 1 Circuit	Voltage below normal, or shorted to low source	X	X
3510	3	227	Sensor Supply 2 Circuit	Voltage above normal, or shorted to high source	X	X
3510	4	187	Sensor Supply 2 Circuit	Voltage below normal, or shorted to low source	X	X
3511	3	239	Sensor Supply 3 Circuit	Voltage above normal, or shorted to high source	X	X
3511	4	238	Sensor Supply 3 Circuit	Voltage below normal, or shorted to low source	X	X
3512	3	2185	Sensor Supply 4 Circuit	Voltage above normal, or shorted to high source	X	X
3512	4	2186	Sensor Supply 4 Circuit	Voltage below normal, or shorted to low source	X	X
3513	3	1695	Sensor Supply 5	Voltage above normal, or shorted to high source	X	X
3513	4	1696	Sensor Supply 5	Voltage below normal, or shorted to low source	X	X
3514	3	515	Sensor Supply 6 Circuit	Voltage above normal, or shorted to high source	X	X
3514	4	516	Sensor Supply 6 Circuit	Voltage below normal, or shorted to low source	X	X
3515	5	4743	Aftertreatment 1 Diesel Exhaust Fluid Temperature 2 Sensor Circuit	Current below normal or open circuit	X	X
3515	6	4744	Aftertreatment 1 Diesel Exhaust Fluid Temperature 2 Sensor Circuit	Current above normal or grounded	X	X
3515	10	4243	Aftertreatment 1 Diesel Exhaust Fluid Temperature 2	Abnormal Rate of Change	X	X
3515	11	4745	Aftertreatment 1 Diesel Exhaust Fluid Temperature 2	Root Cause Not Known	X	X
3521	11	4768	Aftertreatment 1 Diesel Exhaust Fluid Property	Root Cause Not Known	X	X
3597	2	1117	Power Supply Lost With Ignition On	Data erratic, intermittent or incorrect	X	X
3597	12	351	Injector Power Supply	Bad intelligent device or component	X	X
3597	18	1938	ECU Power Output Supply Voltage 1	Data Valid But Below Normal Operating Range , Moderately Severe Level	X	X
3667	2	5221	Engine Air Shutoff Status	Data erratic, intermittent or incorrect		X
3667	3	3139	Engine Air Shutoff Circuit	Voltage above normal, or shorted to high source		X
3667	4	3141	Engine Air Shutoff Circuit	Voltage below normal, or shorted to low source		X
3667	7	4484	Engine Air Shutoff	Mechanical System Not Responding or Out of Adjustment		X
3695	2	4213	Aftertreatment Regeneration Inhibit Switch	Data erratic, intermittent or incorrect	X	X
4094	31	3543	NOx limits exceeded due to Insufficient Reagent Quality	Condition Exists		X
4096	31	3547	Aftertreatment Diesel Exhaust Fluid Tank Empty	Condition Exists	X	X
4185	31	1427	Overspeed Shutdown Relay Driver Diagnostic has detected an error	Condition Exists	X	X
4186	31	1428	Low Oil Pressure (LOP) Shutdown Relay Driver Diagnostic has detected an error	Condition Exists	X	X
4187	31	1429	High Engine Temperature (HET) Shutdown Relay Driver Diagnostic has detected an error	Condition Exists	X	X
4188	31	1431	Pre	Low Oil Pressure Warning Relay Driver Diagnostic has detected an error , Condition Exists	X	X
4223	31	1432	Pre	High Engine Temperature Warning Relay Driver Diagnostic has detected an error , Condition Exists	X	X
4334	2	3596	Aftertreatment 1 Diesel Exhaust Fluid Pressure Sensor	Data erratic, intermittent or incorrect	X	X
4334	3	3571	Aftertreatment 1 Diesel Exhaust Fluid Pressure Sensor	Voltage above normal, or shorted to high source	X	X
4334	4	3572	Aftertreatment 1 Diesel Exhaust Fluid Pressure Sensor	Voltage below normal, or shorted to low source	X	X
4334	16	3575	Aftertreatment 1 Diesel Exhaust Fluid Pressure Sensor	Data Valid But Above Normal Operating Range	X	X
4334	18	3574	Aftertreatment 1 Diesel Exhaust Fluid Pressure Sensor	Data Valid But Below Normal Operating Range	X	X
4337	10	4249	Aftertreatment 1 Diesel Exhaust Fluid Dosing Temperature	Abnormal Rate of Change	X	X
4340	3	3237	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 1 Circuit	Voltage above normal, or shorted to high source	X	X
4340	4	3238	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 1 Circuit	Voltage below normal, or shorted to low source	X	X
