Service Manual

ST-120 Iron Roughneck

Reference	Reference Description
	National Oilwell Varco **RIG SOLUTIONS** 11000 Corporate Centre Drive Houston, TX 77041
Document Number **D811000557-MAN-001**	Rev. **04**

NATIONAL OILWELL VARCO

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Revision History

04	05.09.2013	Fourth Issue	M. Taylor	A. Sharma	A. Jones
03	06.03.2010	Third Issue	P. Solovyov	A. Jones	J. Walker
02	16.01.2009	Second Issue	P. Solovyov	J. Walker	J. Walker
01	09.12.2008	First Issue	P. Solovyov	A. Jones	B. Winter
Rev	**Date (dd.mm.yyyy)**	**Reason for issue**	**Prepared**	**Checked**	**Approved**

Change Description

Revision	Change Description
01	First Issue
02	• Added Section: Making Connections (Page 4-4). • Updated Arm Assembly Control plaque throughout document: From: Lever LEFT SLEW RIGHT To: CW SLEW CCW
03	• Update from “User Manual” to “Service Manual” throughout document and use current template. • Replaced figures with latest model. • Updated and added new procedures in Chapters 2 through 7.
04	• Updated to the current template. • Added five steps under the General System Safety Practices section (Page 1-4). • Added Safety Alert Advisory on page 5-16. • Updated Maintenance Operation Warning Plate (page 5-1). • Added Safety Alert Advisory (page 5-26) and updated illustration (page 5-27). • Updated procedure for Removing Torque Wrench Assembly (page 5-18), added Safety Alert Advisory, and changed Figure 5-8 (page 5-19). • Removed Service Center information, Chapter 7, since it is in Chapter 1.

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General Information 1

Conventions

This manual is intended for use by field engineering, installation, operation, and repair personnel. Every reasonable effort has been made to ensure the accuracy of the information contained herein. National Oilwell Varco® (NOV) will not be held liable for errors in this material, or for consequences arising from misuse of this material.

Advisories

Graphic symbols and bracketed text indicate advisories for a specific topic. This information provides the reader with additional details and may advise the reader to take a specific action to protect personnel from potential injury or lethal conditions. These advisories may also inform the reader of actions necessary to prevent equipment damage.

Note

The note symbol indicates that additional information is provided about the current topic.

Caution

The caution symbol indicates that potential damage to equipment, or injury to personnel exists. Follow instructions explicitly. Extreme care should be taken when performing operations or procedures preceded by this caution symbol.

Warning

The warning symbol indicates a definite risk of equipment damage or danger to personnel. Failure to follow safe work procedures could result in serious or fatal injury to personnel, significant equipment damage, or extended rig down time.

Conventions

Advisories

Hot Surfaces

The hot surface symbol indicates the presence of a hot surface or component. Touching this surface could result in bodily injury. To reduce the risk of injury from a hot component, allow the surface to cool before touching.

Illustrations

Illustrations (figures) provide a graphical representation of equipment components or screen snapshots for use in identifying parts, or establishing nomenclature, and may or may not be drawn to scale.

For component information specific to your rig configuration, see the technical drawings included with your NOV documentation.

Safety Requirements

The NOV equipment is installed and operated in a controlled drilling rig environment involving hazardous situations. Proper maintenance is important for safe and reliable operation. Procedures outlined in the equipment manuals are the recommended methods of performing operations and maintenance.

To avoid injury to personnel or equipment damage, carefully observe requirements outlined in this section.

Proper Use of Equipment

NOV equipment is designed for specific functions and applications, and should be used only for its intended purpose.

Safety Requirements

Safe Lifting

When lifting and handling NOV equipment, use approved lifting procedures and safe methods.

Always follow all federal, state and local rules, codes, and rig-specific safety guidelines when lifting and handling NOV equipment. Operators and maintenance personnel should be properly trained in safe lifting procedures and the inspection of material handling equipment and lifting components. Safe lifting recommendations provided in this manual do not take precedence over local safety rules and regulations, OSHA regulations, or instructions issued by the manufacturers of rig hoisting equipment and other tools on the rig.

Lifting equipment improperly creates a hazardous working environment. To avoid lifting hazards, only lift equipment with material handling equipment rated for the expected load and only from the designated lift points. Failure to follow safe lifting guidelines may result in serious or fatal injury to personnel, significant equipment damage, and extended rig down time.

Personnel Training

All personnel performing installation, operations, repair, or maintenance procedures on the equipment, or those in the vicinity of the equipment, should be trained in rig safety, tool operation, and maintenance to ensure their safety.

Personnel should wear protective gear during installation, maintenance, and certain operations.

Contact the NOV training department for more information about equipment operation and maintenance training.

Safety Requirements

Recommended Tools

Service operations may require the use of tools designed specifically for the purpose described. The equipment manufacturer recommends that only those tools specified be used when stated. Ensure that personnel and equipment safety are not jeopardized when following service procedures and that personnel are not using tools that were not specifically recommended by the manufacturer.

General System Safety Practices

The equipment discussed in this manual may require or contain one or more utilities such as electrical, hydraulic, pneumatic, or cooling water.

Read and follow the guidelines below before installing equipment or performing maintenance to avoid endangering exposed persons or damaging equipment.

- Isolate energy sources before beginning work.
- Avoid performing maintenance or repairs while the equipment is in operation.
- Wear proper protective equipment during equipment installation, maintenance, or repair.
- Read and understand the manual before operation of the equipment.
- Ensure that personnel are clear of the operating path of the equipment before operation.
- Shut down the equipment when not in use.
- When restarting the equipment, ensure that all personnel are clear of the equipment before use. If tool moves unexpectedly, shut down and lock out equipment immediately and inspect equipment for damage.
- Do not, for any reason, place hands or limbs in any portion of the roughneck while the equipment is enabled or operating.

Safety Requirements

Replacing Components

- Verify that all components (such as cables, hoses, etc.) are tagged and labeled during assembly and disassembly of equipment to ensure correct installment.
- Replace failed or damaged components with original equipment manufacturer certified parts. Failure to do so could result in equipment damage or injury to personnel.

Safety Requirements

Routine Maintenance

Equipment must be maintained on a routine basis. See product-specific service manuals for maintenance recommendations.

During operation, surfaces may become hot enough to cause bodily injury. To reduce the risk of injury from hot components, allow the surface to cool before touching.

Failure to conduct routine maintenance could result in equipment damage or injury to personnel.

Service Centers

For a directory of NOV Service Centers, see document number D811001337-DAS-001, titled “Service Center Directory.” This document is located in the User Manual.

The link below provides after-hours contact information for emergencies or other equipment issues requiring an immediate response by NOV service personnel.

www.nov.com/contact_us/24hr_EmergencyList.asp

Overview 2

Tool Description

The ST-120 Iron Roughneck is a drill floor tool used for make-up and break-out of drilling tubular connections. Designed for use on offshore and large land rigs, the durable Iron Roughneck features a manually operated extend/retract scissor-arm system. The Iron Roughneck allows clearance around the Well Center and the Mousehole during use or when placed in the parked position.

The Iron Roughneck can make or break all tool connections from 4" – 10" outside diameter, and can handle nominal drill pipe from 3-1/2" up to 7". The Iron Roughneck can also make and break stabilizers, spiral collars, and other Bottom Hole Assembly (BHA) components with sufficient connection length.

For safe operating conditions, place the Iron Roughneck in the parked position when it is not in use.

This document describes the day-to-day care and operation of the Iron Roughneck. It is essential that the operators have the required knowledge, education, and training before using the tool and related equipment and systems.

Head Assembly and Arm Assembly Controls are used to operate the Iron Roughneck. Refer to ***section titled "Control Console Assembly" on page 2-24***. For convenient operation, the Control Console Assembly can be mounted on the front left or right side of the Iron Roughneck Head Assembly. The hydraulic control components safely and quickly provide up to 100,000 ft.-lbs. makeup torque and 120,000 ft.-lbs breakout torque.

The Iron Roughneck works at Well Center and at the Mousehole. When the Iron Roughneck is not in use, personnel can operate a control valve to rotate the tool around the column into the storage position.

The ST-120 Iron Roughneck can be installed on the drill floor by either of the two following methods:

- Single, floor-mounted socket with no hanging cable (see to Figure 2-14).
- Floor mount assembly with an upper tie back assembly to secure the Iron Roughneck to the rig structure (see Figure 2-15).

Iron Roughneck Components

Table 2-1. Iron Roughneck Components

Assembly	Description
Head Assembly	The Head Assembly includes Spin Wrench and Torque Wrench Assemblies. The Head Assembly is connected to the Arm Assembly. The Control Console support is located on the front of the Head Assembly. For details, refer to ***section titled "Head Assembly" on page 2-20***.
• **Spin Wrench Assembly**	The Spin Wrench rollers grip the connection and spins with a torque of 3000 ft.-lb. For details, refer to ***section titled "Spin Wrench Assembly" on page 2-22***.
• **Torque Wrench Assembly**	The Torque Wrench can make up the connection with a maximum torque of 100,000 ft.-lb, and break out connections with a maximum torque of 120,000 ft.-lb. For details, refer to ***section titled "Torque Wrench Assembly" on page 2-21***.
Control Console Assembly	The Iron Roughneck operator-controlled control console is installed on the front of the Iron Roughneck. The control console can be mounted on the front left or front right side, depending on the space requirements of the rig floor. For details, refer to ***section titled "Control Console Assembly" on page 2-24***.
Arm Assembly	Capable of extending and retracting, the Arm Assembly supports and provides horizontal travel of the Head Assembly for positioning at the Well Center, Mousehole, and Parked/ Standby positions. For details, refer to and ***section titled "Arm Assembly" on page 2-19***.
Column Assembly	The Column Assembly, which is mounted either on a floor socket or on the drill floor, provides vertical and rotational travel for the Iron Roughneck for alignment with either the Mousehole or Well Center as required. For details, refer to ***section titled "Column Assembly" on page 2-18***.
Mounting Assemblies	
• **Iron Roughneck - Floor Socket Mount Model**	The Column Assembly is attached to the Floor Socket assembly to secure the Iron Roughneck to the drill floor. For details, refer to ***section titled "Floor Socket Assembly Installation" on page 2-15***.
• **Iron Roughneck - Floor Mount Model**	The Column Base Assembly is welded to the drill floor and a Tie-Back structure secures the Iron Roughneck to the Mast. For details, refer to ***section titled "Floor Mount Assembly Installation Options" on page 2-16***.

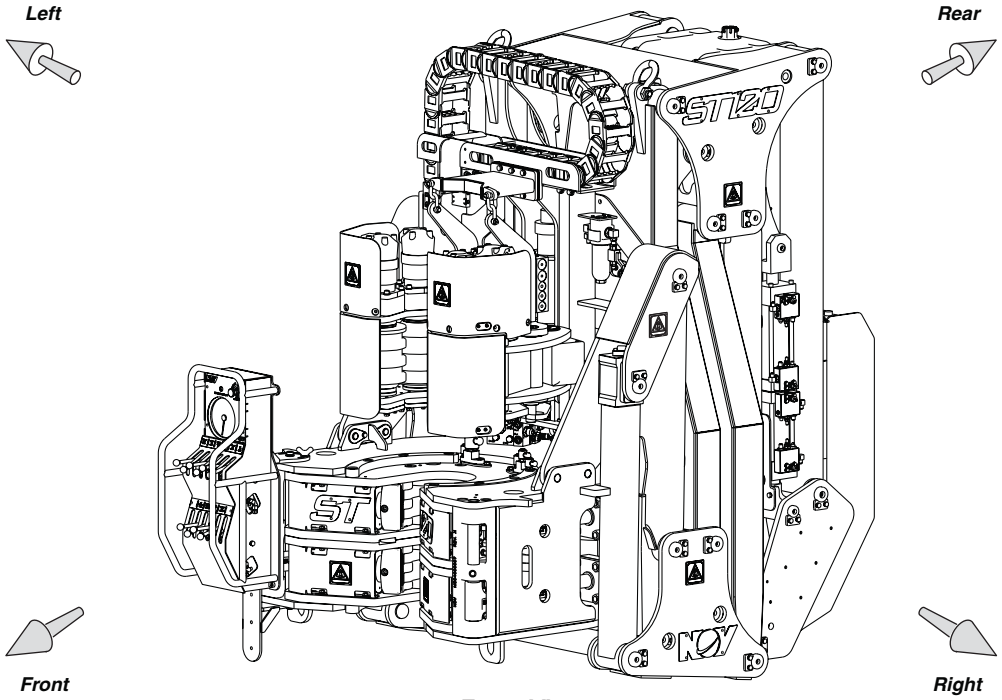
Iron Roughneck Components

Table 2-1. Iron Roughneck Components (cont.)

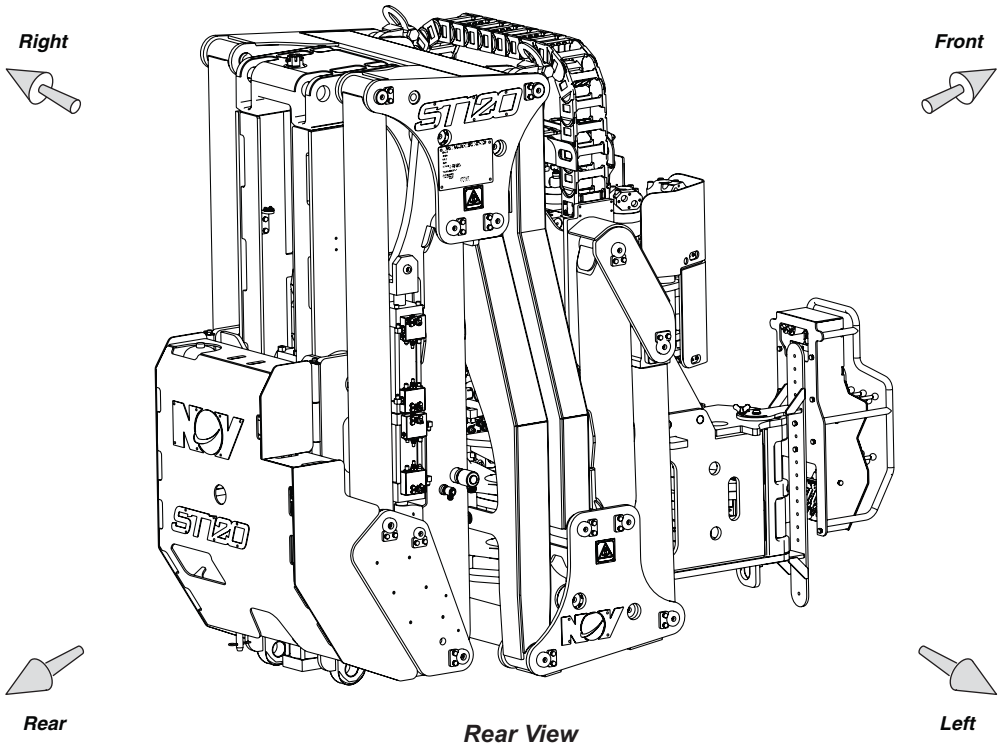
Assembly	Description
Hydraulic Assembly	The Hydraulic Assembly provides operations functions for movable components of the Iron Roughneck. For details, refer to ***section titled "Hydraulic Assemblies" on page 2-23***.
Bit Breaker Assembly	The Bit Breaker Assembly is auxiliary equipment used for making or breaking tubing to drill bit connections. See section titled "Bit Breaker Assembly" on page 2-25.

Tool Orientation

The Iron Roughneck Head Assembly can be positioned over Well Center or Mousehole for tubular makeup and breakout procedures. Refer to Chapter 4, titled "Positioning and Adjusting the Iron Roughneck.



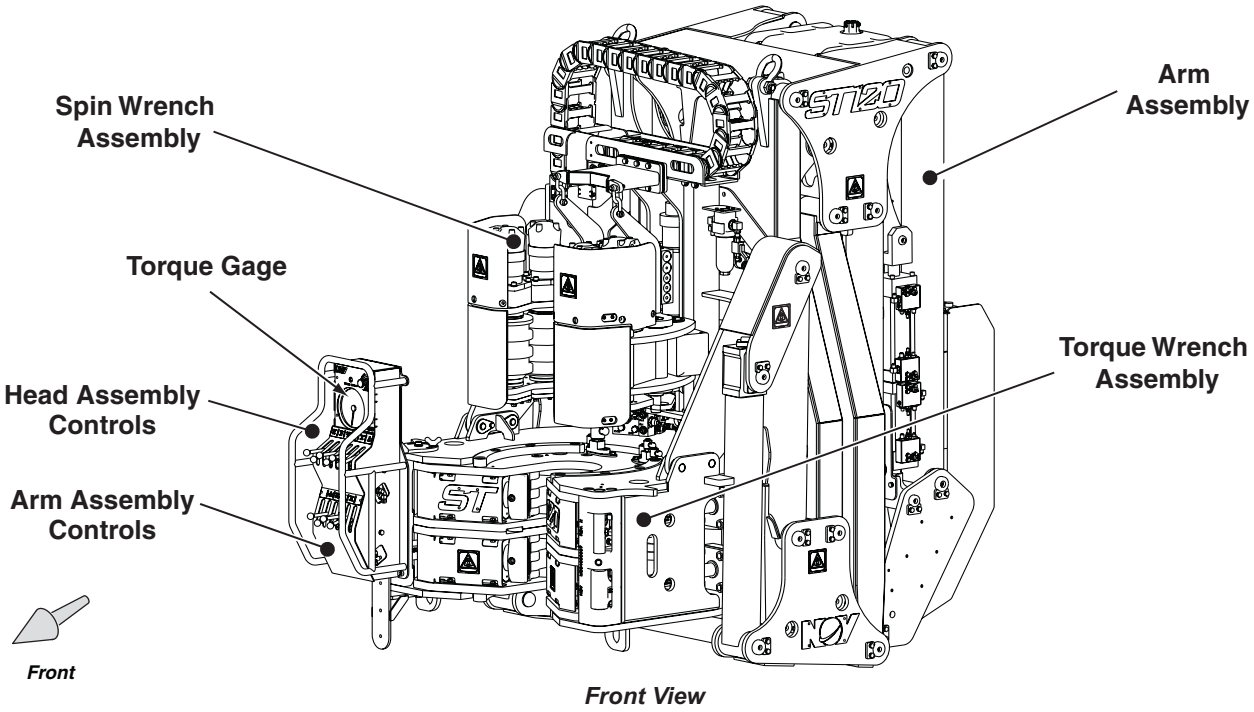
Front View



Rear View

Figure 2-1. Iron Roughneck - Orientation

Tool Orientation



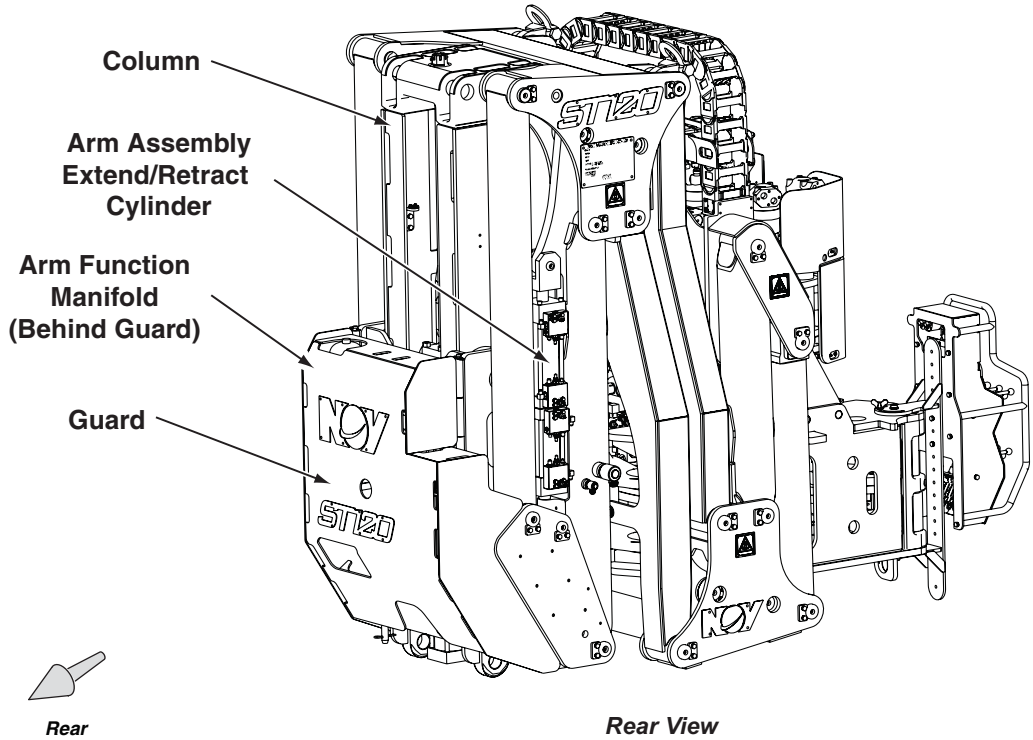


Figure 2-2. Iron Roughneck - General Description

Specifications

Hydraulic Requirements

Required Operating Pressure	2,500 psi (172 bar)
Required Flow Rate	45 gpm (170 lpm)
Maximum Input Pressure	3,000 psi (206 bar)
Minimum Input Pressure	2,500 psi (172 bar)
Maximum Flow Rate	65 gpm (246 lpm)
Supply Connections	1" pressure, 1 1/4" tank, and 1/2" drain

Spin Wrench

Speed	80 rpm on 5" OD Tubular
Torque	3,000 ft-lb (4,067 N-m) on 5" OD Tubular

Torque Wrench

Make-up Torque	100,000 ft-lb (135,582 N-m)
Break-out Torque	120,000 ft-lb (162,698 17)
Connection Range	3 1/2" - 10"

Specifications

Socket Mounted Option

The Iron Roughneck is flexible for positioning as required according to rig floor specifications.

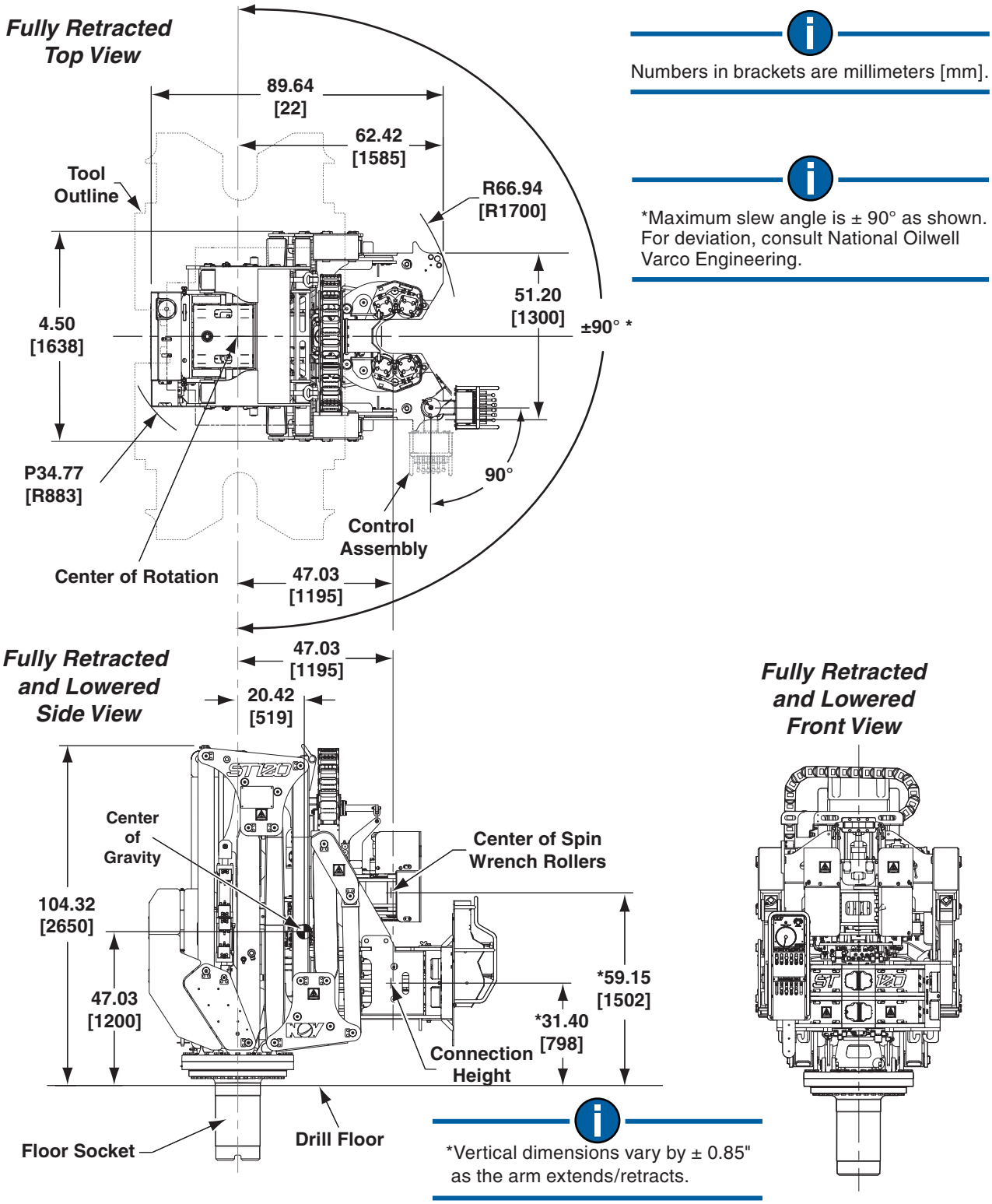


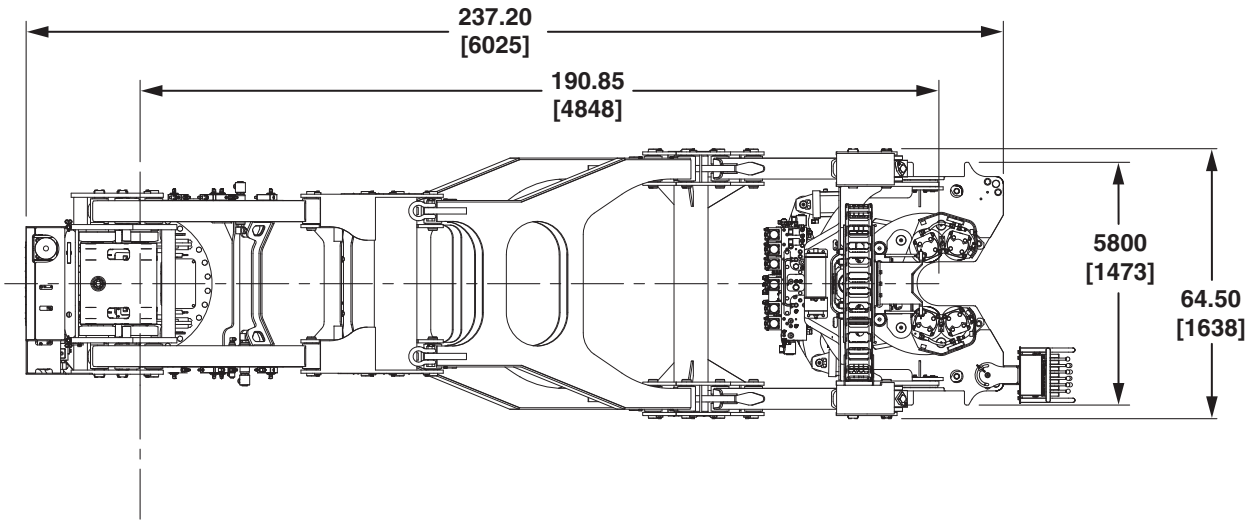
Figure 2-3. Socket Mounted Option - Range of Operation (1 of 4)

Specifications

Socket Mounted Option

Numbers in brackets are millimeters [mm].

Fully Extended Top View



Fully Extended and Fully Lowered Side View

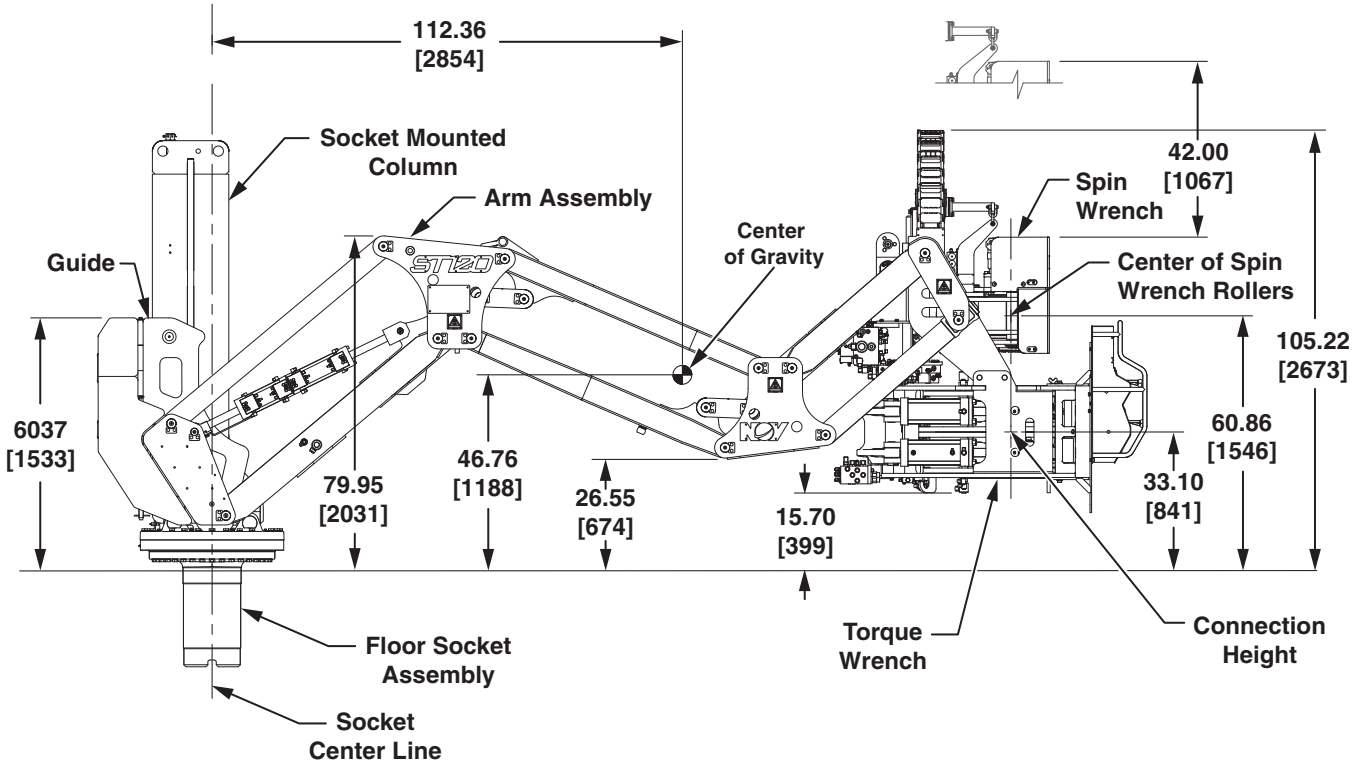


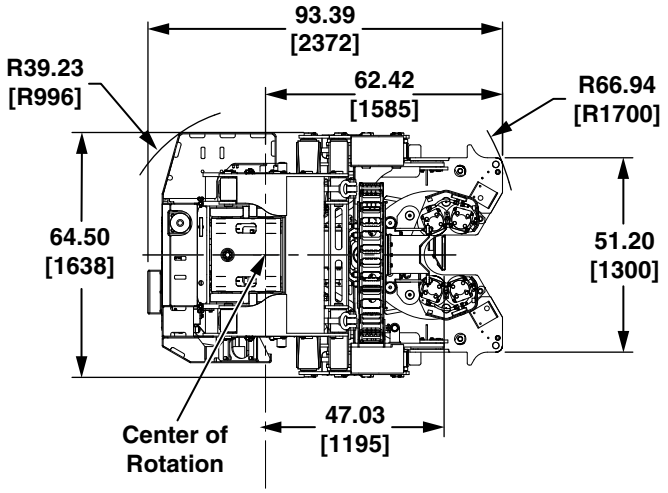
Figure 2-4. Socket Mounted Option - Range of Operation (2 of 4)

Specifications

Socket Mounted Option

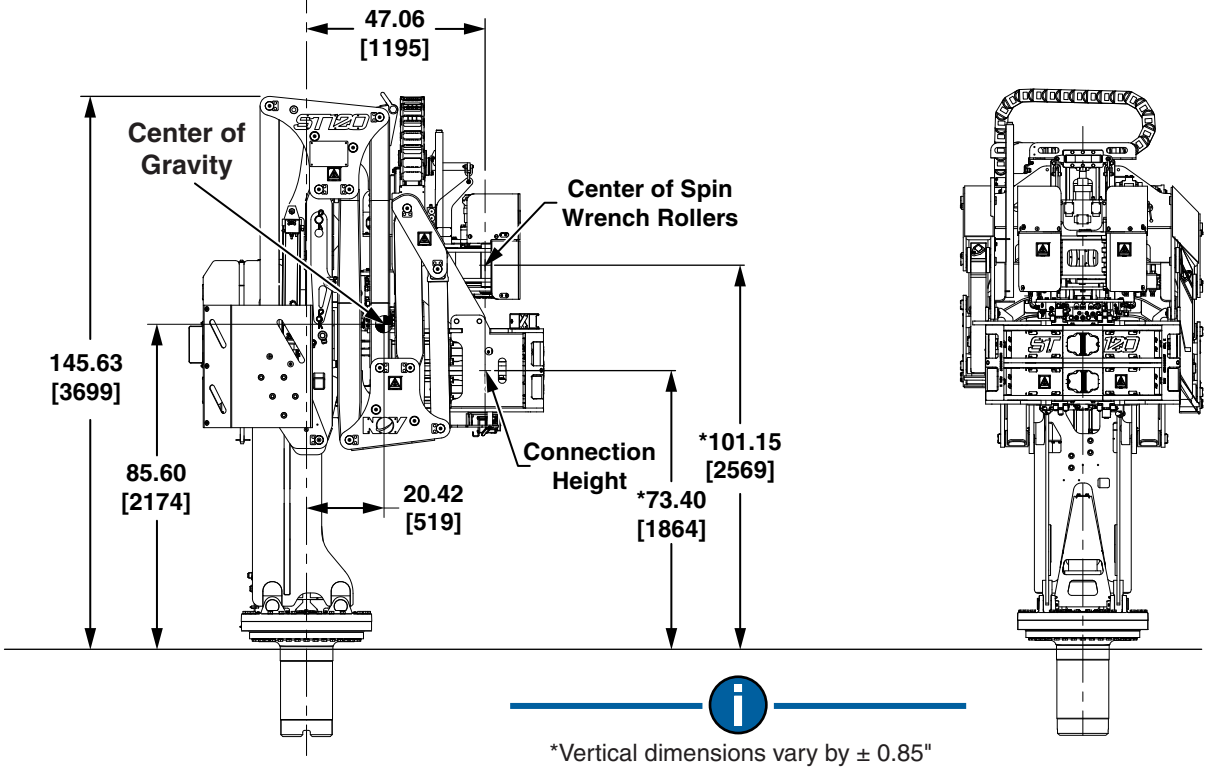
Fully Retracted Top View

Numbers in brackets are millimeters [mm].



Fully Retracted and Fully Raised Side View

Fully Raised Front View



*Vertical dimensions vary by ± 0.85" as the arm extends/retracts.

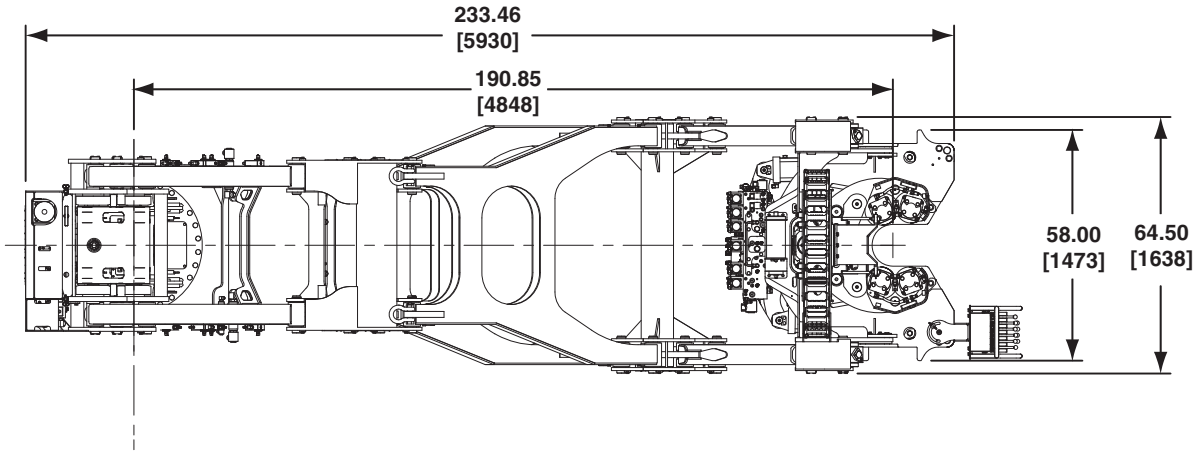
Figure 2-5. Socket Mounted Option - Range of Operation (3 of 4)

Specifications

Socket Mounted Option

Numbers in brackets are millimeters [mm].

Fully Extended Top View



Fully Extended and Fully Raised Side View

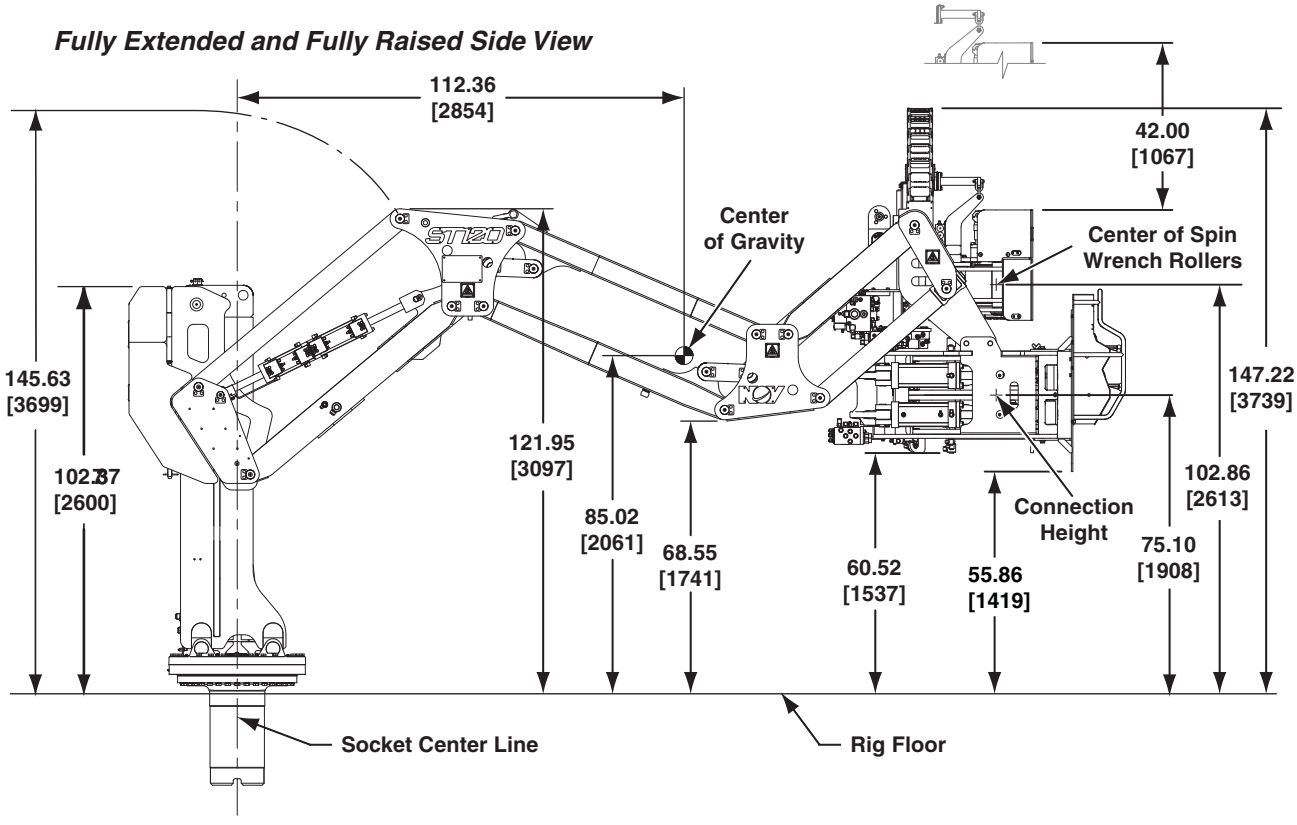


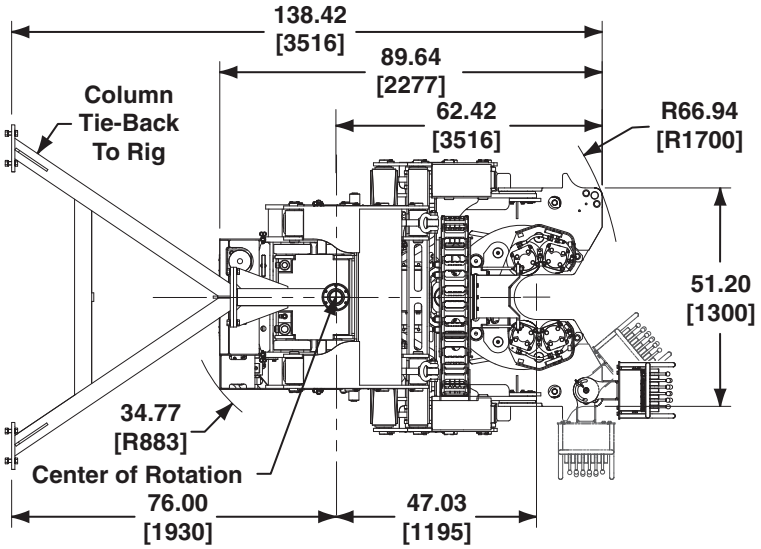
Figure 2-6. Socket Mounted Option - Range of Operation (4 of 4)

Specifications

Floor Base Mounted Option

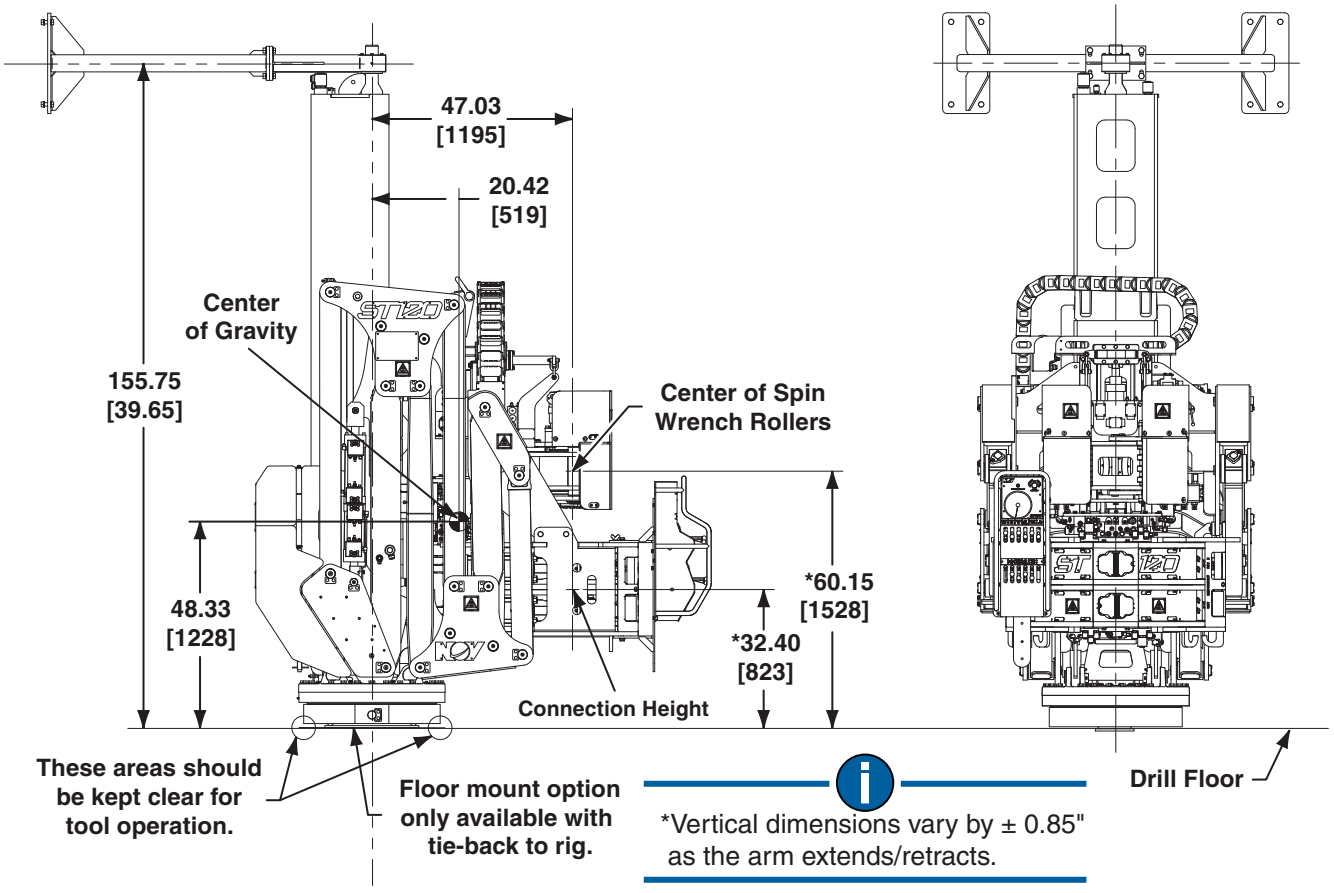
Fully Retracted and Lowered Top View

Numbers in brackets are millimeters [mm].



Fully Retracted and Fully Lowered Side View

Fully Retracted and Fully Lowered Front View



*Vertical dimensions vary by ± 0.85" as the arm extends/retracts.

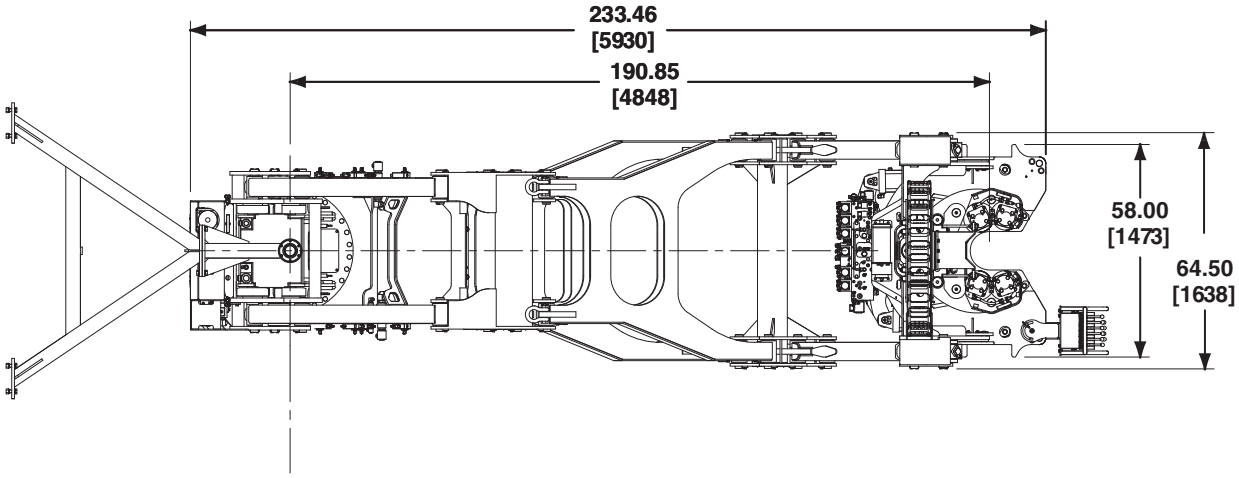
Figure 2-7. Floor Mount Assembly Option - Range of Operation (1 of 4)

Specifications

Floor Base Mounted Option

Numbers in brackets are millimeters [mm].