4340	5	3258	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 1 Circuit	Current below normal or open circuit	X	X
4342	3	3239	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 2 Circuit	Voltage above normal, or shorted to high source	X	X
4342	4	3241	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 2 Circuit	Voltage below normal, or shorted to low source	X	X

J1939_SPN	J1939_FMI	Cummins' Fault Code	Circuit	Cummins Detailed Description	JT25/JT30	JT60/JT100
4342	5	3261	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 2 Circuit	Current below normal or open circuit	X	X
4344	3	3422	Aftertreatment Diesel Exhaust Fluid Line Heater 3 Circuit	Voltage above normal, or shorted to high source	X	X
4344	4	3423	Aftertreatment Diesel Exhaust Fluid Line Heater 3 Circuit	Voltage below normal, or shorted to low source	X	X
4344	5	3425	Aftertreatment Diesel Exhaust Fluid Line Heater 3 Circuit	Current below normal or open circuit	X	X
4360	0	3229	Aftertreatment 1 SCR Intake Temperature	Data valid but above normal operational range , Most Severe Level	X	X
4360	2	3144	Aftertreatment 1 SCR Intake Temperature Sensor	Data erratic, intermittent or incorrect	X	X
4360	3	3142	Aftertreatment 1 SCR Intake Temperature Sensor Circuit	Voltage above normal, or shorted to high source	X	X
4360	4	3143	Aftertreatment 1 SCR Intake Temperature Sensor Circuit	Voltage below normal, or shorted to low source	X	X
4360	15	3164	Aftertreatment 1 SCR Intake Temperature	Data Valid But Above Normal Operating Range , Least Severe	X	X
4360	16	3231	Aftertreatment 1 SCR Intake Temperature	Data Valid But Above Normal Operating Range , Moderately Severe Level	X	X
4363	0	3165	Aftertreatment 1 SCR Outlet Temperature	Data valid but above normal operational range , Most Severe	X	X
4363	2	3148	Aftertreatment 1 SCR Outlet Temperature Sensor	Data erratic, intermittent or incorrect	X	X
4363	3	3146	Aftertreatment 1 SCR Outlet Temperature Sensor Circuit	Voltage above normal, or shorted to high source	X	X
4363	4	3147	Aftertreatment 1 SCR Outlet Temperature Sensor Circuit	Voltage below normal, or shorted to low source	X	X
4363	16	3235	Aftertreatment 1 SCR Outlet Temperature	Data Valid But Above Normal Operating Range , Moderately Severe Level	X	X
4364	18	3582	Aftertreatment SCR Catalyst Conversion Efficiency	Data Valid But Below Normal Operating Range , Moderately Severe Level	X	X
4376	3	3577	Aftertreatment Diesel Exhaust Fluid Return Valve	Voltage above normal, or shorted to high source	X	X
4376	4	3578	Aftertreatment Diesel Exhaust Fluid Return Valve	Voltage below normal, or shorted to low source	X	X
4376	7	4157	Aftertreatment Diesel Exhaust Fluid Return Valve	Mechanical system not responding or out of adjust	X	X
4765	2	3315	Aftertreatment 1 Diesel Oxidation Catalyst Intake Temperature	Data erratic, intermittent or incorrect	X	X
4765	3	3314	Aftertreatment 1 Diesel Oxidation Catalyst Intake Temperature Sensor Circuit	Voltage above normal, or shorted to high source	X	X
4765	4	3313	Aftertreatment 1 Diesel Oxidation Catalyst Intake Temperature Sensor Circuit	Voltage below normal, or shorted to low source	X	X
4765	16	3251	Aftertreatment 1 Diesel Oxidation Catalyst Intake Temperature	Data Valid But Above Normal Operating Range	X	X
4766	0	5387	Aftertreatment 1 Diesel Oxidation Catalyst Outlet Gas Temperature	Data Valid But Above Normal Operating Range , Most Severe Level	X	X
4766	2	5386	Aftertreatment 1 Diesel Oxidation Catalyst Outlet Gas Temperature	Data Erratic, Intermittent, or Incorrect	X	X
4766	3	4533	Aftertreatment 1 Diesel Oxidation Catalyst Outlet Gas Temperature Sensor Circuit	Voltage above normal, or shorted to high source	X	X
4766	4	4534	Aftertreatment 1 Diesel Oxidation Catalyst Outlet Gas Temperature Sensor Circuit	Voltage below normal, or shorted to low source	X	X