Fully Extended Top View



Fully Extended Side View

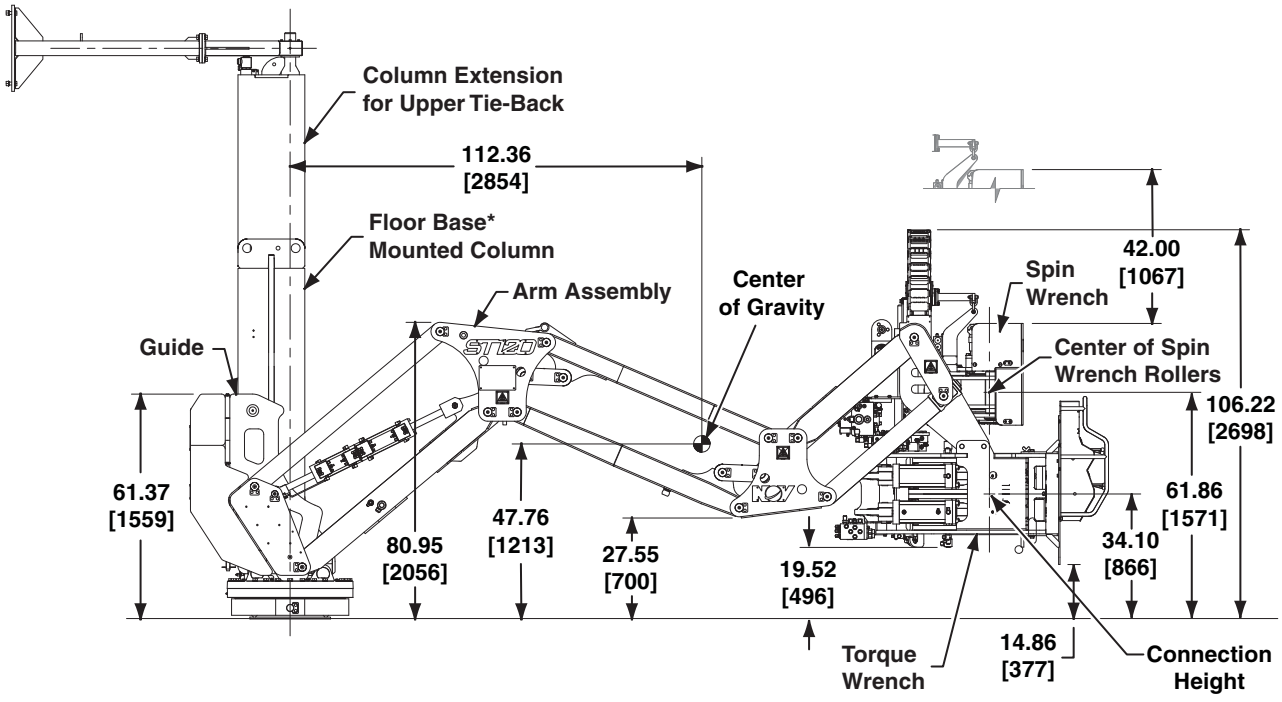


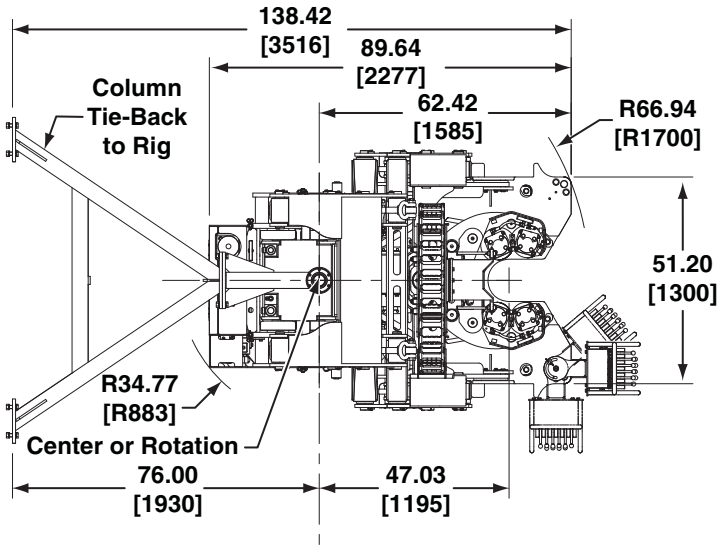
Figure 2-8. Floor Mount Assembly Option - Range of Operation (2 of 4)

Specifications

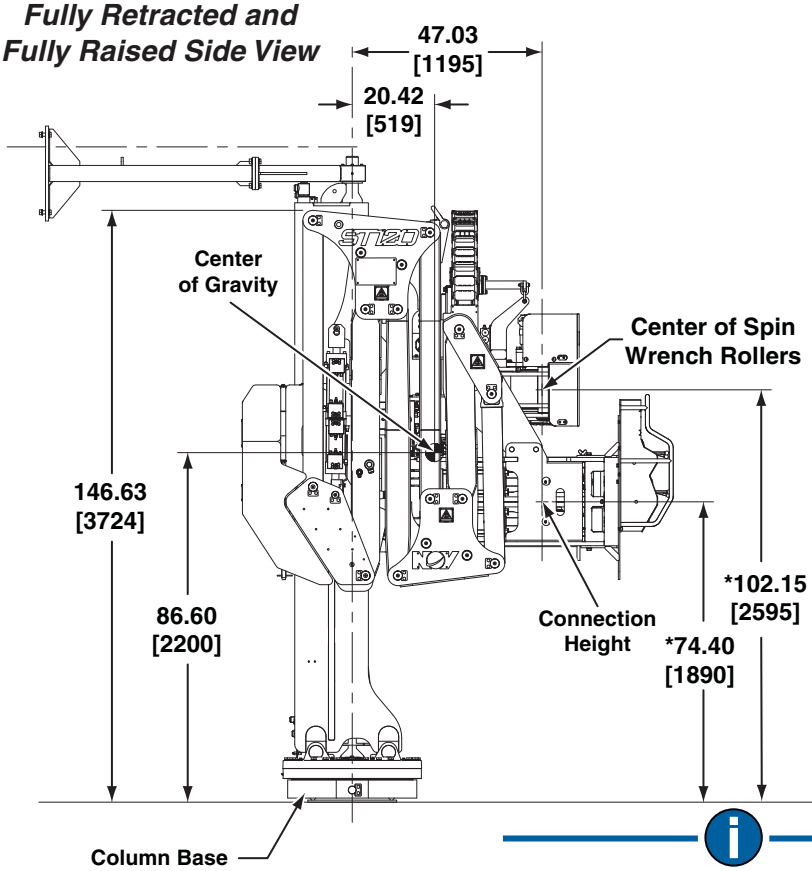
Floor Base Mounted Option

Fully Retracted and Fully Raised Top View

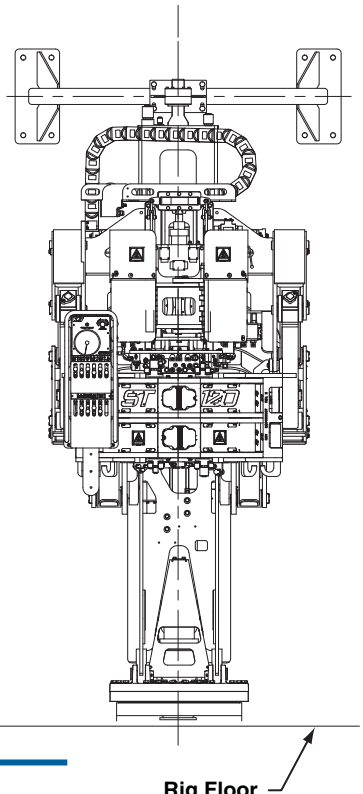
Numbers in brackets are millimeters [mm].



Fully Retracted and Fully Raised Side View



Fully Retracted and Fully Raised Front View



*Vertical dimensions vary by ± 0.85" as the arm extends/retracts.

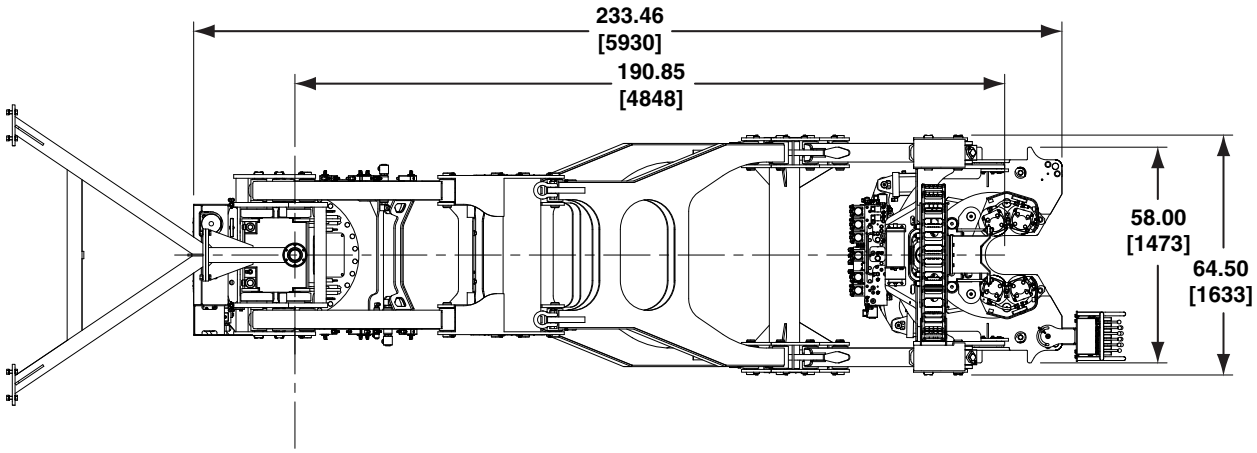
Figure 2-9. Floor Mount Assembly Option - Range of Operation (3 of 4)

Specifications

Floor Base Mounted Option

Fully Extended and Fully Raised Top View

Numbers in brackets are millimeters [mm].



Fully Extended and Fully Raised Side View

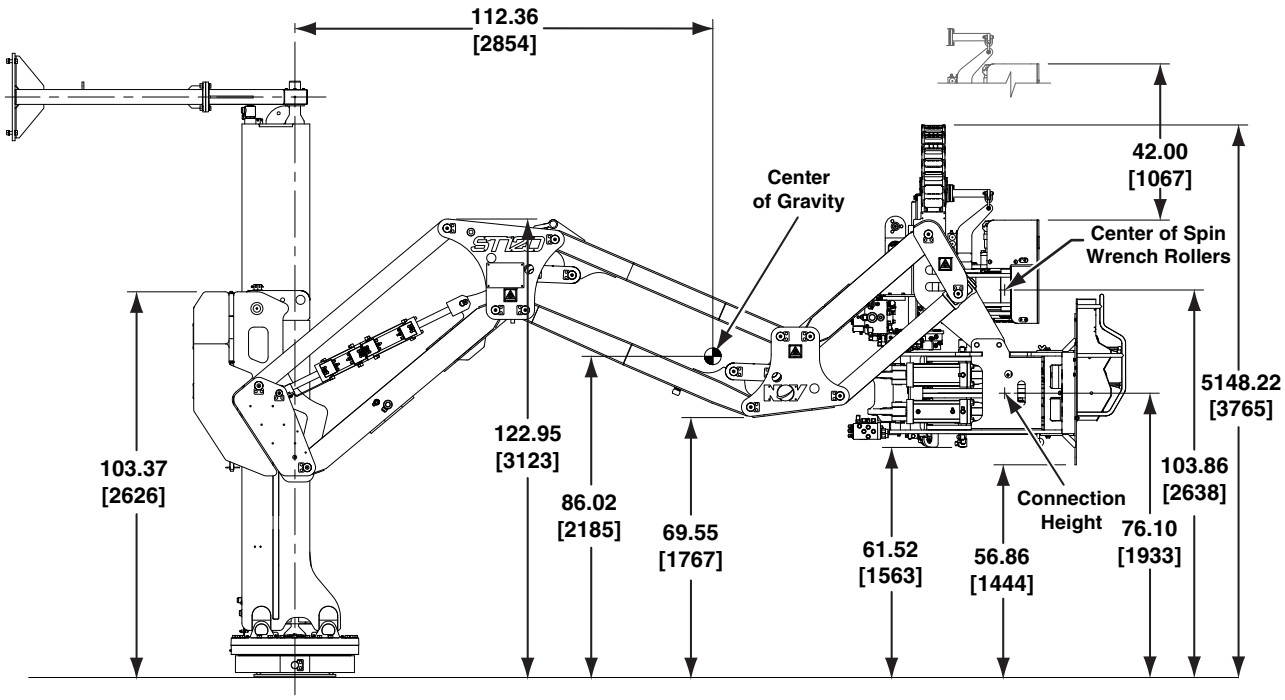


Figure 2-10. Floor Mount Assembly Option - Range of Operation (4 of 4)

Installation Options

The ST-120 Iron Roughneck can be installed on the drill floor by either a single, floor-mounted socket, or a floor-base assembly with a tie back assembly. See Figure 2-11 and Figure 2-12.

Floor Socket Assembly Installation

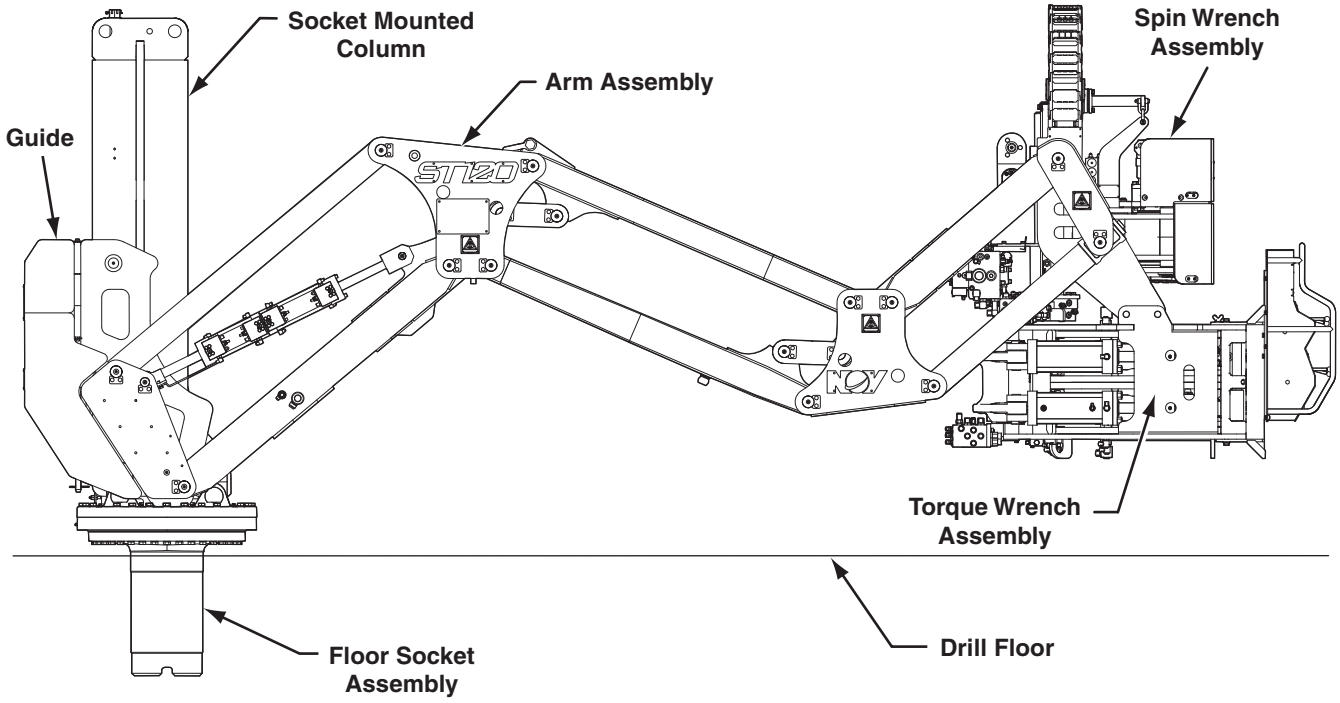


Figure 2-11. Floor Socket Assembly Installation Options

Installation Options

Floor Mount Assembly Installation

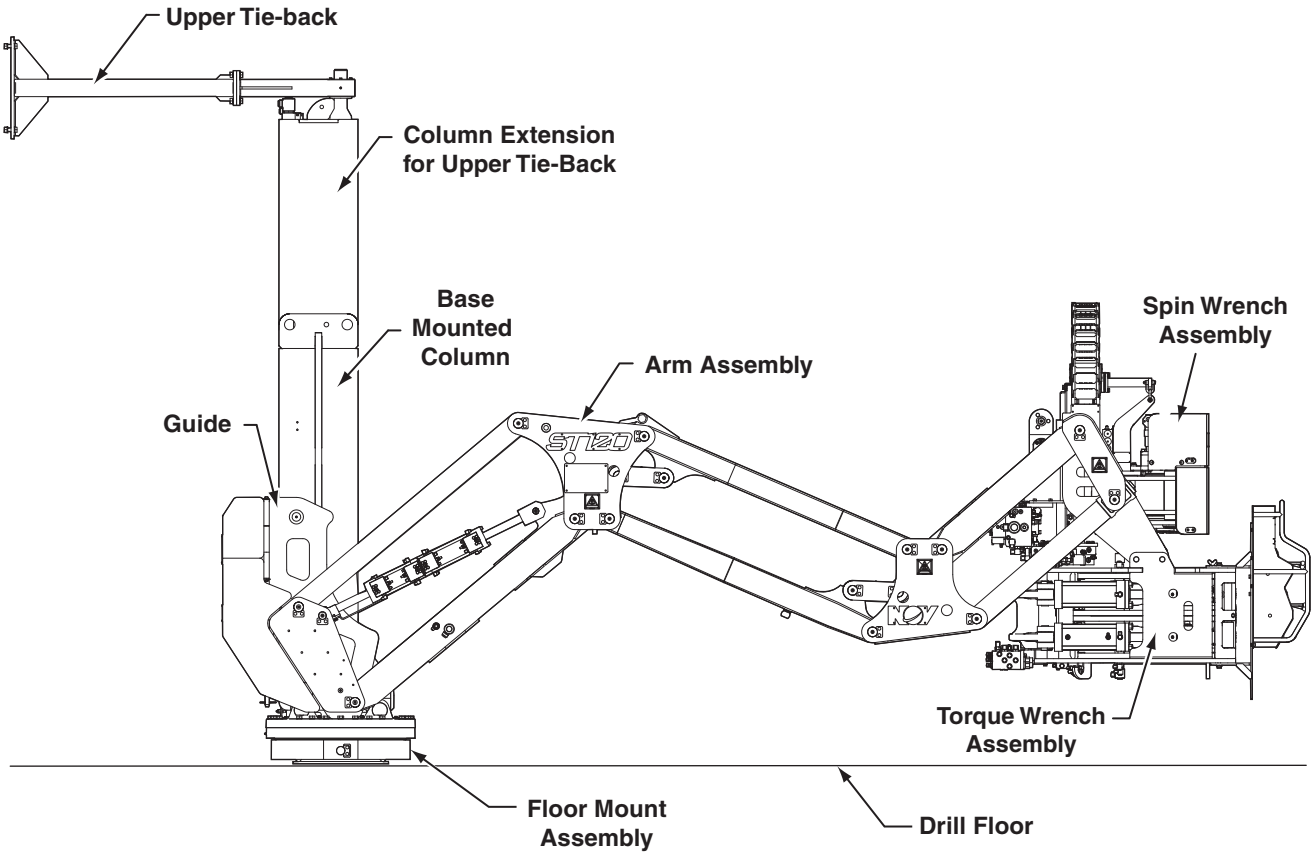


Figure 2-12. Floor Mount Assembly Installation Options

Assembly Description

Floor Socket Assembly

The Iron Roughneck is installed on the drill floor using a single, floor-mounted socket. The Socket Assembly enables the Iron Roughneck to be rotated for proper alignment over the Well Center or Mousehole.

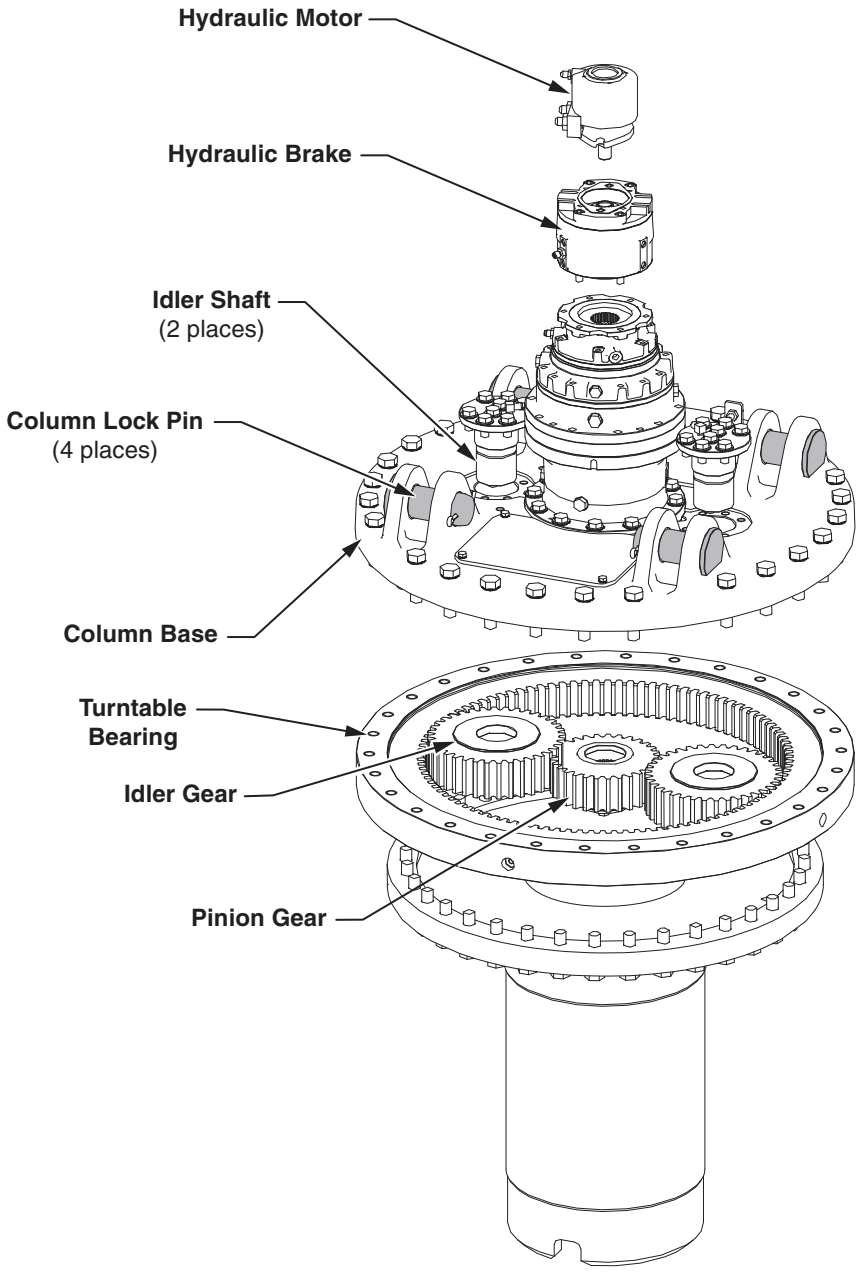


Figure 2-13. Floor Socket Assembly

Assembly Description

Column Assembly

The Column Assembly, which is mounted on the drill floor, provides vertical and rotational travel for the Iron Roughneck for alignment with either the Mousehole or Well Center as required.

If air is introduced into the duplex extend cylinder, use extreme caution when extending the arm for the first time.

As the arm extends, the air will compress causing the arm to extend rapidly. Support unit with tugger and stand to the side until air is purged.

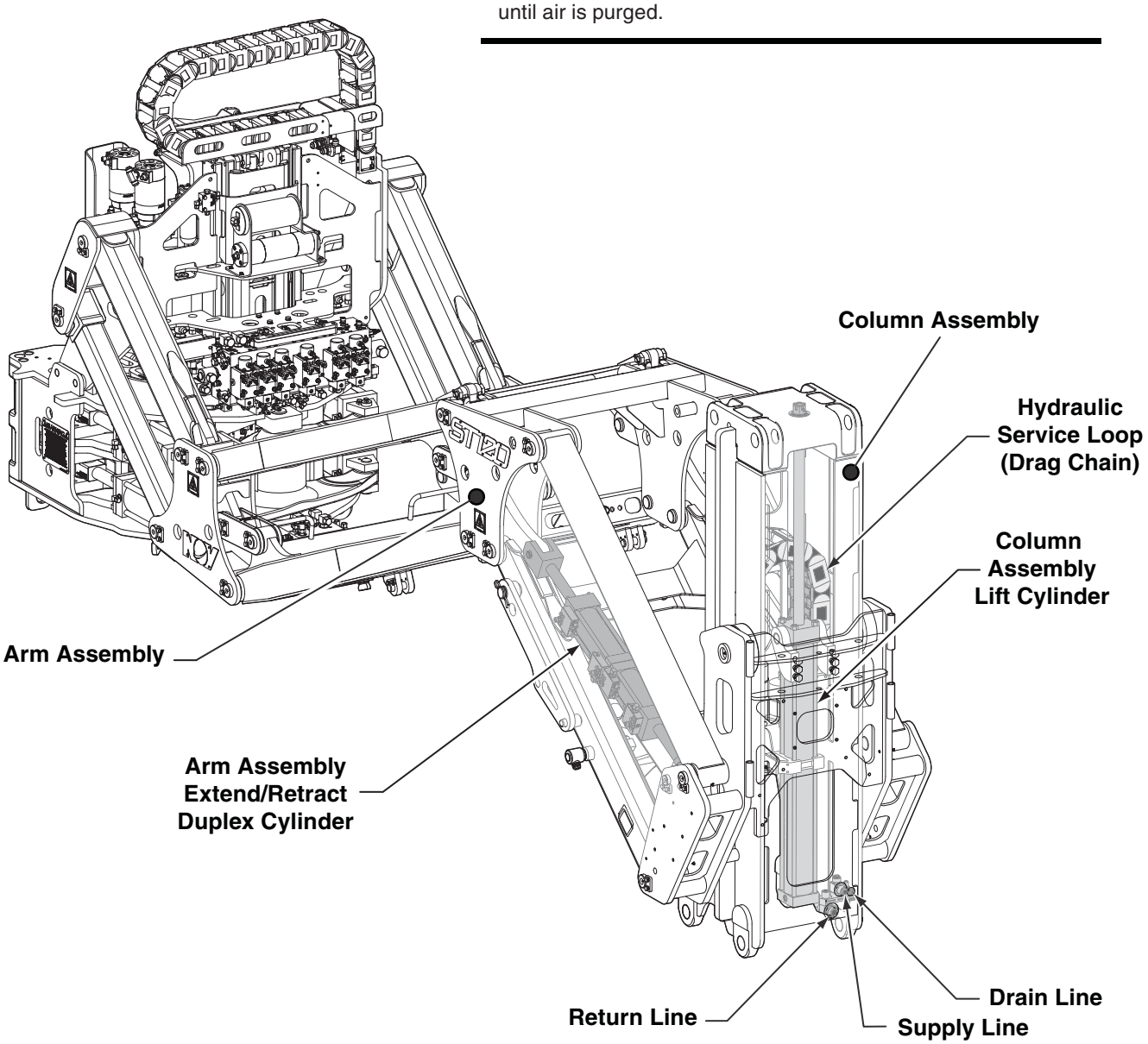


Figure 2-14. Column Assembly

Assembly Description

Arm Assembly

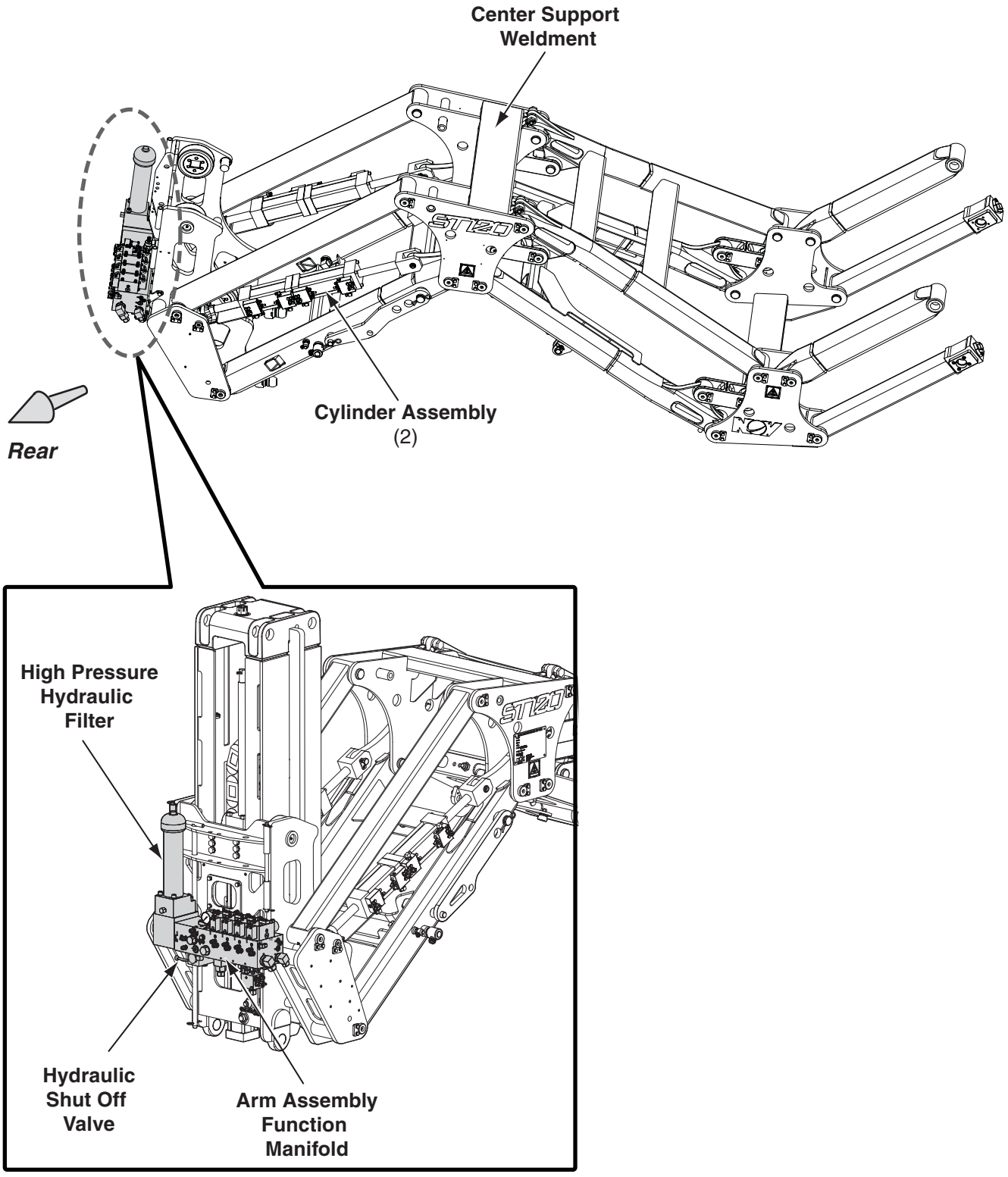


Figure 2-15. Arm Assembly

Assembly Description

Head Assembly

The Iron Roughneck Head Assembly attaches to the scissor-arm which provides horizontal travel to align the Iron Roughneck with Well Center or Mousehole. The Head Assembly contains the spin wrench and torque wrench assemblies.

The control console can be installed on the left or right side of the Iron Roughneck carriage. Refer to ST-120 Installation Procedure, included in the *User Manual*.

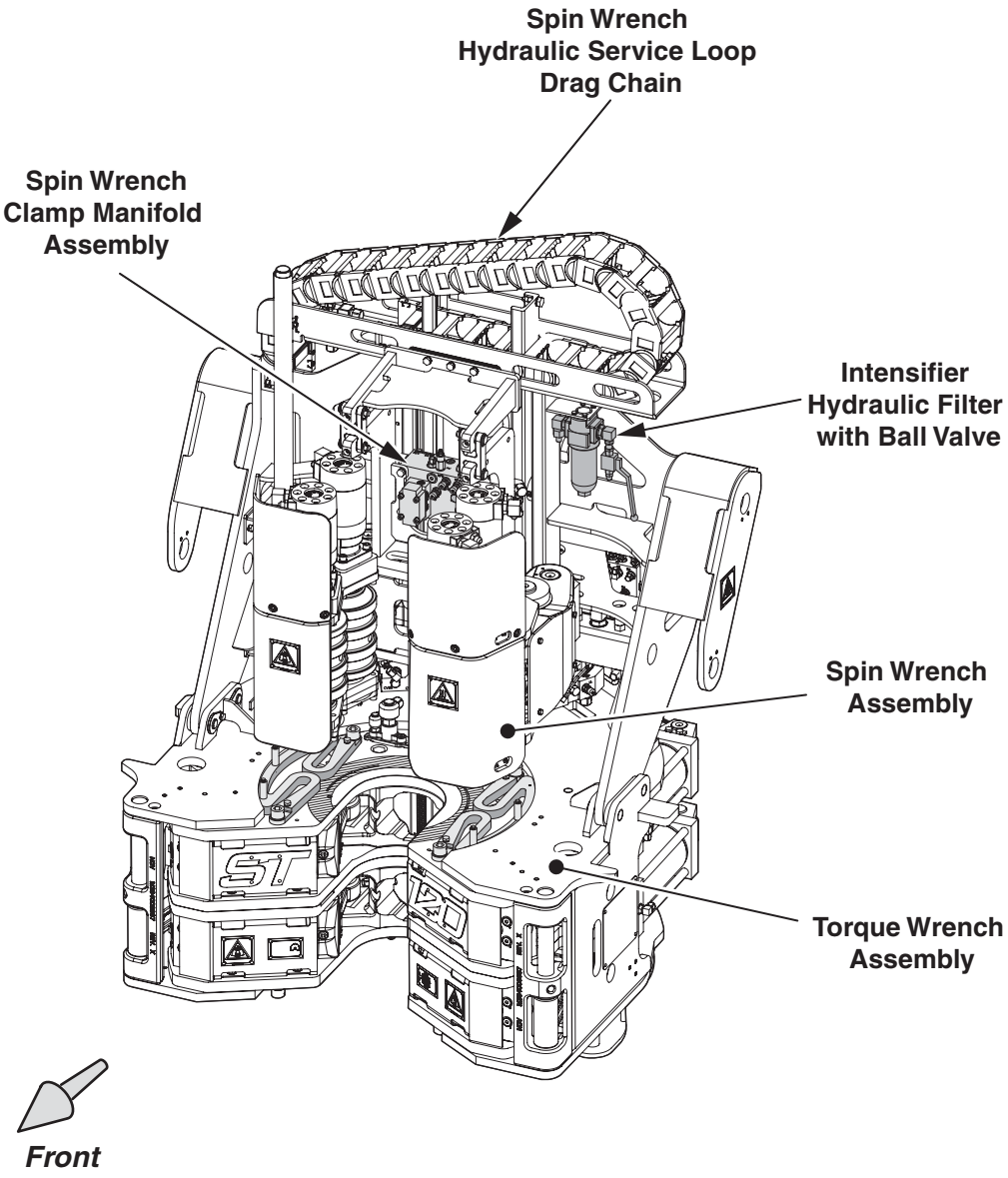


Figure 2-16. ST-120 Head Assembly

Assembly Description

Torque Wrench Assembly

The Torque Wrench can make up connections up to a maximum torque of 100,000 ft.-lb. The Torque Wrench can break out connections up to a maximum torque of 120,000 ft.-lb. Follow general safety precautions when working around the Torque Wrench. Failure to follow the precautions in these warnings may result in serious injury to personnel and/or damage to equipment.

Ensure power is OFF to the Torque Wrench before touching or performing repairs and maintenance. The Torque Wrench presents pinching hazards.

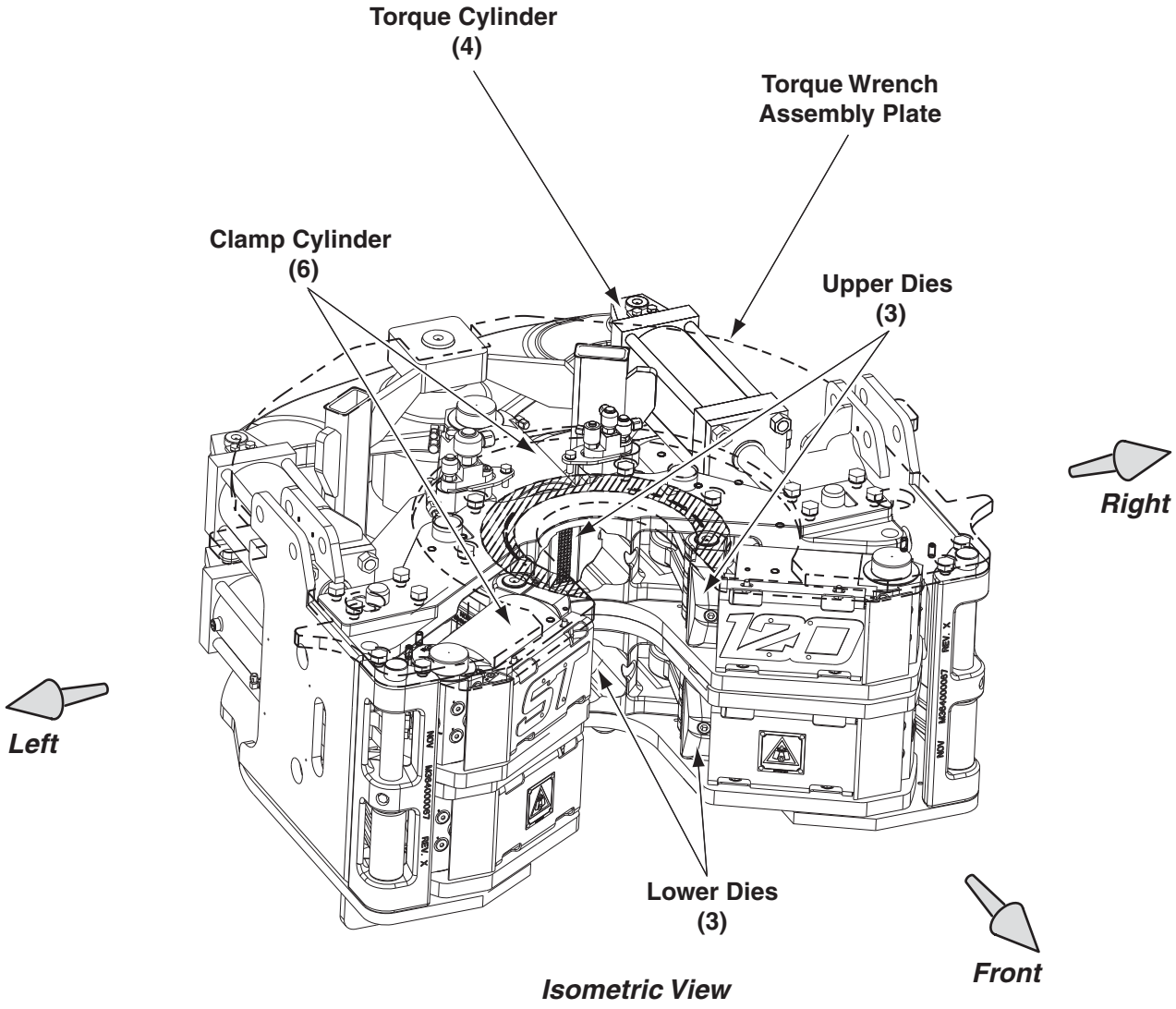
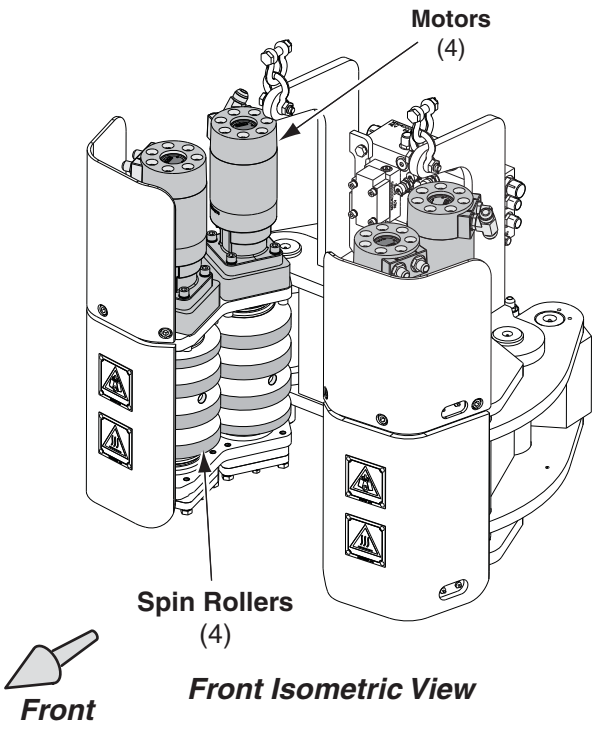


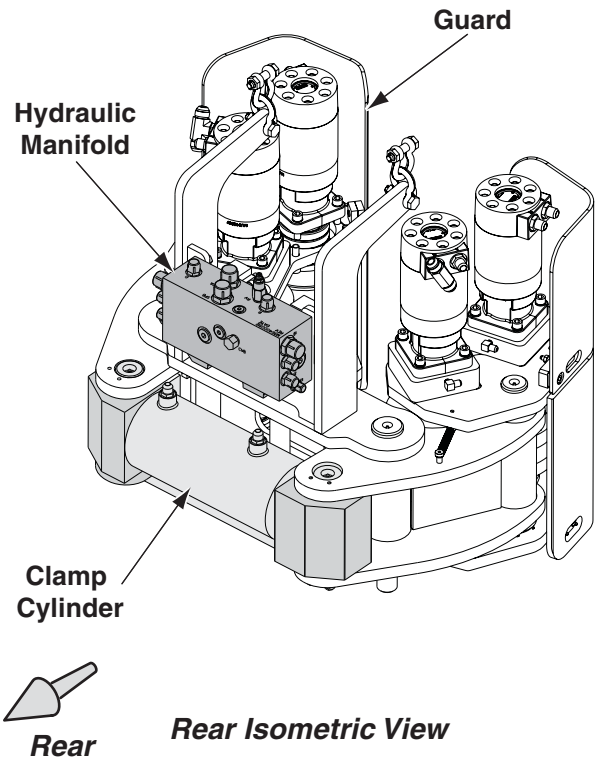
Figure 2-17. Torque Wrench Assembly

Assembly Description

Spin Wrench Assembly

The Spin Wrench rollers grip the connection and spins with a torque of 3,000 ft.-lbs, on 5" OD tubulars.





Ensure power is OFF to the Spin Wrench before touching or performing repairs and maintenance. Spin rollers present pinching hazards.

Spin rollers can become hot during operation. Ensure spin rollers are allowed to cool before touching or performing repairs and maintenance.

Ensure tools, clothing, or personal equipment do not come in contact with the spin rollers during operation. Objects can become tangled in the spin rollers and lead to serious personal injury or equipment damage.

Figure 2-18. Replace Spin Rollers

Assembly Description

Hydraulic Assemblies

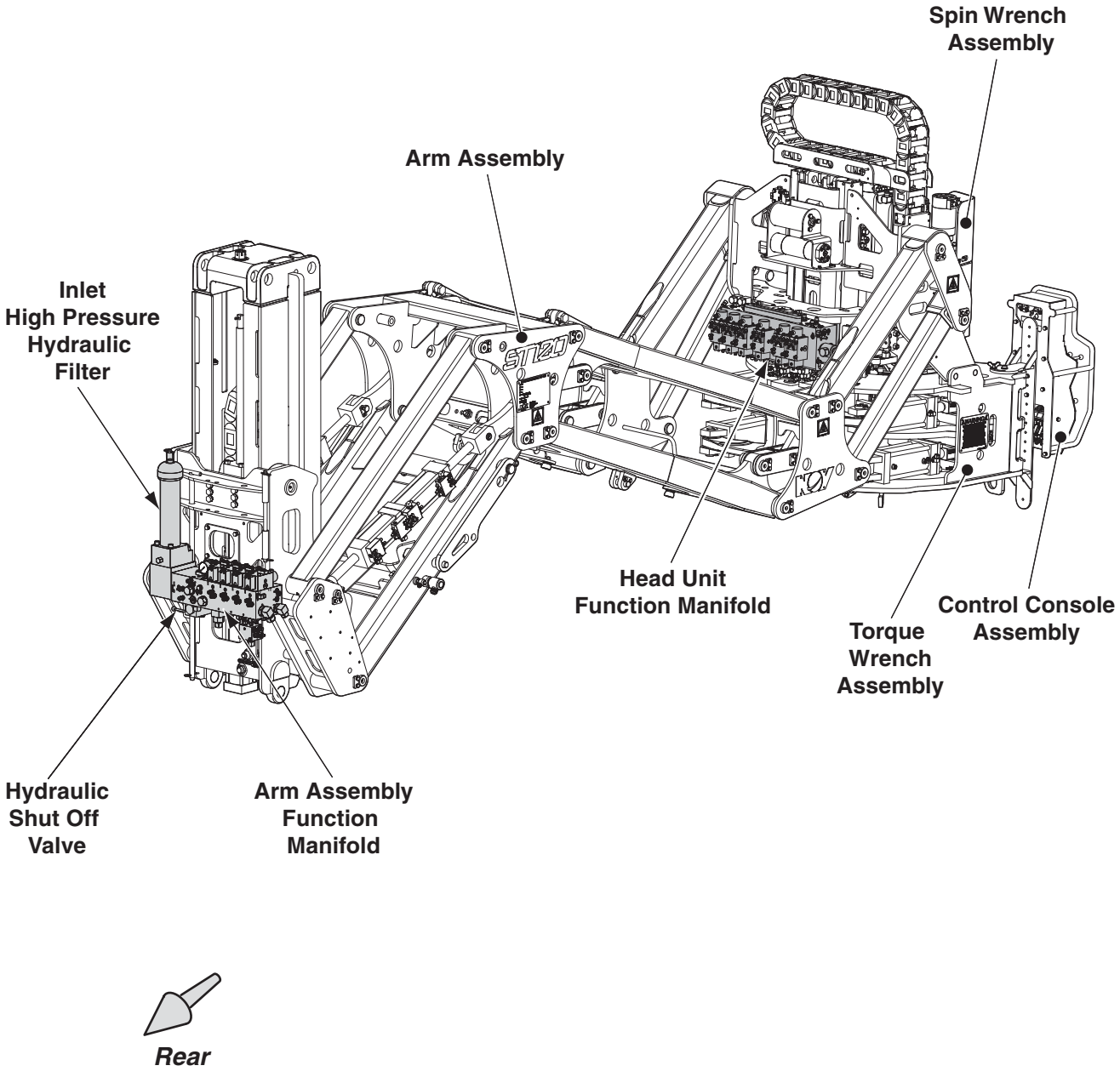
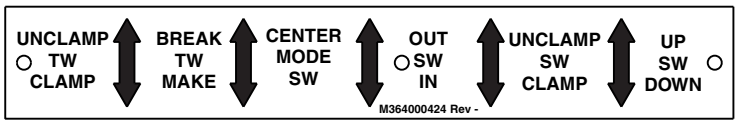


Figure 2-19. ST-120 Hydraulic Assemblies

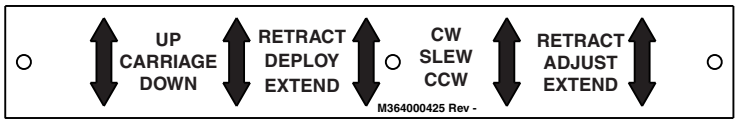
Assembly Description

Control Console Assembly

The Iron Roughneck Control Console can be installed on the right or left side of the Head Assembly and adjusted out 90°. Refer to Figure 2-5 on page 2-9. The ST-120 Iron Roughneck Control Console includes Head Assembly and Head Assembly controls.



Head Assembly Control Plaque



Arm Assembly Control Plaque

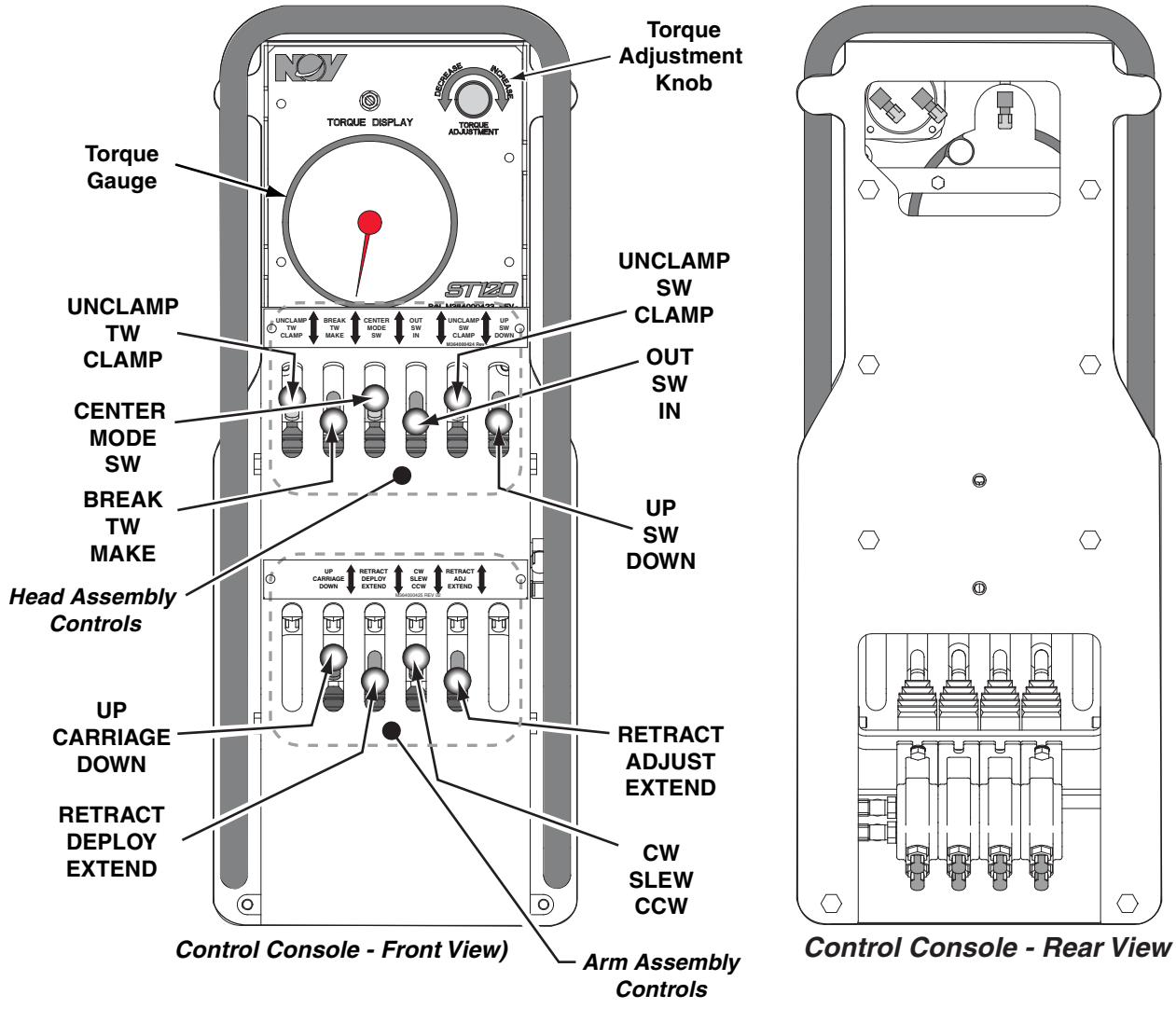


Figure 2-20. Control Console Views

Auxiliary Equipment

Bit Breaker Assembly

Uniform holes in the side panels can be used to adjust the height of the guide plates, lock plates, and adapter plates.