4766	15	5389	Aftertreatment 1 Diesel Oxidation Catalyst Outlet Gas Temperature	Data Valid But Above Normal Operating Range , Least Severe Level	X	X
4766	16	5388	Aftertreatment 1 Diesel Oxidation Catalyst Outlet Gas Temperature	Data Valid But Above Normal Operating Range , Moderately Severe Level	X	X
4792	7	3751	Aftertreatment SCR Catalyst System	Mechanical system not responding or out of adjustment	X	X
4792	14	4585	Aftertreatment 1 SCR Catalyst System	Special Instructions		X
4794	31	3151	Aftertreatment 1 SCR Catalyst System Missing	Condition Exists	X	X
4796	31	1664	Aftertreatment 1 Diesel Oxidation Catalyst Missing	Condition Exists	X	X
5018	11	2637	Aftertreatment 1 Diesel Oxidation Catalyst Face Plugged	Root Cause Not Known	X	X
5018	14	5617	Aftertreatment 1 Diesel Oxidation Catalyst System	Special Instructions	X	X
5024	10	3649	Aftertreatment 1 Intake NOx Sensor Heater	Abnormal rate of change	X	X
5031	10	3583	Aftertreatment 1 Outlet NOx Sensor Heater	Abnormal rate of change	X	X
5125	3	3419	Sensor Supply 7 Circuit	Voltage above normal, or shorted to high source	X	X
5125	4	3421	Sensor Supply 7 Circuit	Voltage below normal, or shorted to low source	X	X
5245	31	4863	Aftertreatment SCR Operator Inducement Active	Condition Exists		X
5246	0	3712	Aftertreatment SCR Operator Inducement	Data valid but above normal operational range , Most Severe level	X	X
5298	18	1691	Aftertreatment 1 Diesel Oxidation Catalyst Conversion Efficiency	Data Valid But Below Normal Operating Range , Moderately Severe Level	X	X
5394	2	3755	Aftertreatment Diesel Exhaust Fluid Dosing Valve	Data erratic, intermittent or incorrect	X	X
5394	5	3567	Aftertreatment Diesel Exhaust Fluid Dosing Valve	Current below normal or open circuit	X	X
5394	7	3568	Aftertreatment Diesel Exhaust Fluid Dosing Valve	Mechanical system not responding or out of adjustment	X	X
5484	3	3633	Engine Fan Clutch 2 Control Circuit	Voltage above normal, or shorted to high source	X	X
5484	4	3634	Engine Fan Clutch 2 Control Circuit	Voltage below normal, or shorted to low source	X	X
5491	3	3562	Aftertreatment Diesel Exhaust Fluid Line Heater Relay	Voltage above normal, or shorted to high source	X	X
5491	4	3563	Aftertreatment Diesel Exhaust Fluid Line Heater Relay	Voltage below normal, or shorted to low source	X	X
5571	0	3741	High Pressure Common Rail Fuel Pressure Relief Valve	Data valid but above normal operational range	X	X
5571	3	4262	High Pressure Common Rail Fuel Pressure Relief Valve	Voltage Above Normal, or Shorted to High Source		X

J1939_SPN	J1939_FMI	Cummins' Fault Code	Circuit	Cummins Detailed Description	JT25/JT30	JT60/JT100
5571	4	4263	High Pressure Common Rail Fuel Pressure Relief Valve	Voltage below normal, or shorted to low source		X
5571	7	3727	High Pressure Common Rail Fuel Pressure Relief Valve	Mechanical system not responding or out of adjustment	X	X
5571	15	5585	High Pressure Common Rail Fuel Pressure Relief Valve	Data Valid But Above Normal Operating Range , Least Severe Level	X	X
5571	31	4867	High Pressure Common Rail Fuel Pressure Relief Valve	Condition Exists		X
5603	9	3843	Cruise Control Disable Command	Abnormal update rate		X
5603	31	3845	Cruise Control Disable Command	Condition Exists		X
5605	31	3844	Cruise Control Pause Command	Condition Exists		X
5742	3	4161	Aftertreatment Diesel Particulate Filter Temperature Sensor Module	Voltage Above Normal, or Shorted to high source	X	X
5742	4	4162	Aftertreatment Diesel Particulate Filter Temperature Sensor Module	Voltage below normal, or shorted to low source	X	X
5742	9	4151	Aftertreatment Diesel Particulate Filter Temperature Sensor Module	Abnormal update rate	X	X
5742	12	4158	Aftertreatment Diesel Particulate Filter Temperature Sensor Module	Bad intelligent device or component	X	X