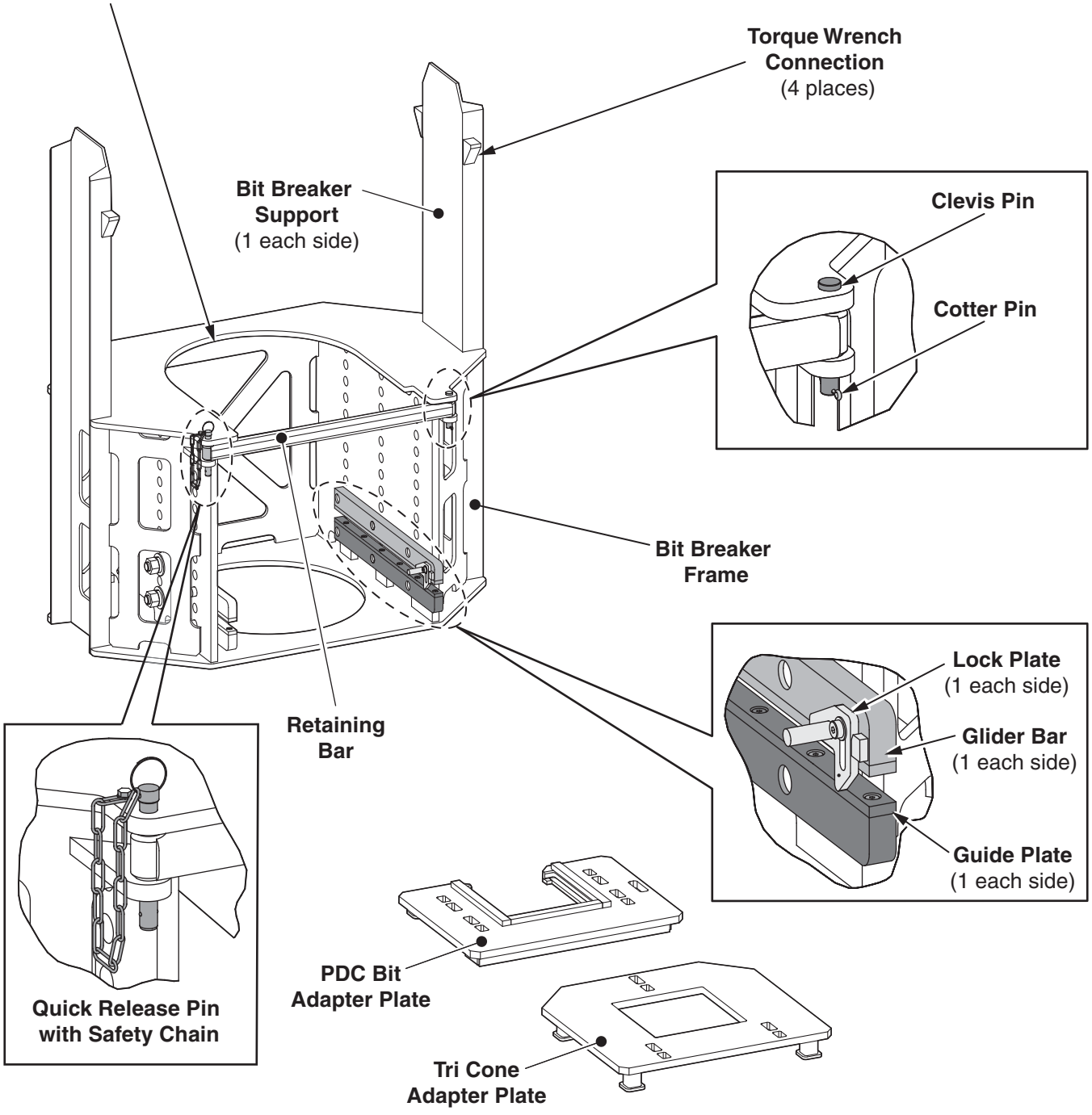


Figure 2-21. Bit Breaker Carrier

Pinch Point Hazards

Keep all body parts clear of pinch point hazards.

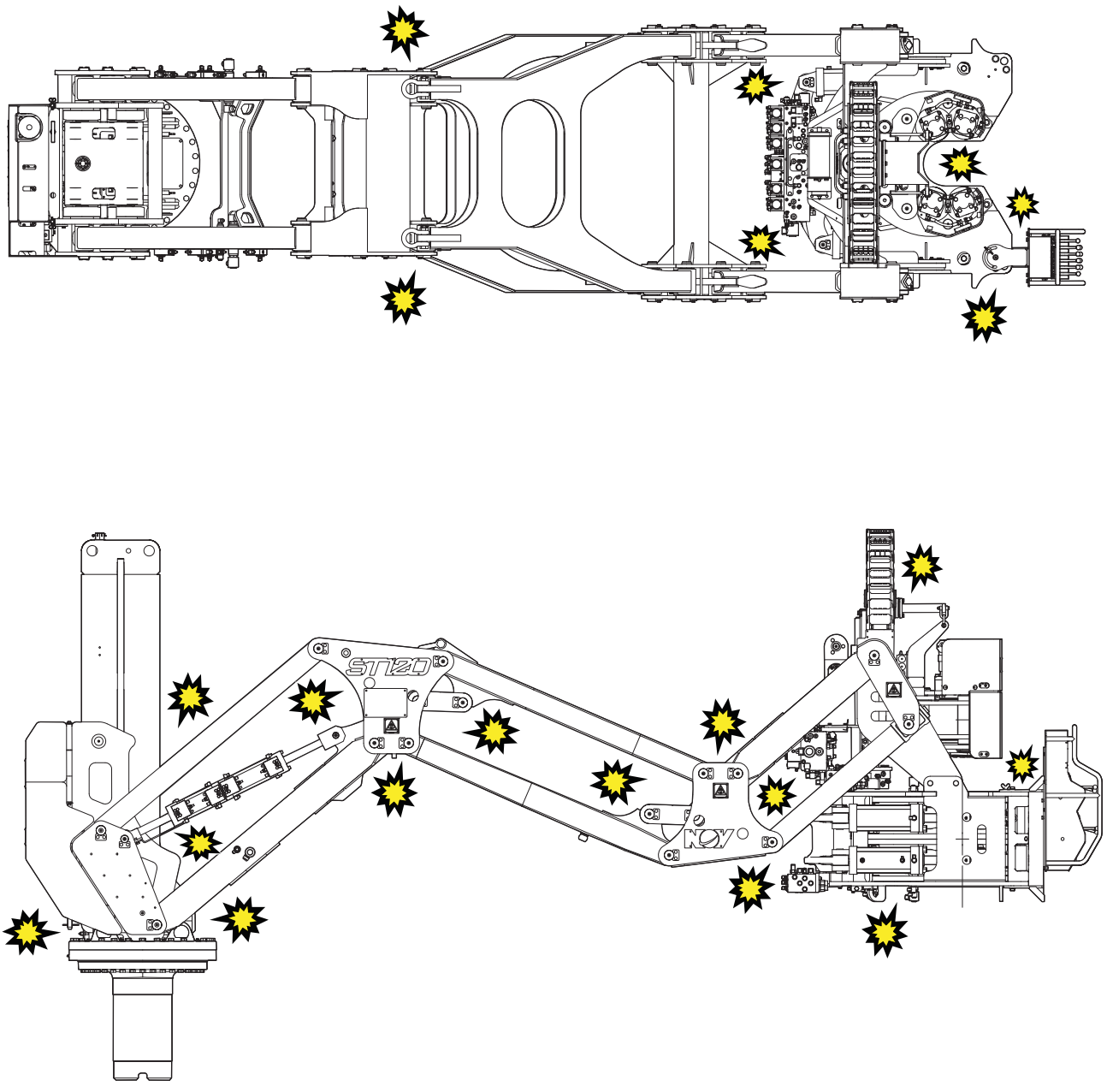


Figure 2-22. Iron Roughneck Pinch Point Hazards

Installation 3

ST-120 Iron Roughneck Installation Procedures Manual

A separate, custom installation manual is required for the ST-120 Generation 2 Iron Roughneck models. Please refer to the *ST-120 Installation Procedures Manual* in the Technical Drawing Package included in the ST-120 Shipping Package.

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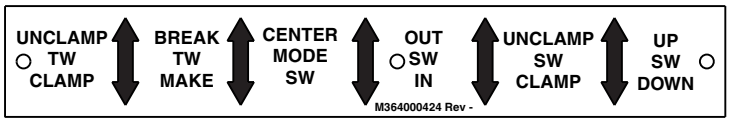
Operation 4

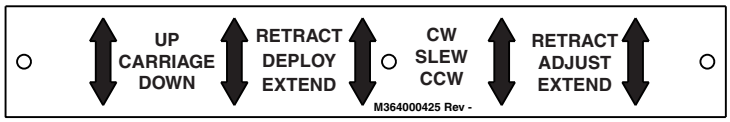
Operating the Iron Roughneck

Control Console

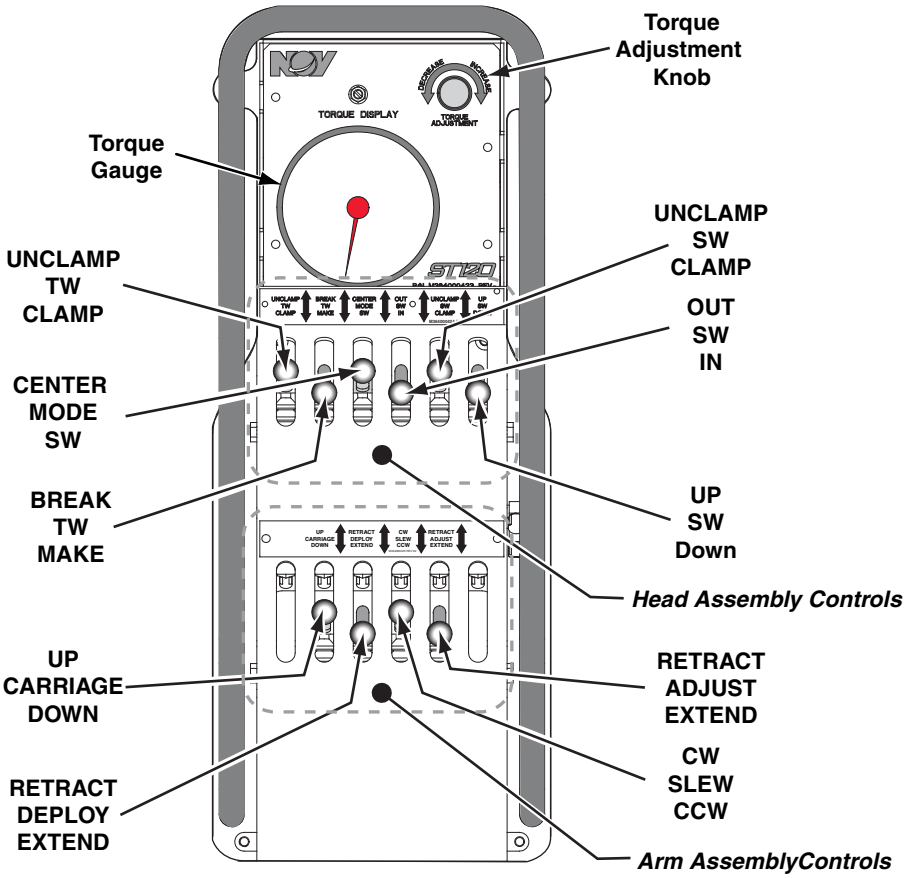
The Control Console levers operate the Head Assembly (Torque Wrench and Spin Wrench) and the Arm Assembly. For operating procedures, refer to section titled "Positioning and Adjusting the Iron Roughneck" on page 4-3.



Head Assembly Control Plaque



Arm Assembly Control Plaque



Control Console (Front View)

Figure 4-1. Head Assembly and Arm Assembly Control Console

Operating the Iron Roughneck

Normal Sounds

Sounds in the following list may occur during normal operation.

- **Ticking:** Ticking noise occurs when jaws have made contact with pipe and the intensifier is building pressure.
- **Whining:** The torque wrench clamp flow dividers make a whining noise when the jaws are being clamped prior to making contact with pipe. The torque wrench also makes a whining noise when the output torque is set in the lower range.
- **Humming:** Humming noise occurs from the slew system when slewing.

Normal Occurrences

Activity described in the following list may occur during normal operation:

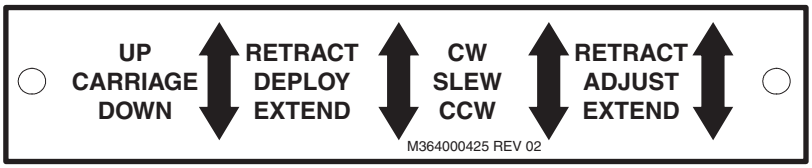
- Torque Wrench may cycle left or right slowly when operating other functions.*
- Spin Wrench may move up and down when operating other functions.*
- Spin Wrench may drift down when raised above the first stage of the telescopic cylinder.*
- Torque gage drops to ZERO when going to full make position.*
- Spin Wrench rollers may rotate very slowly when operating other functions.*

*Component motion that occurs when operating other functions is due to high return pressure.Operating the Iron Roughneck

Positioning and Adjusting the Iron Roughneck

Before operating the ST-120 for the first time, be sure to remove the storage pin and place it in a secure location. Do not operate the ST-120 Iron Roughneck when the storage pin is installed.

Special attention is necessary if hard banding is present. Do not grip on hard banding.



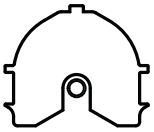
Arm Assembly Control Plaque

Procedure

Use Arm Assembly Control Levers for the following steps:

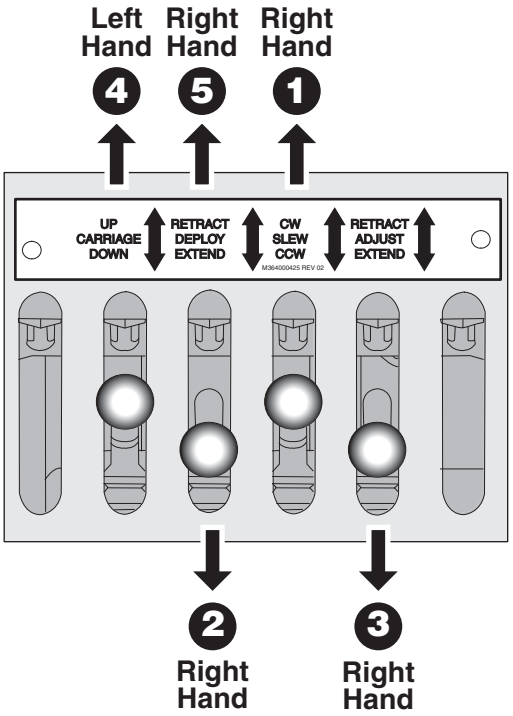
1. Hold the SLEW lever until the tool aligns with either the well center or the mousehole as required.
2. Hold the DEPLOY lever in the EXTEND position until the cylinders reach full extension.
3. Hold the ADJUST lever in the EXTEND position until the torque wrench and spin wrench are aligned properly with the drill pipe.

Wrench and Proper Pipe Alignment



Center drill pipe in wrench opening within ½" of center before clamping to avoid damage to drill pipe and/or the ST-120.

4. Hold the CARRIAGE lever in the UP or DOWN position to align the torque wrench vertically with the drill pipe.
5. During operation, use the DEPLOY lever for consistent alignment with the drill pipe.



Arm Assembly Controls

Figure 4-2. Positioning and Adjusting the Iron Roughneck

Operating the Iron Roughneck

Positioning and Adjusting the Iron Roughneck

Use control levers to align the iron roughneck with the tubular.

Numbers in brackets are millimeter [mm].

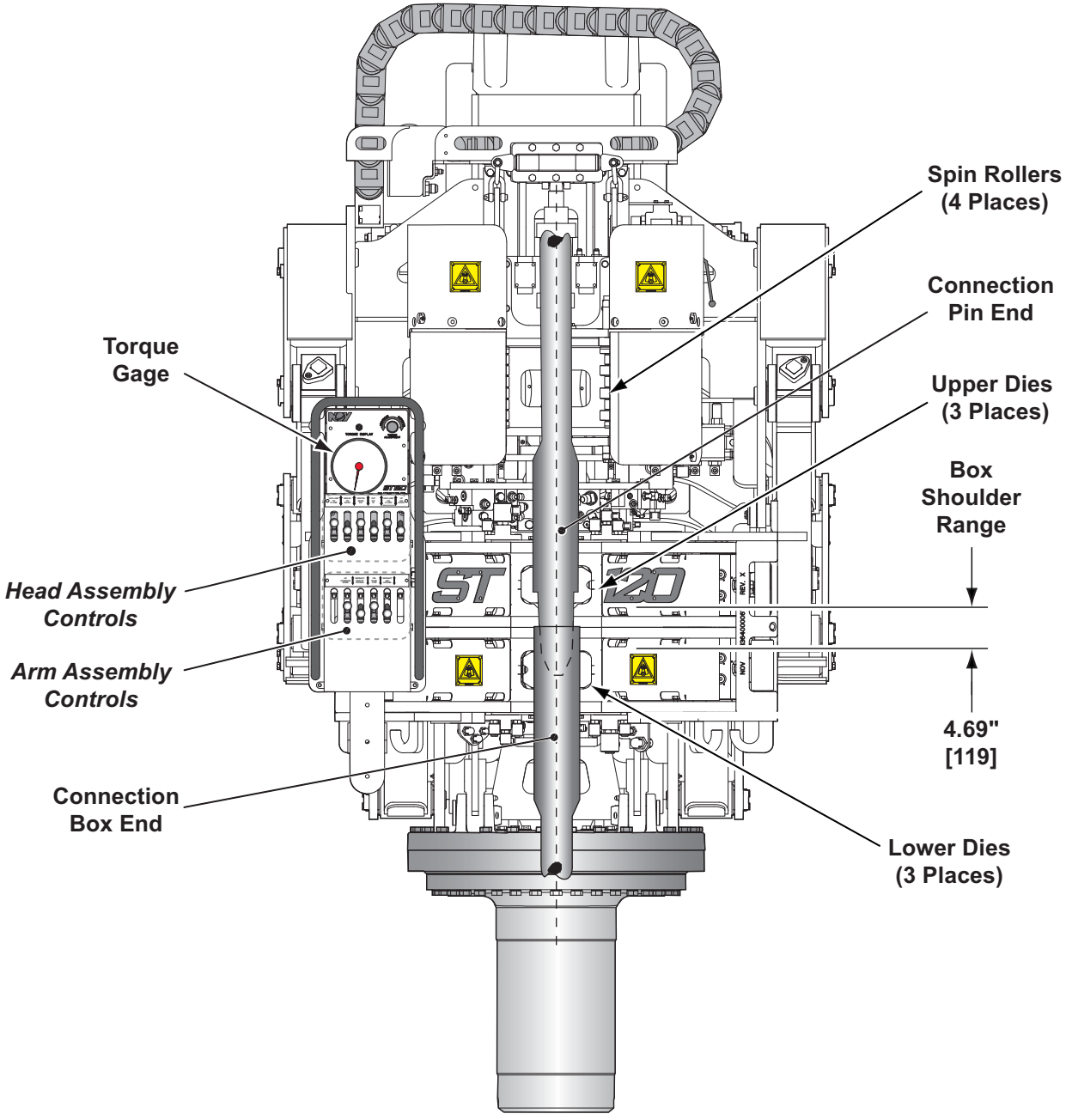
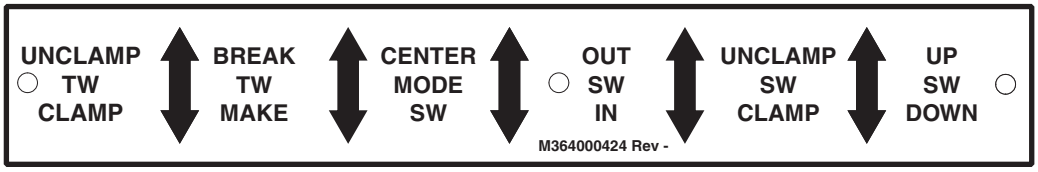


Figure 4-3. Positioning the Iron Roughneck

Operating the Iron Roughneck

Making Connections



Head Assembly Control Plaque

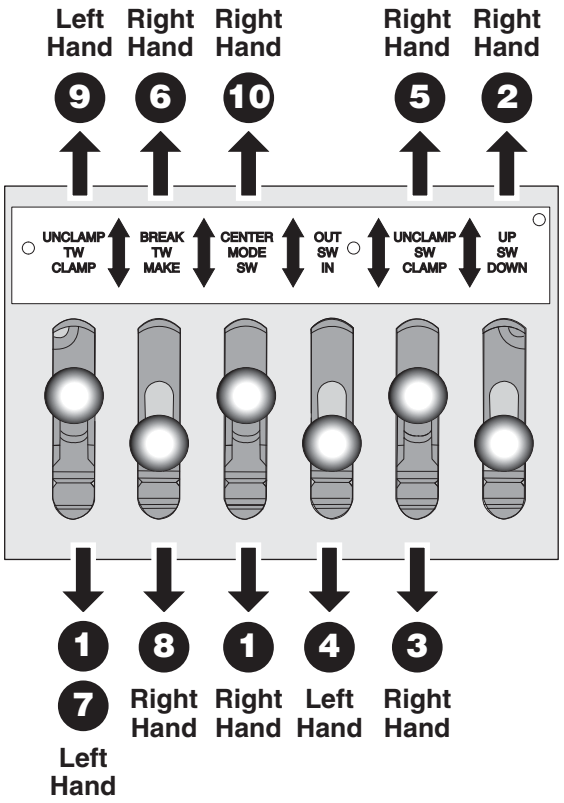
Procedure

Use the Head Assembly Control Levers for the following steps:

1. Hold MODE lever in SW position and activate TW lever in CLAMP position until the lower jaws make contact on the drill pipe. Release.
2. Hold SW lever in UP position until the spin wrench raises approximately 6 inches.
3. Hold the SW lever in the CLAMP position.
4. While holding SW-CLAMP lever, hold SW lever in the IN position until the drill pipe shoulders. Release.
5. Hold SW lever in the UNCLAMP position to retract the roller carriers.
6. Hold TW lever in the BREAK position until the upper wrench is aligned in the MAKE position. Release.
7. Hold TW lever in the CLAMP position until the upper jaws make contact with the drill pipe.
8. While holding TW-CLAMP, move TW lever to the MAKE position until the required torque is reached.

> If the wrench does not reach the required torque value in one stroke, unclamp and repeat steps 6, 7, and 8.

9. Hold TW lever in the UNCLAMP position to retract jaws. Release.
10. Hold MODE lever in CENTER position until the upper wrench is centered. Release.

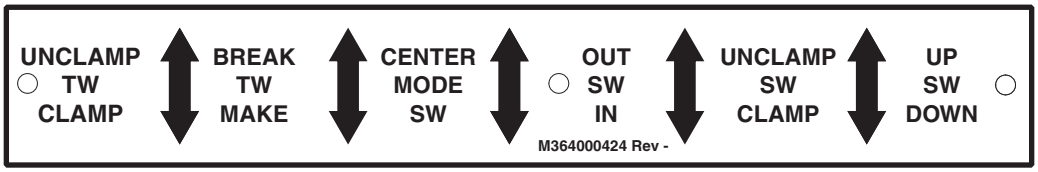


Head Assembly Controls

Figure 4-4. Head Assembly Controls - Making Connections

Operating the Iron Roughneck

Breaking Connections



Head Assembly Control Plaque

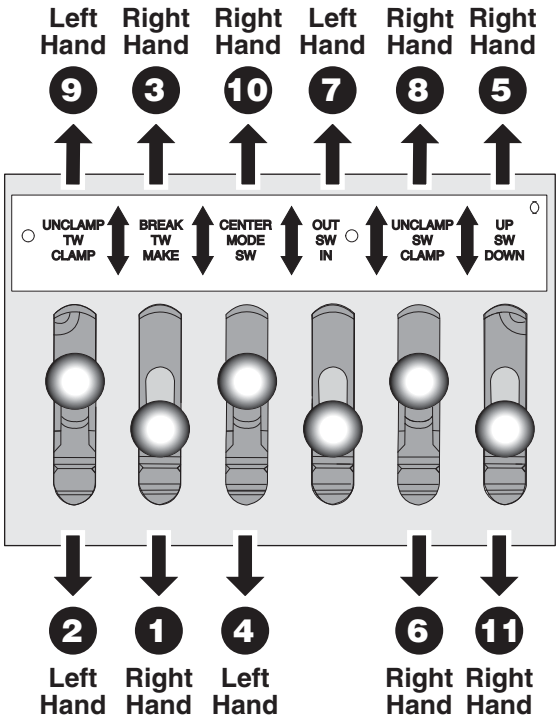
Procedure

Use the Head Assembly Control Levers for the following steps:

1. To place the upper Torque Wrench in the “break-out” position, hold TW lever in MAKE position until the wrench stops rotating. Release.
2. Hold TW lever in CLAMP position.
3. While holding TW-CLAMP, move TW lever to the BREAK position until the connection is broken.

If connection is not broken in one stroke, repeat steps 1, 2, and 3.

4. Hold MODE lever to SW position until the upper jaws retract from the pipe. Release.
5. Hold SW lever in UP position until the spin wrench raises approximately 6 inches.
6. Hold SW lever in CLAMP position.
7. While holding SW-CLAMP lever, move SW lever to the OUT position until the connection is unthreaded. Release.
8. Move SW lever to UNCLAMP to retract the jaws and the roller carriers respectively.
9. Move TW lever to UNCLAMP to retract jaws. Release.
10. Hold the MODE lever in the CENTER position until the upper Torque Wrench is centered. Release.



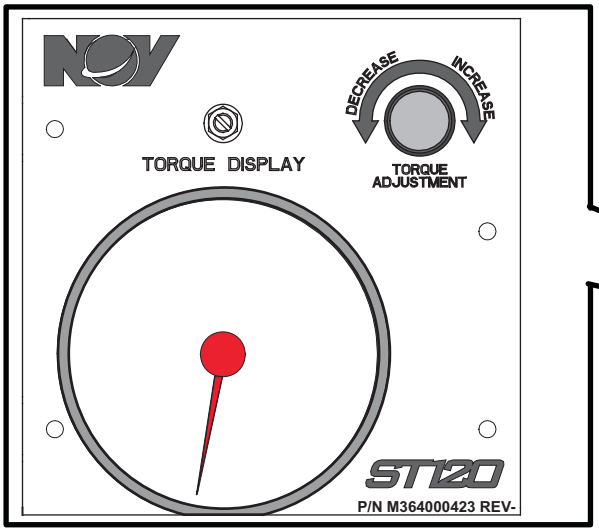
Head Assembly Controls

Figure 4-5. Head Assembly Controls - Breaking Connections

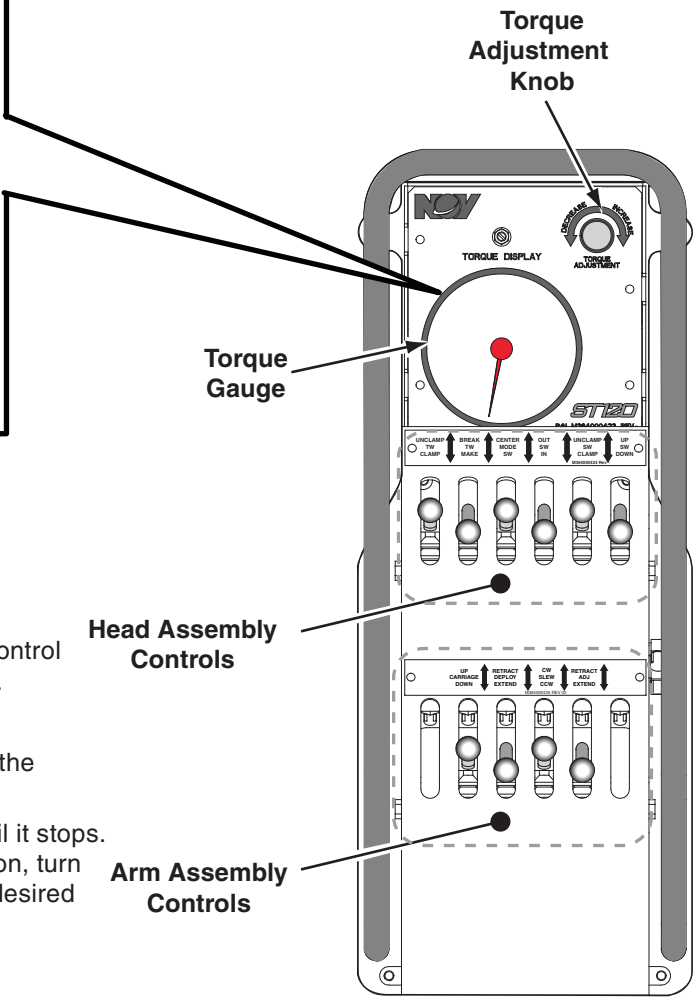
Operating the Iron Roughneck

Adjusting Makeup Torque

National Oilwell Varco offers an additional gage kit that can be installed in the driller's cabin (Remote Torque Gage kit, PN M364000562.)



Torque Gage Display Detail



Control Console (Front View)

Procedure

Perform the following steps to adjust the torque:

1. Turn the adjustment knob located on the main control panel counterclockwise (decrease) until it stops.
2. Verify that the torque gage reads zero.
3. Position the reference indicator (red needle) on the torque gage at the desired torque value.
4. Actuate the TW lever in the BREAK position until it stops. While holding the TW lever in the BREAK position, turn the torque adjustment knob clockwise until the desired torque is set.

If torque cylinders reach end of stroke during a makeup cycle, and the gage reads zero, recycle the jaws and retorque.

Figure 4-6. Adjusting Makeup Torque

Operating the Iron Roughneck

Moving the Grounding Links to the Upper Jaw

For bit breaking function, the upper jaw stays stationary while the lower jaw rotates. To achieve this, the grounding links are transferred from the lower jaw to the upper jaw.

Procedure

Before performing any hydraulic or mechanical work on the tool, ensure the hydraulic ball valve located on the rear of the ST-120 Iron Roughneck is off and control levers are actuated to bleed system pressure.

1. Uninstall the bolt securing the frame retaining pin to the grounding frame.

Restrain the frame retaining pin before completely removing this bolt. Once the bolt is removed, the frame retaining pin could fall out the bottom of the torque wrench.

2. Remove the frame retaining pin from the grounding frame and the torque wrench frame.
3. Uninstall the jaw retaining pin securing the anti-rotation link to the lower jaw.

Jaw retaining pin is retained by a cotter pin that can be removed through the side of the torque wrench frame. The jaw retaining pin can subsequently be removed downwards from beneath the torque wrench.

4. Remove the anti-rotation link from the lower jaw.
5. Turn the anti-rotation link up-side-down and install in the upper jaw.
6. Install the jaw retaining pin to secure the anti-rotation link to the upper jaw.
7. Install the frame retaining pin through the torque wrench frame, grounding frame and the anti-rotation link.
8. Re-install the bolt securing the frame retaining pin to the grounding frame.

Operating the Iron Roughneck

Moving the Grounding Links to the Upper Jaw

9. Perform steps 1-8 for both sides of the torque wrench.

Due to inverting the grounding frame from the lower wrench to the upper wrench, make-up and break-out function will be backwards on the control console.

10. Torque all bolts to NOV torque specification.

Lock out hydraulics to disable equipment operation and avoid personal injury and equipment damage.

During operation, surfaces may become hot enough to cause bodily injury. To reduce the risk of injury from a hot component, allow the surface to cool before touching.

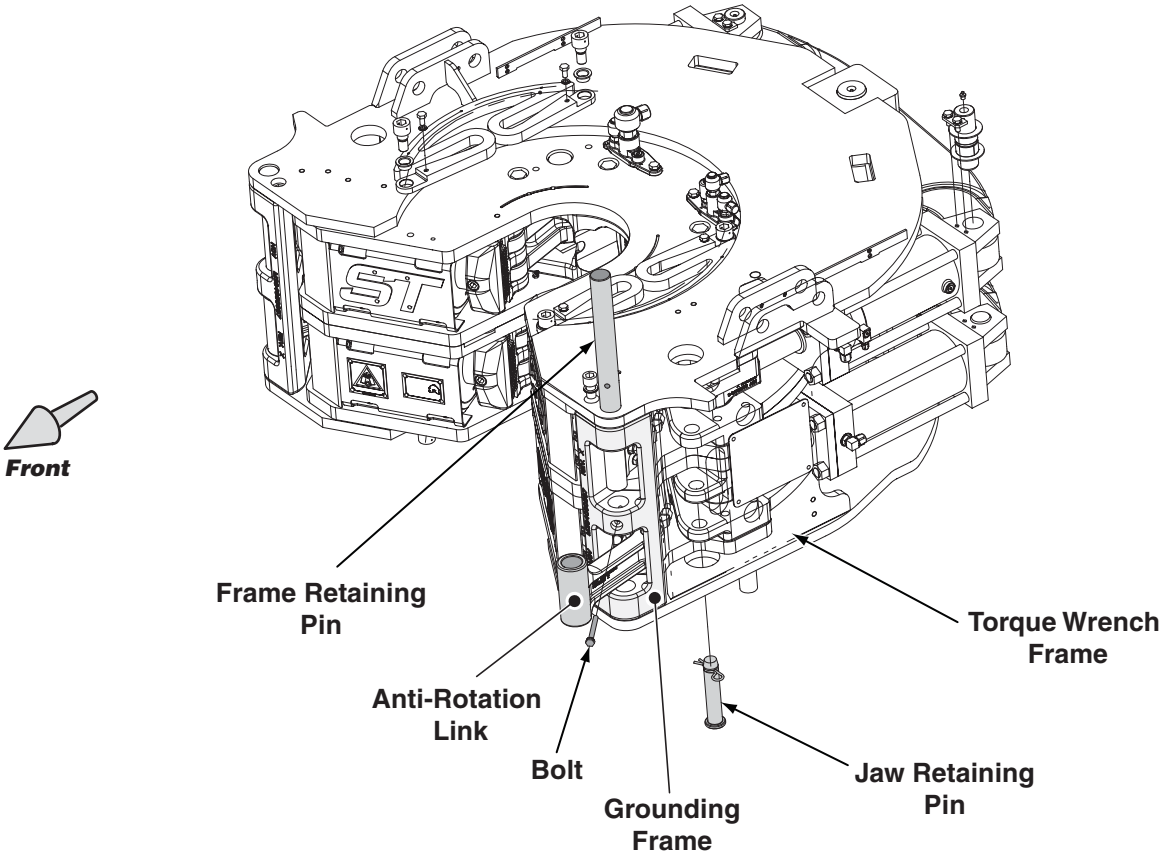


Figure 4-7. Moving Grounding Links to the Upper Jaw

Operating the Iron Roughneck

Setting up the Bit Breaker Assembly

Procedure

To perform this procedure, refer to Figure 4-8, Figure 4-9, and Figure 4-10.

1. Adjust the guide plate on the side panel to accommodate the bit.
2. Position the bit breaker such that the drill bit is in the bit breaker frame top open area.
3. Slide the PDC bit adapter plate through the guide plate on the side panel of the bit breaker.
4. Index the PDC bit adapter plate to the drill bit.
5. Position the ST-120 above the bit and the Bit Breaker Assembly.
6. Index the bit breaker to the ST-120 Torque Wrench frame.

Using the Bit Breaker Assembly

For bit connecting and breaking procedures, refer to section titled "Making Connections" on page 4-5 and section titled "Breaking Connections" on page 4-6.

Operating the Iron Roughneck

Setting Up the Bit Breaker Assembly

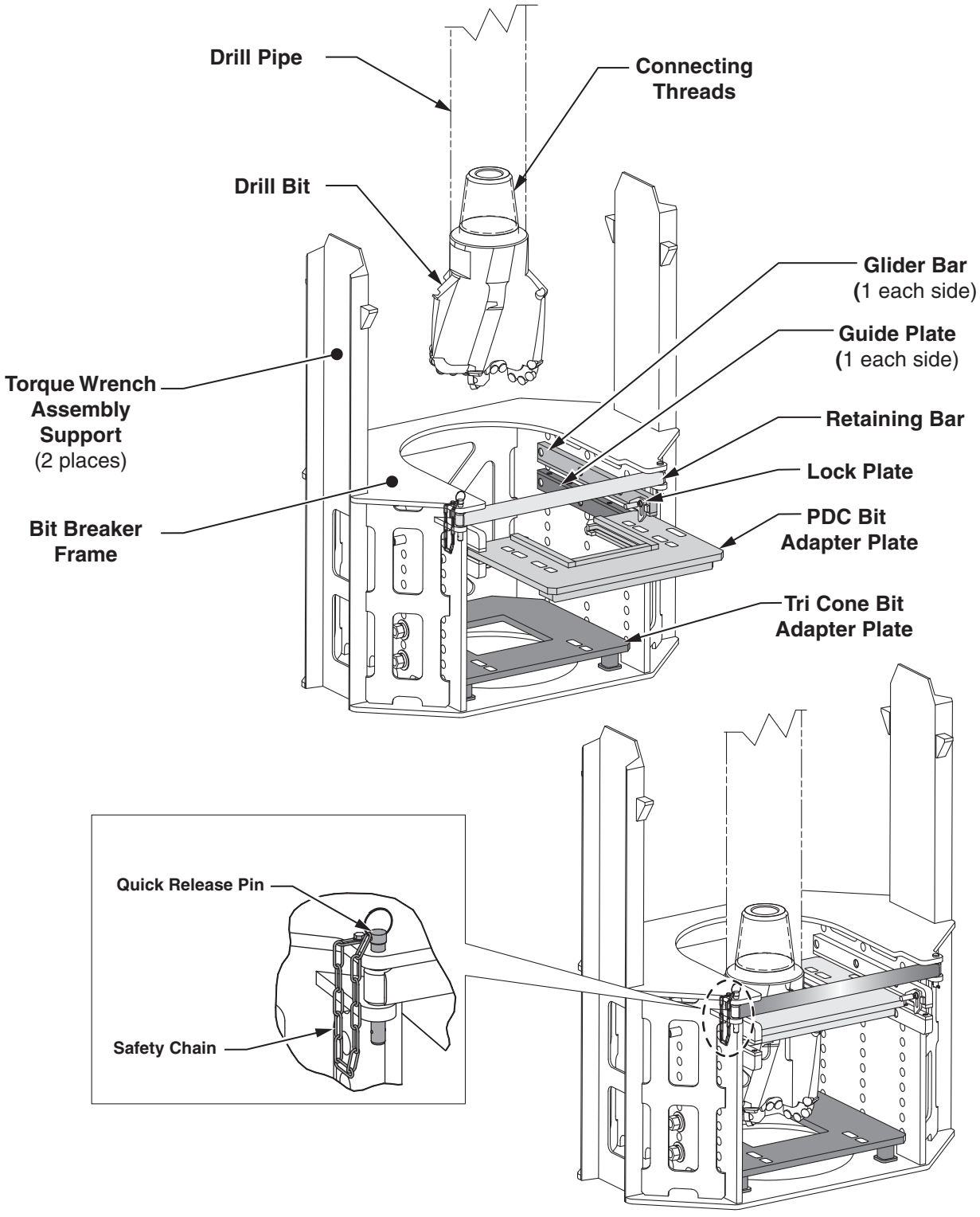


Figure 4-8. Bit Breaker Set Up

Operating the Iron Roughneck

Using the Bit Breaker Assembly

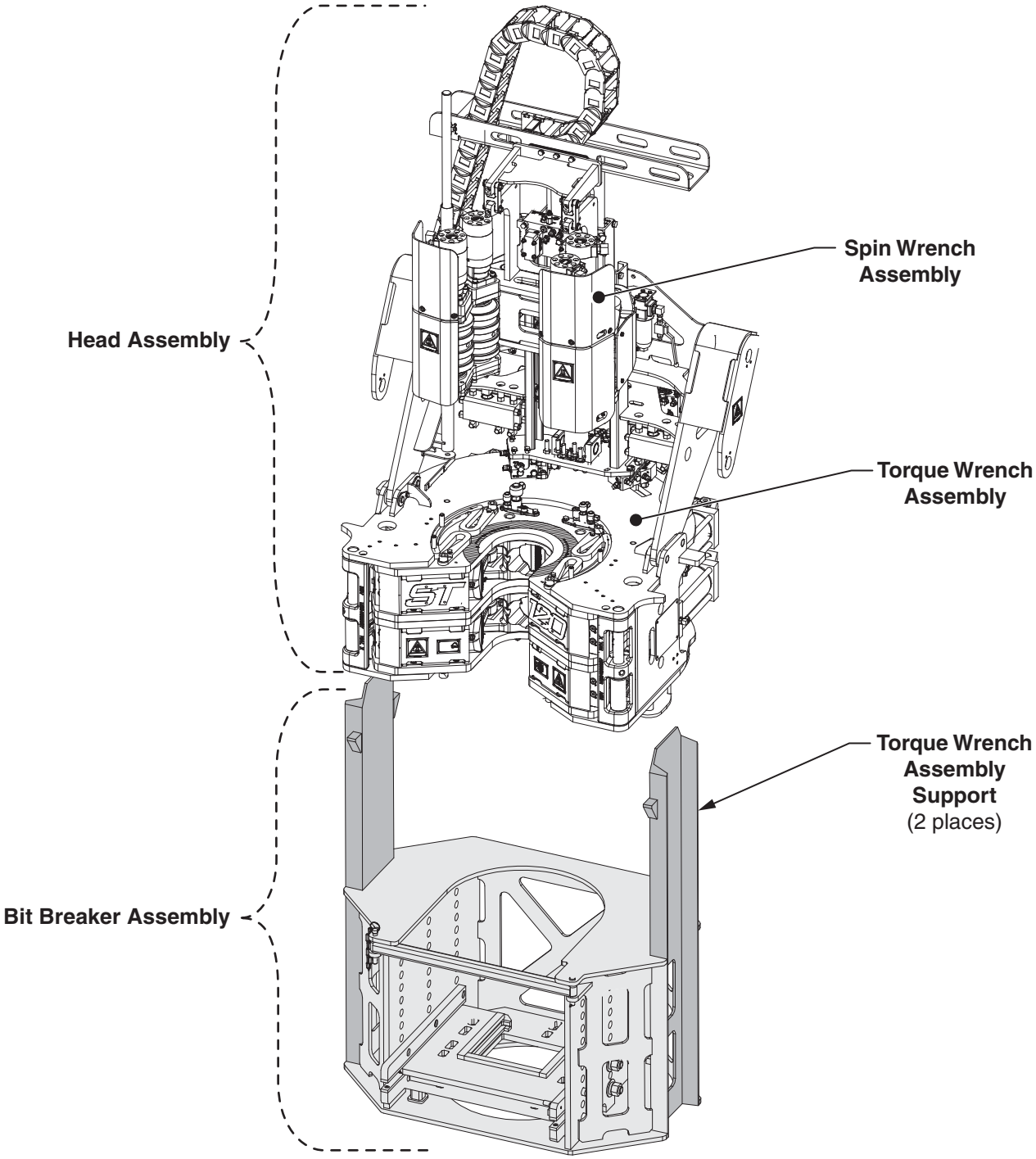


Figure 4-9. Torque Wrench Assembly Interface with Bit Breaker Assembly (1 of 2)

Operating the Iron Roughneck

Using the Bit Breaker Assembly

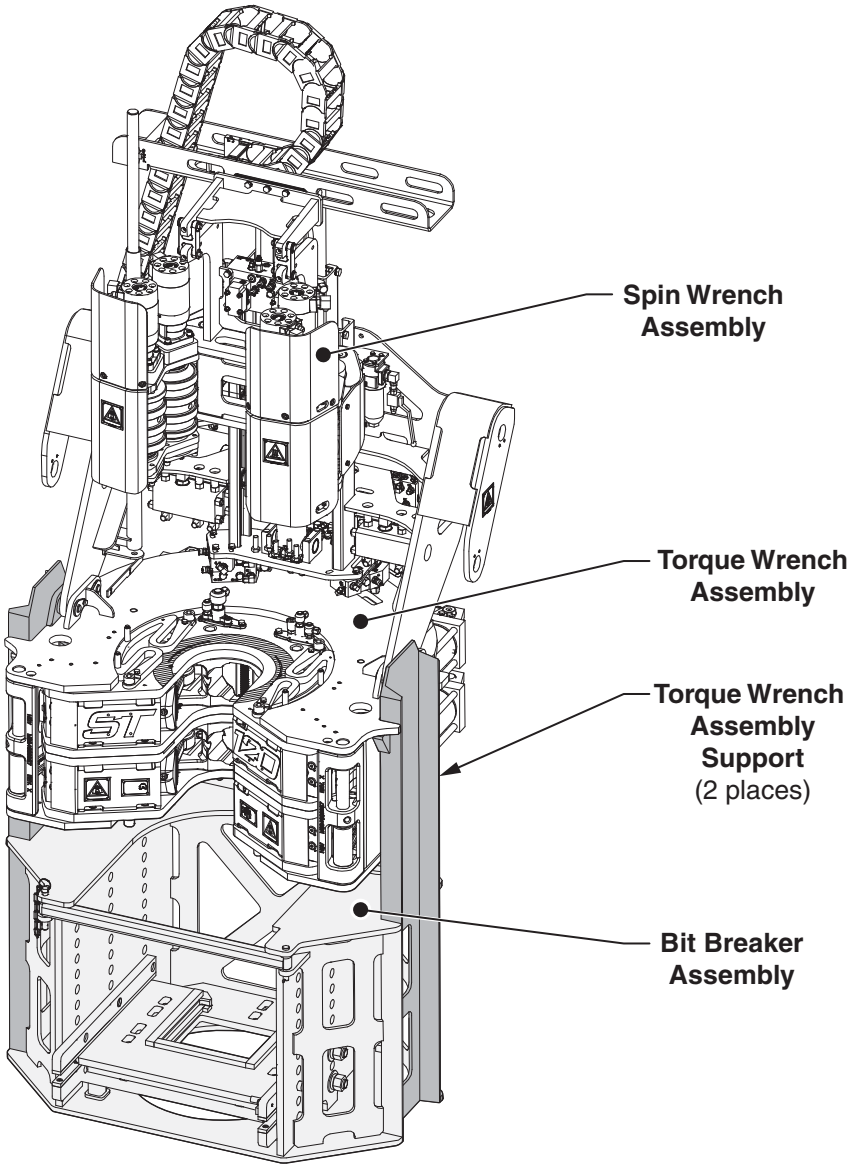


Figure 4-10. Torque Wrench Assembly Interface with Bit Breaker Assembly (2 of 2)

Operating the Iron Roughneck

Locking Out the Arm Assembly

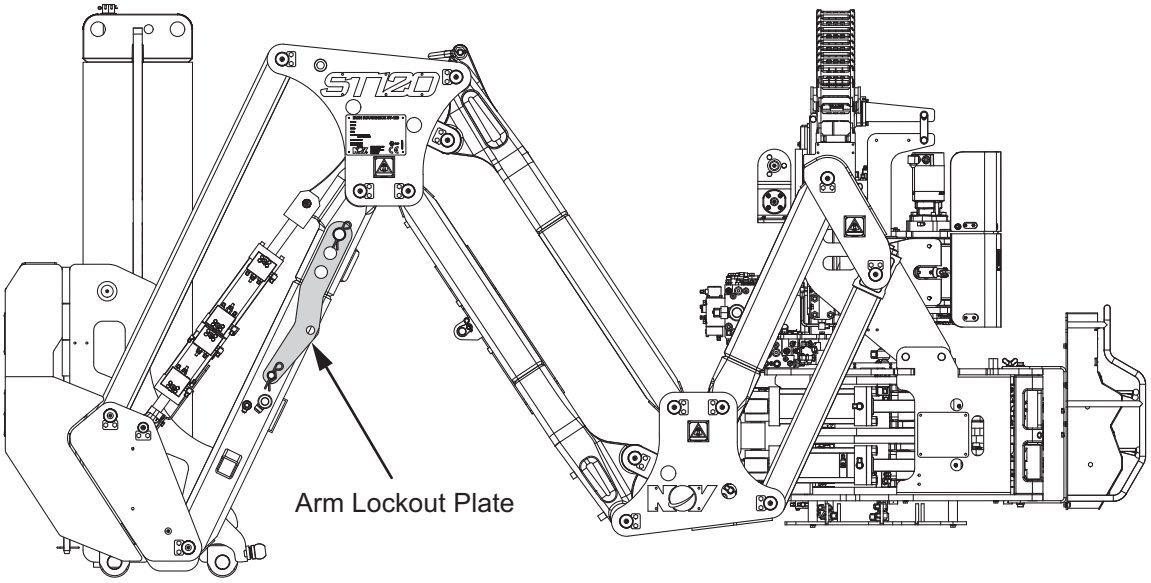
Use the control console features to operate the Iron Roughneck during installation procedures. See figure Figure 4-11.