5742	16	4163	Aftertreatment Diesel Particulate Filter Temperature Sensor Module	Data Valid But Above Normal Operating Range	X	X
5743	3	4164	Aftertreatment Selective Catalytic Reduction Temperature Sensor Module	Voltage Above Normal, or Shorted to high source	X	X
5743	4	4165	Aftertreatment Selective Catalytic Reduction Temperature Sensor Module	Voltage below normal, or Shorted to low source	X	X
5743	9	4152	Aftertreatment Selective Catalytic Reduction Temperature Sensor Module	Abnormal update rate	X	X
5743	11	4261	Aftertreatment Selective Catalytic Reduction Temperature Sensor Module	Root Cause Not Known	X	X
5743	12	4159	Aftertreatment Selective Catalytic Reduction Temperature Sensor Module	Bad intelligent device or component	X	X
5743	16	4166	Aftertreatment Selective Catalytic Reduction Temperature Sensor Module	Data Valid But Above Normal	X	X
5745	3	4168	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Heater	Voltage Above Normal, or Shorted to High	X	X
5745	4	4169	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Heater	Voltage below normal, or shorted to low source	X	X
5745	18	4171	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Heater	Data Valid But Below Normal Operating Range	X	X
5746	3	4155	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Heater Relay	Voltage Above Normal, or Shorted to high source	X	X
5746	4	4156	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Heater Relay	Voltage below normal, or shorted to low source	X	X
5798	10	4251	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Heater Temperature	Abnormal Rate of Change	X	X
6655	3	4951	Maintain ECU Power Lamp	Voltage Above Normal, or Shorted to High Source		X
6655	4	4952	Maintain ECU Power Lamp	Voltage Below Normal, or Shorted to Low Source		X
6713	9	5177	VGT Actuator Driver Circuit	Abnormal update rate		X
6713	13	4956	Variable Geometry Turbocharger Actuator Software	Out of Calibration		X
6713	31	4957	Variable Geometry Turbocharger Actuator Software	Condition Exists		X
6802	31	5278	Aftertreatment 1 Diesel Exhaust Fluid Dosing System Frozen	Condition Exists	X	X
6881	9	5653	SCR Operator Inducement Override Switch	Abnormal Update Rate	X	X
6881	13	5654	SCR Operator Inducement Override Switch	Out of Calibration	X	X
6882	3	5393	Aftertreatment Diesel Oxidation Catalyst Temperature Sensor Module	Voltage Above Normal or Shorted to High Source	X	X
6882	4	5394	Aftertreatment Diesel Oxidation Catalyst Temperature Sensor Module	Voltage Below Normal or Shorted to Low Source	X	X
6882	9	5391	Aftertreatment Diesel Oxidation Catalyst Temperature Sensor Module	Abnormal Update Rate	X	X
6882	11	5395	Aftertreatment Diesel Oxidation Catalyst Temperature Sensor Module	Root Cause Not Known	X	X
6882	12	5392	Aftertreatment Diesel Oxidation Catalyst Temperature Sensor Module	Bad Intelligent Device or Component	X	X
6882	16	5396	Aftertreatment Diesel Oxidation Catalyst Temperature Sensor Module	Data Valid But Above Normal Operating Range , Moderately Severe Level	X	X
6918	31	5632	SCR System Cleaning Inhibited Due to Inhibit Switch	Condition Exists	X	X
6928	31	5631	SCR System Cleaning Inhibited Due to System Timeout	Condition Exists	X	X
520784	3	5183	Fan Blade Pitch Position Sensor Circuit	Voltage Above Normal, or Shorted to High Source	X	X
520784	4	5184	Fan Blade Pitch Position Sensor Circuit	Voltage Below Normal, or Shorted to Low Source	X	X
520784	5	5185	Fan Blade Pitch	Mechanical system not responding or out of adjustment	X	X
520808	31	5291	Engine Emergency Shutdown Switch Activated	Condition Exists		X
520809	31	5292	Excessive Time Since Last Engine Air Shutoff Maintenance Test	Condition Exists		X
524286	31	5617	Aftertreatment 1 Diesel Oxidation Catalyst System	Special Instruction	X	X