Procedure

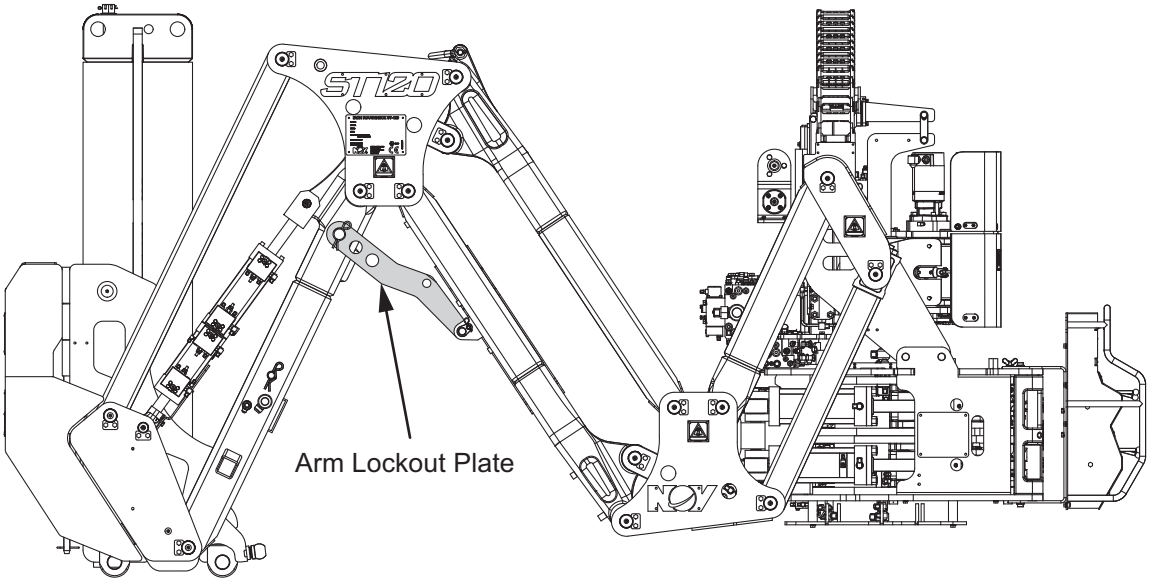
1. Once the hydraulic service loop has been installed, turn the ball valve on the rear of the ST-120 to the ON position.
2. Extend the arm, by activating the DEPLOY EXTEND lever on the control console, to the point where the Arm Assembly Lock Plate can be installed.
3. Install the Arm Assembly Lock Plate.
4. Turn the ball valve on the rear of the ST-120 to the OFF position.
5. Actuate the Spin Wrench INlever on the control console to bleed any residual pressure in the hydraulic system.

Operating the Iron Roughneck

Locking Out the Arm Assembly



View showing arm retracted to a position close enough to rotate the locking arm.



View showing the locking arm rotated into the locked position.

Figure 4-11. Arm Assembly Lockout

Hydraulic Failure Operation

Safety Precautions

Before performing hydraulic failure manual operation, see the following safety sections:

- See “Safety Requirements,” page 1-2.
- See See “Pinch Point Hazards,” page 2-26.
- See “Safety Precautions,” page 4-16.

If the hydraulic system fails, shut off the hydraulic supply and perform the appropriate actions to enable manual operation of components. Some procedures may be required to repair and stabilize hydraulic system functions.

During operation, surfaces may become hot enough to cause bodily injury. To reduce the risk of injury from a hot component, allow the surface to cool before touching.

Procedures described in this section will result in hydraulic fluid leaks, that can exposes personnel to possible slip-and-fall injuries. Lubricants that are not contained or cleaned up immediately can cause environmental contamination. Therefore, personnel must immediately collect and cleaned up any spilled or escaping oil. Personnel must dispose of excess hydraulic fluids and lubricants, and cleaning materials appropriately.

Before performing hydraulic failure procedures, ensure the hydraulic ball valve, located on the rear of ST-120 Iron Roughneck, is off and control levers are actuated to bleed system pressure.

Hydraulic Failure Operation

Safety Precautions

Manual iron roughneck operating procedures must only be performed in emergency conditions. Manual operation includes procedures that slow production and may cause personal injury and equipment damage. Perform manual operation procedures with extreme caution.

Release all hydraulic oil pressure before disconnecting hydraulic lines. Hydraulic oil under pressure can penetrate skin and cause serious injury.

Hydraulic Failure Operation

Slew Base Assembly

Procedure

If the socket base assembly needs to be rotated during hydraulic failure, please do the following:

1. Extend the arm, if necessary, to allow access to the column.
See section titled "Moving Arm Assembly" on page 4-21.
2. Disconnect lines A and B of the hydraulic slew motor from the connection to the hoses in the column.
3. Connect lines A and B of the hydraulic slew motor. These lines are equipped with quick disconnect connections and should couple together. See Figure 4-12.
4. Next, using a hydraulic power source of no more than 500 psi, connect to the brake release line C (#6 male JIC fitting) and release the brake.
5. Once the brake is released, the socket base assembly should be able to rotate. Rotate into the position desired and release hydraulic pressure to the brake.
6. Next, disconnect the A and B lines of the hydraulic motor and reconnect each to the appropriate hose in the column. Disconnect hydraulic power source from the brake and replace hose.

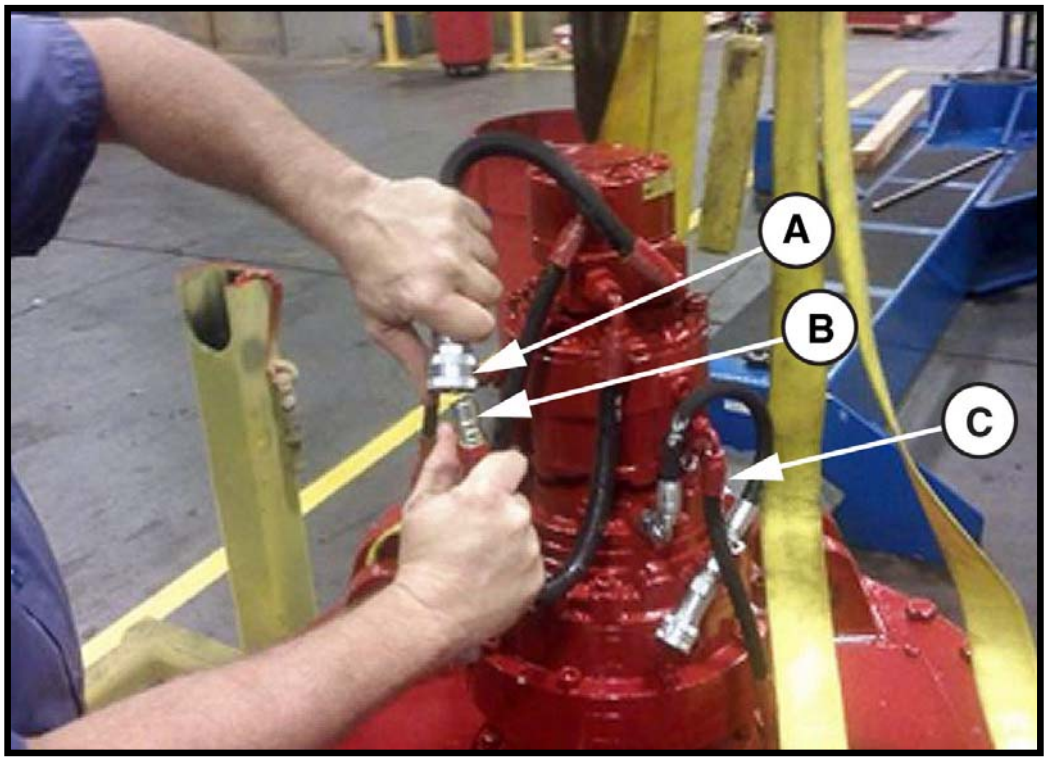


Figure 4-12. Manual Slew Hydraulic Connection

Hydraulic Failure Operation

Opening Torque Wrench

Procedure

If the torque wrench clamp cylinders need to be retracted during a hydraulic failure, please do the following:

1. To deactivate torque wrench clamp cylinders, locate and slowly remove the plugs in port “P” on all four forward clamp cylinders to gradually release hydraulic pressure.
2. Once all residual pressure is relieved, use a pry-bar to retract clamp cylinders from drill pipe.

If the clamp cylinder plug is released quickly, it will be projected by extreme hydraulic pressure and cause a hazard for personnel. Hydraulic pressure should be relieved very slowly to ensure safety. Hydraulic oil under pressure can penetrate skin and cause serious personal injury.

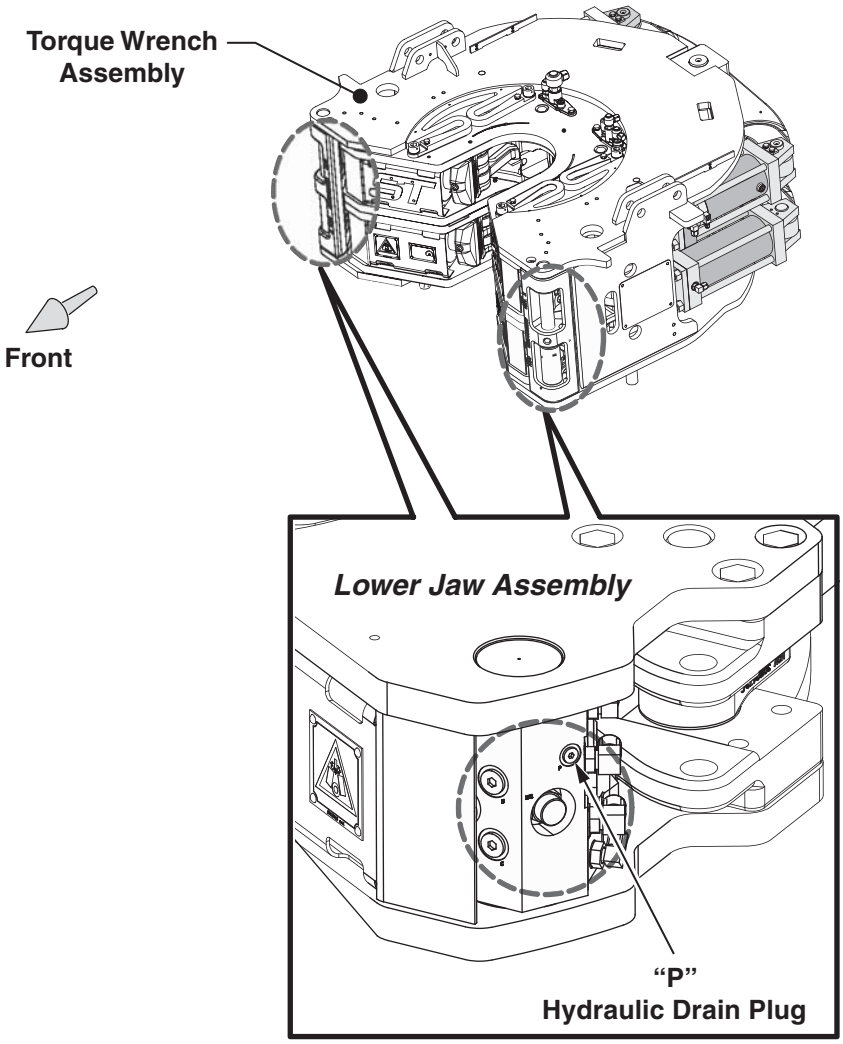


Figure 4-13. Open Torque Wrench If Hydraulic Failure Occurs

Hydraulic Failure Operation

Opening Spin Wrench

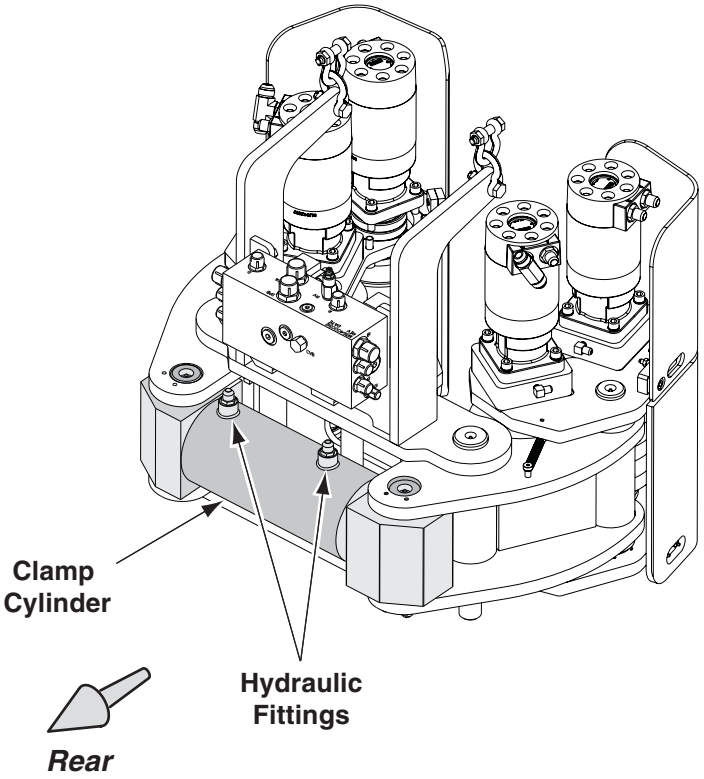
Procedure

If the spin wrench clamp cylinders need to be retracted during a hydraulic failure, please do the following:

1. Slowly and carefully loosen fittings on spin wrench clamp cylinder.

If the clamp cylinder plug is released quickly, it will be projected by extreme hydraulic pressure and cause a hazard for personnel. Hydraulic pressure should be relieved very slowly to ensure safety. Hydraulic oil under pressure can penetrate skin and cause serious personal injury.

2. Once any residual pressure is relieved, remove hydraulic connections from the spin wrench clamp cylinder.
3. Use a pry-bar to move rollers away from drill pipe.



Rear Isometric View

Figure 4-14. Open Spin Wrench if Hydraulic Failure Occurs

Hydraulic Failure Operation

Moving Arm Assembly

Hydraulic fluid will be expelled from test fitting ports as the Extend Cylinders extend or retract. Take measures to contain spills.

Procedure

If the Arm Assembly needs to be extended or retracted during a hydraulic failure, please do the following:

1. Use a Stauff test coupling to bleed pressure from Extend Cylinders. Slowly screw the test coupling onto each test fitting (4 fittings per cylinder) until all hydraulic pressure is relieved.
2. Once all pressure has been relieved, remove all test fittings from the Extend Cylinders.
   - **Optional Procedure**
     Once all pressure has been relieved, remove all test fittings from Extend Cylinders. As an option, open-ended hoses can be connected to test fitting ports where open ends can be placed in a container to minimize hydraulic fluid spilling.
3. Extend or retract the ST-120 Arm Assembly by pushing or pulling the Head Assembly in the required direction.

Hydraulic Failure Operation

Moving Arm Assembly

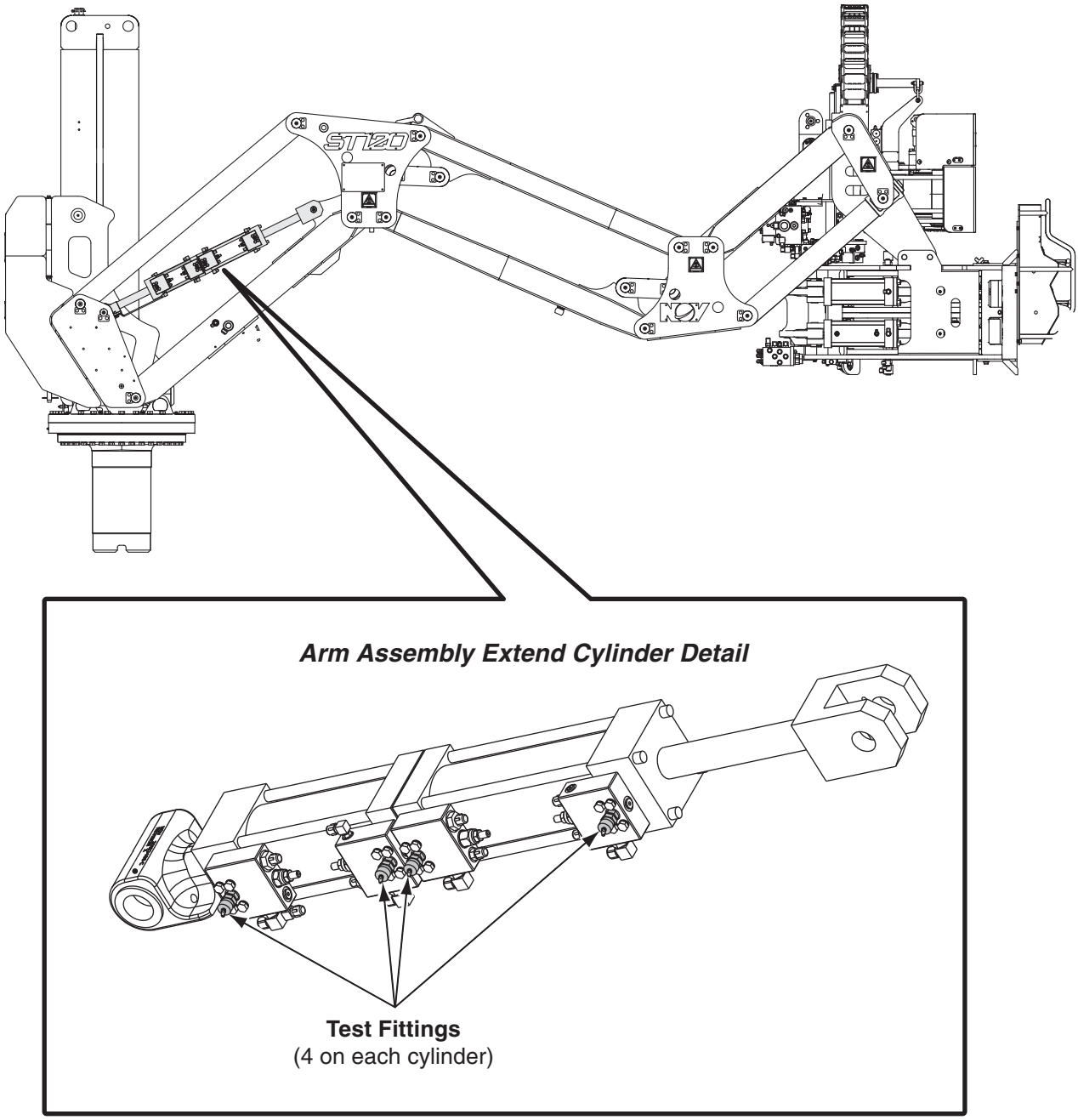


Figure 4-15. Arm Assembly Extend Cylinder

Securing the Iron Roughneck on a Floating Vessel

Floating vessels are subject to the actions of waves and wind, resulting in unpredictable floor motions. Such motions can cause an iron roughneck to make sudden and unexpected movements. When this begins to occur, operations should cease and the iron roughneck should be secured at standby position. Refer to section titled "Storing the Iron Roughneck" on page 4-28.

NOV offers a special kit (PIN M364000413) for use on floating vessels. The kit allows securing the iron roughneck at well center, mousehole, and standby positions.

Procedure

When conditions exceed the parameters listed under Operational Environment:

1. Immediately stop operation.
2. Retract the Iron Roughneck fully, install the storage pin, and secure the Iron Roughneck in a standby position. See Table 4-1 and Table 4-2 for maximum operational/survival conditions on floating vessels.

For dynamic conditions in excess of the values listed in Tables 4-1 and 4-2, please consult NOV Engineering.

Table 4-1. Operational Environment

Condition	Parameter
Roll/Pitch	❑ 4° pitch, single amplitude on 10 second period ❑ 50 ft. roll center below rig floor
Heave	2% Acceleration force
Wind	No wind assumed on rig floor during operation
Design Temp	-20°C Min. to 40°C Max.
Ice Thickness	None

Table 4-2. Survival Environment

(ST-120 Iron Roughneck must be stored with storage pin installed.)

Condition	Parameter
Roll/Pitch	❑ 20° pitch, single amplitude on 10 second period ❑ 50 ft. roll center below rig floor (ST-120 in secured parked position)
Heave	30 ft. on 10 second period (ST-120 in secured parked position)
Wind	No wind assumed on rig floor during operation
Design Temp	-20°C Min. to 40°C Max.
Ice Thickness	None

Transport Skid Installation and Removal

NOV recommends using the supplied wire rope sling (NOV PN M364000518) with master link when lifting the iron roughneck.

Always keep the iron roughneck in an upright position to avoid equipment damage and personal injury or death.

When transporting the iron roughneck, always use the iron roughneck lifting lugs and lifting shackles. No other part is rated for, nor intended to support the full weight of the iron roughneck.

For stability, always transport the iron roughneck with the Transport Frame Installed. For added security, straps can be attached to major structural components as required.

Transport Skid Installation and Removal

Transport Skid Installation

Procedure

The following steps assume the ST-120 is being removed from its service location on the rig and being placed on the shipping skid.

1. Ensure the iron roughneck is in the fully retracted position, and all hydraulic lines connecting the column to the base assembly have been disconnected.
2. Ensure the storage pin is installed.
3. Place the transport skid on a strong surface.
4. Attach ST-120 Iron Roughneck wire rope sling to lifting shackles.
5. Remove the column lock pins connecting the column to the base assembly.
6. Hoist and move the iron roughneck and center it on the transport skid:
   a. Align the Iron Roughneck column base support with the transport skid base supports.
   b. Align the bottom of the torque wrench base plate with the transport skid lower support.
7. Insert the column lock pins to connect the column support to the transport skid base supports.
8. Insert hairpin cotter pins.
9. Place the transport skid support cap on the inside edge of the torque wrench top plate.
10. Insert top lock washers and hex nuts on the top ends of each 8" threaded rods.
11. Insert threaded rods through the transport skid support cap and transport skid lower support.
12. Install lock washers and hex nuts on the bottom end of the threaded rods.
13. Tighten hex nuts securely to the transport frame support column. Tighten to appropriate torque.
14. Attach wire rope sling to ST-120 Iron Roughneck lifting shackles and hoist and move the iron roughneck and transport skid to the proper location.

Transport Skid Removal

Procedure

1. Use the lifting shackles to hoist the iron roughneck.
2. Remove the column lock pins and transport skid support cap.
3. Attach ST-120 Iron Roughneck wire rope sling to lifting shackles and hoist the iron roughneck to the required location.
4. Retain all transport skid components and move the transport skid to storage.

Transport Skid Installation and Removal

ST-120 Iron Roughneck and Transport Skid

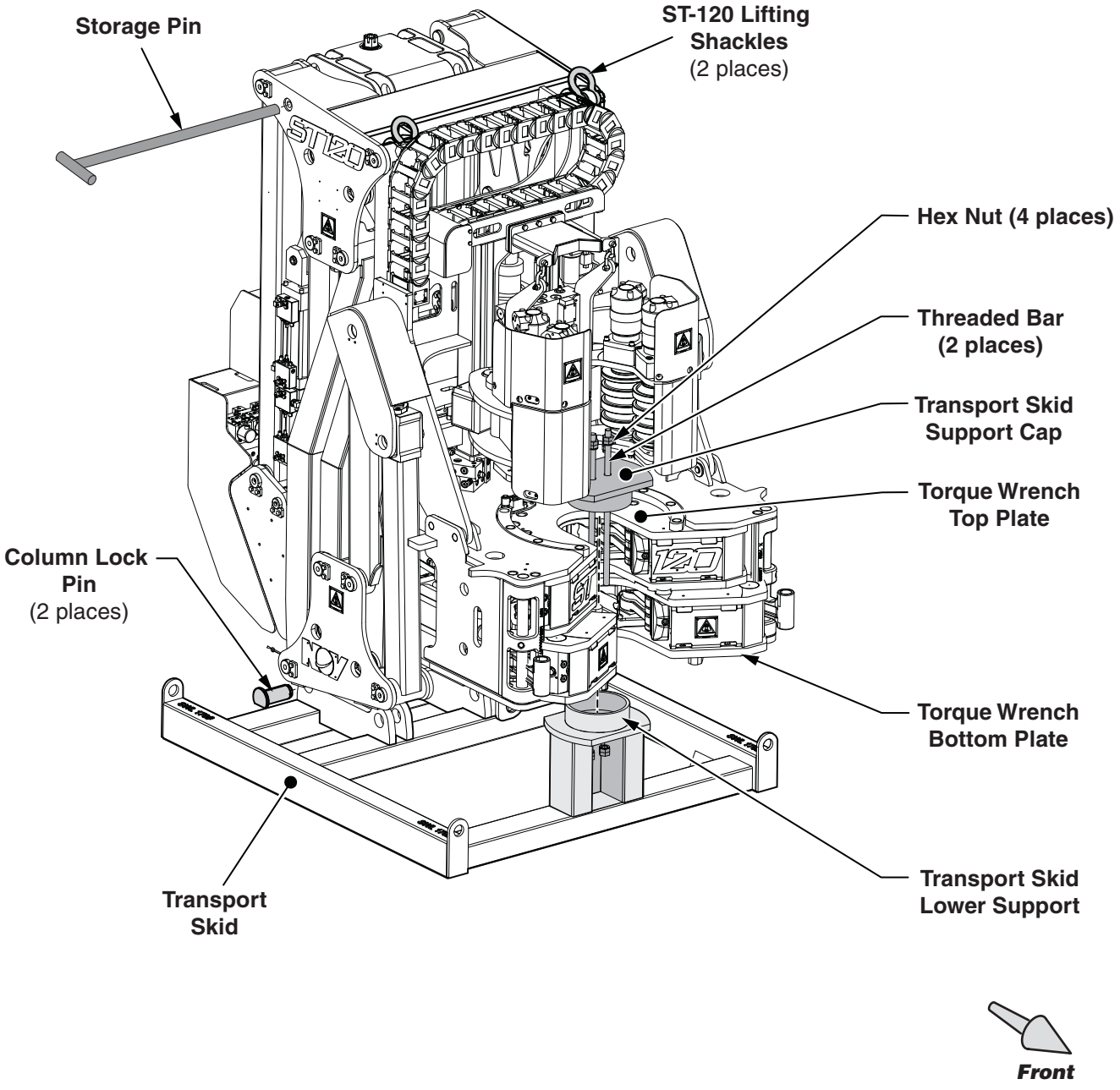


Figure 4-16. Transport and Skid Installation

Transporting the Iron Roughneck

When transporting the iron roughneck, ensure the unit remains vertical and is stable. Always transport the iron roughneck with the transport skid installed to increase stability. See “Transport Skid Installation and Removal,” page 4-24.

Always keep the iron roughneck in an upright position. Never place the iron roughneck on it’s sides or back. Failure to heed this caution will cause damage to the equipment.

Storing the Iron Roughneck

Long Term Storage

- Palletize the ST-120 Iron Roughneck and store it in indoor storage. A cargo container would be appropriate for indoor/outdoor storage.
- Avoid wide variations in temperature and high humidity. The preferred environment is clean and dry at 60°F (16°C) ambient temperature. If high humidity is unavoidable, 70°F (21°C) ambient temperature is recommended.
- All exposed unpainted metal surfaces are coated with a rust preventive at the factory prior to shipment. Coat all unpainted metal surfaces with rust preventative prior to storage or transport.
- The recommended rust preventive (slushing compound) for bare metal surfaces is Kendall Grade 5 (GE-D6C6A1) or equivalent.
- All openings should be covered to prevent water or dust from entering. Ensure cover allows for air circulation around equipment. NOV does not recommend using a silica gel or a dehydrating agent.
- During storage, lubricant drains from the top half of the roller bearings, allowing corrosion on the exposed areas. To prevent corrosion, periodically rotate the column to slew to distribute lubricant over the top of the bearings. Perform this at three-month intervals if the iron roughneck is stored indoors, and at monthly intervals if stored outdoors.

Return to Service After Storage

Before placing the Iron Roughneck back into service, the following tasks should be completed and/or verified.

- Remove all rust preventative and any corrosion, taking special care with all load-carrying components.
- Blow out all dust and dirt from equipment as required with clean, dry air.
- A complete system test and adjustment should be performed as detailed in the ST-120 Iron Roughneck Commissioning Procedure.

Maintenance 5

Maintenance Warning

Anytime before shutting down the tool for maintenance, follow this precautions:

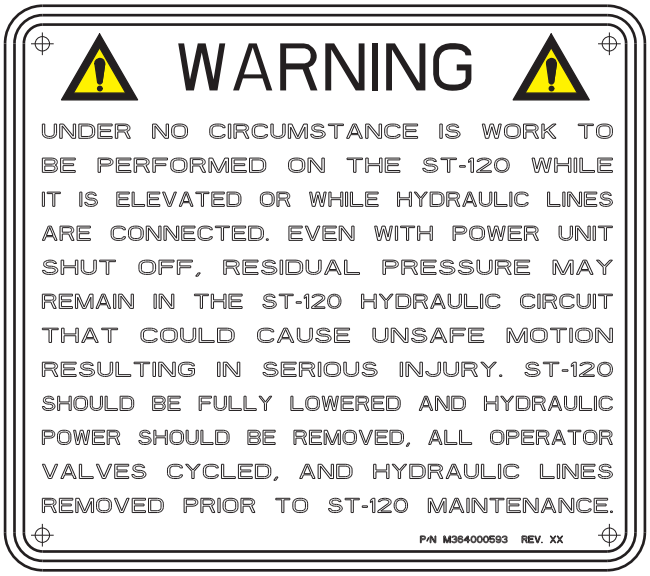


Figure 5-1. Maintenance Operation Warning Plate

During Operation, surfaces may become hot enough to cause bodily injury. To reduce the risk of injury from a hot component, allow the surface to cool before touching.

Recommended Lubricants

Hydraulic Fluids

Minimum start-up and operating temperatures are as follows:

Table 5-1. Arctic Service Lubricant Criteria

Non-Arctic Service: -10°F to 125°F / -29°C to 52°C

First Choice	Hydraulic Oil - premium grade with anti-wear and anti-rust additives
	Viscosity = 48-55 SUS @ 210°F (6.8 - 8.9 cSt @ 100°C)
	Viscosity Index = 132
	Pour Point = -30°F (-34°C)
	ISO/ASTM Viscosity Grade = 46
Second Choice	Automatic Transmission Fluid
	Type “F” meeting Ford Motor Company specification ESW-M2C33-F
Third Choice	Hydraulic Transmission Oil.
	Viscosity = Typically 49 SUS @ 210°F (7 cSt @ 100°C
	Viscosity Index = 100 minimum
	Pour Point = -35°F (-37 C)
	ISO/ASTM Viscosity Grade = 46

Recommended Lubricants

Hydraulic Fluids

Arctic Service Lubricant Criteria (continued)

Arctic Service: -50°F to 0°F / -45°C to -18°C

First Choice	Hydraulic Oil - premium shear stable high VI anti-wear hydraulic oil
	Viscosity = 46.6 SUS @ 210°F (6.1 cSt @ 100°C)
	Viscosity Index = 153
	Pour Point = -58°F (-50°C)
	ISO/ASTM Viscosity Grade = 32
Second Choice	Automatic Transmission Fluid - Dextron III
	Viscosity = 51 SUS @ 210°F (7.5 c0.St @ 100°C)
	Viscosity Index = 172
	Pour Point = -54°F (-48°C)

Recommended Lubricants

Gear Oil

The following charts give the recommended grades for various temperatures surrounding the reservoirs.

Table 5-2. Temperature Criteria

Temperature		Recommended Grade
50°F to 125°F	(10°C to 52°C)	AGMA NO. 7 EP, ISO/ASTM VG 460
15°F to 60°F	(9°C to 16°C)	AGMA NO. 6 EP, ISO/ASTM VG 320
-20°F to 25°F	(-29°C to -4°C	AGMA NO. 4 EP, ISO/ASTM VG 150
-50°F to 0°F -45°	(C to -18°C)	AGMA NO. 3 EP, ISO/ASTM VG 100

For additional wear protection, the use of Dow Corning Molykote-M Gear Guard (5% to 10% by volume) is recommended.

Table 5-3. General Temperature Criteria

General Lubricants	Recommended Grade
Above 20°F (-7°C)	NLGI Gr. No. 2, lithium base, general-purpose, extreme pressure grease.
Below 20°F (-7°C)	NLGI Gr. No. 1, lithium base, general-purpose, extreme pressure grease.

When adding to or changing lubricants (gear oil or hydraulic oil), every precaution should be taken to prevent any contamination of the lubricants. Do not mix different types of fluids.

Recommended Lubricants

Table 5-4. Lubricant Chart

Component/ Lube Description	Environment	Lube Type	ASTM / ISO-VG Grade	NLGI	AGMA	Viscosity	Viscosity Index	Pour Point°
Hydraulic Fluids	-20°F –125°F (-29°C – 52°C)	Hydraulic Oil[1]	46	---	---	48-55 SUS @ 210°F 6.8-8.9 cST @ 100°C	132	-30°F (-34°C
		Automatic Transmission Fluid - Type “F” meeting Ford Motor Co. Spec. ESW-M2C33-F						
		Hydraulic Transmission Oil	46	---	---	48-55 SUS @ 210°F 6.8-8.9 cST @ 100°C	100 MIN.	-35°F (-37°C
	-50°F – 0°F (-46°C – 18°C)	Synthetic Hydraulic Oil[2]	32	---	---	47 SUS @ 210°F 6.1 cST @ 100°C	140	-55°F (-48°C
		Automatic Transmission Fluid - Dexron III			---	51 SUS @ 210°F 7.5 cST @ 100°C	172	-54°F (-48°C
Gearbox and Swivel Bearing	15°F to 60°F (10°C to 52°C)	EP Gear Oil[3]	460	---	#7 EP	150 SUS @ 210°F 30.3 cST @100°C	95	20°F (-7°C
	-20°F to 25°F (10°C to 52°C)	EP Gear Oil[3]	320	---	#6 EP	120 SUS @ 210°F 24.0 cST @100°C	95	0°F (-18°C
	50°F to 125°F (10°C to 52°C)	EP Gear Oil[3]	150	---	#4 EP	78.1 SUS @ 210°F 14.5 cST @100°C	95	-10°F (-23°C
	-50°F to 0°F (10°C to 52°C)	Synthetic Gear Oil	100	---	---	77.1 SUS @ 210°F 14.4 cST @100°C	149	-50°F (-46°C
General Lubricants	Above 20°F (-7°C)	EP Grease[4]	---	#2	---	---	---	---
		EP Grease[4]	---	#1	---	---	---	---

Footnotes:

1. *Must be Premium Grade with Anti-Rust and Anti-Wear Additives.*
2. *Must be Premium Shear Stable High VI Anti-Wear hydraulic oil.*
3. *For additional wear protection, the use of Dow-Corning Molykote-M Gear Guard (5% - 10% by volume is recommended.*
4. *Lithium base, general-purpose, extreme pressure grease.*
5. *Lithium soap base grease, per motor manufacturer’s specifications.*
6. Fluids and Lubricants must pour freely at minimum operating temperature. If machine is started when the temperature is near or below the pour point of a lubricant, the lubricant may be congealed and incapable of providing a lubricating film, resulting in metal-to-metal friction; which can cause sparks or hot spots.

Inspection and Lubrication

Inspecting Hardware and Fittings

1. Visually inspect the Iron Roughneck for loose or missing hardware and fittings daily. Make sure all lock safety wire is undamaged.
2. Check intensifier hydraulic indicator filter weekly. Replace as necessary if the indicator is red during operation.
3. Check inlet high pressure hydraulic filter indicator weekly. Replace as necessary if the indicator is red during operation.
4. Inspect all hoses for wear or damage. Replace as necessary.
5. Tighten any fittings that appear to be leaking.

All hoses are clearly labeled. Consult hose kit drawings for proper routing and hose specification and always label when replacing hoses on the Iron Roughneck.

When changing hydraulic cartridge valves, refer to the hydraulic schematic for proper settings.

Inspection and Lubrication

Lubricating the Iron Roughneck

The lubrication intervals described in this manual are based on lubricant supplier recommendations. Severe conditions such as extreme loads or temperature, corrosive atmosphere, etc., may require more frequent lubrication.

Worn bushings, binding parts, rust accumulations, and other abnormal conditions indicate more frequent lubrication is necessary.

Inspect all grease fittings daily as shown on the following page, and apply grease as needed or weekly.

During inspection and lubrication, lock out hydraulics to disable equipment operation to avoid personal injury or equipment damage.

Clean any grease which falls to the floor to prevent personal injury due to slipping.

Maintenance Schedule

Inspection, Lubrication, and Maintenance

Power down the Iron Roughneck and allow hot surfaces to cool before performing inspection and maintenance procedures.

Table 5-5. Maintenance Schedule by Component

Major Components			
Item	**Inspection**	**Lubrication**	**Maintenance**
General			
1. Hardware	Weekly	N/A	❑ Tighten to proper torque. ❑ Replace if missing.
2. Hoses and Connectors	Weekly	N/A	❑ Tighten connections if loose. ❑ Replace if damaged, leaking, or kinked.
3. Cleanliness: Equipment and Work Areas	Daily	N/A	❑ Remove corrosives and contaminants: salt, sand, mud, oil, and grease. ❑ Dispose of components properly.
4. Intensifier Filter	Monthly	N/A	See “Changing Intensifier Hydraulic Filter,” page 5-23.
Head Assembly			
Spin Wrench Assembly			
1. Grease Fittings - behind cover	Weekly	Weekly	See “Lubrication (1 of 5),” page 5-10.
2. Grease Fittings behind spin wrench	Weekly	Weekly	See “Lubrication (2 of 5),” page 5-11.
3. Spin Wrench General Maintenance	Weekly	Weekly	See “Lubrication (4 of 5),” page 5-13.
4. Spin Rollers	Weekly	N/A	Replace if worn or damaged. See “Replacing Spin Rollers,” page 5-20.

Maintenance Schedule

Inspection, Lubrication, and Maintenance

Table 5-5. Maintenance Schedule by Component (continued)

Major Components (continued)

Item	Inspection	Lubrication	Maintenance
Torque Wrench Assembly			
1. Grease Fittings	Weekly	Weekly	See “Lubrication (3 of 5),” page 5-12. See “Lubrication (4 of 5),” page 5-13.
2. Replace Dies	Daily	N/A	See “Replacing Wrench Dies,” page 5-17.
Arm Assembly			
1. Structure Fittings	Weekly	Weekly	See “Lubrication (5 of 5),” page 5-14.
2. System Hydraulic Filter	Monthly	N/A	See “Changing Inlet Hydraulic Filter,” page 5-24.
3. Arm Pin Fittings	Weekly	Weekly	See “Lubrication (2 of 5),” page 5-11. See “Lubrication (4 of 5),” page 5-13. See “Lubrication (5 of 5),” page 5-14.
Column Assembly			
1. Break and Gearbox Expansion Oil Tank	Weekly (Oil Level)	6 Months	See “Changing Oil,” page 5-28.
Column Base			
2. Slew Bearing Grease Fittings	Weekly	Monthly	See “Lubrication (4 of 5),” page 5-13.
3. Slew Idler Gear Grease Fittings	Weekly	Weekly	See “Lubrication (5 of 5),” page 5-14.

Maintenance Schedule
ST-120 Iron Roughneck

During operation, surfaces may become hot enough to cause bodily injury. To reduce the risk of injury from a hot component, allow the surface to cool before touching.

Each grease fitting is to be greased until clean grease is seen extruding from the related component.

Instructions

- Inspect all marked areas daily.
- Grease areas as indicated.

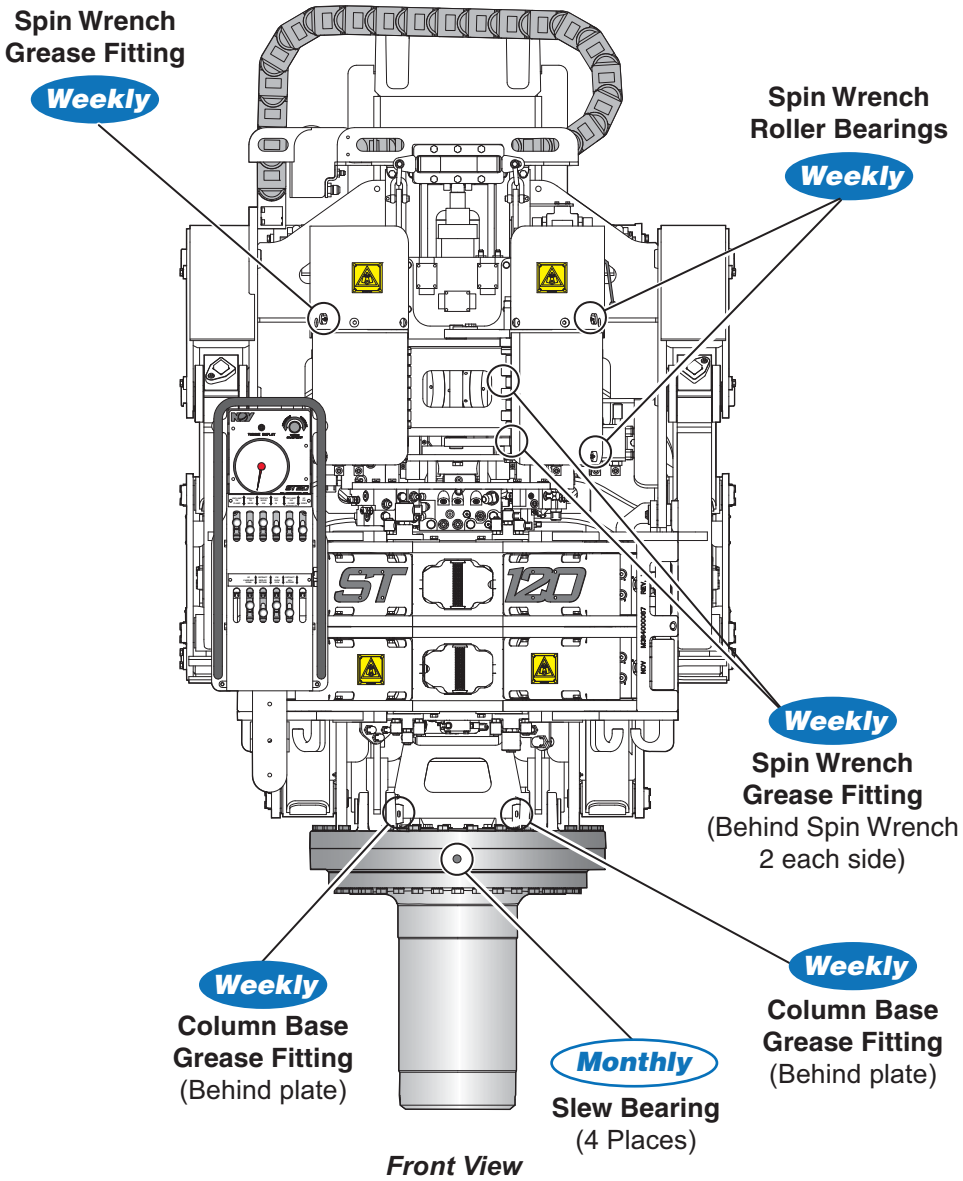
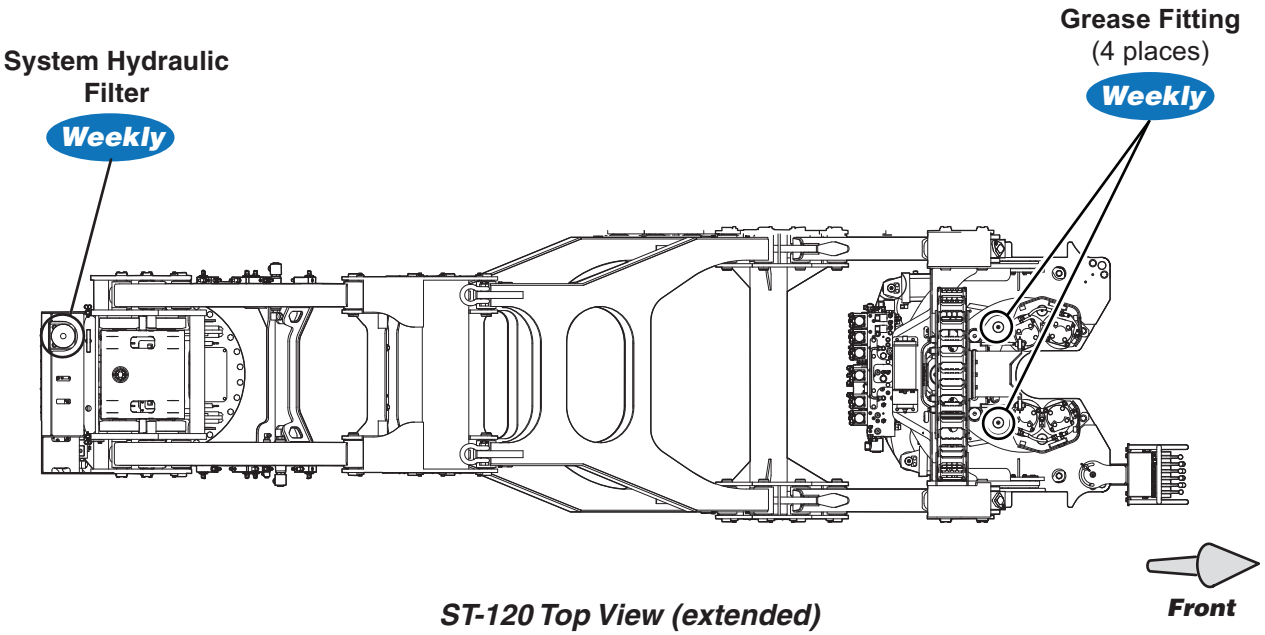


Figure 5-2. Lubrication (1 of 5)

Maintenance Schedule
ST-120 iron Roughneck

During operation, surfaces may become hot enough to cause bodily injury. To reduce the risk of injury from a hot component, allow the surface to cool before touching.

Each grease fitting is to be greased until clean grease is seen extruding from the related component.



ST-120 Top View (extended)

Figure 5-3. Lubrication (2 of 5)

Maintenance Schedule

Torque Wrench Assembly

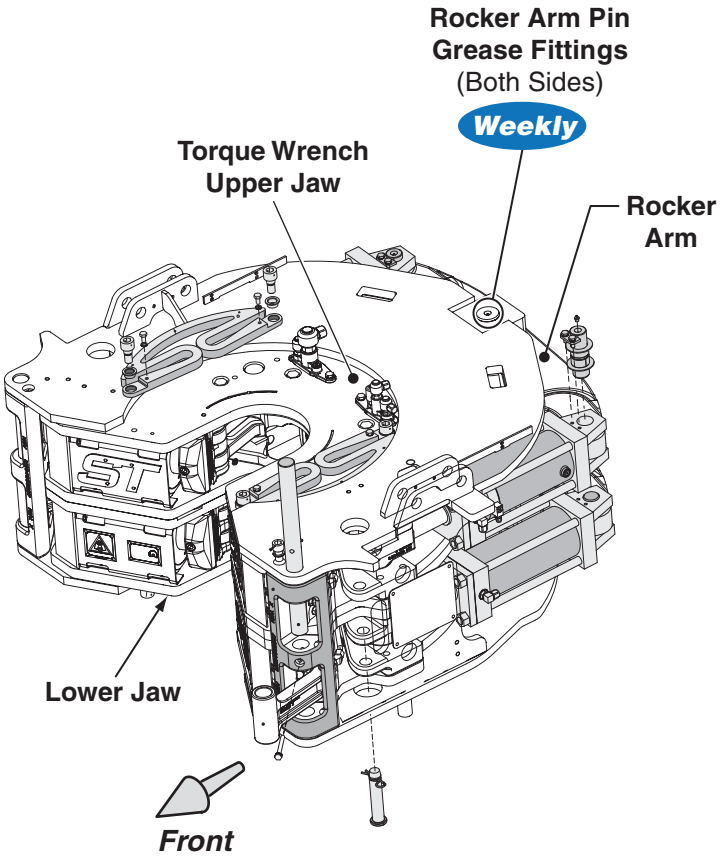
During operation, surfaces may become hot enough to cause bodily injury. To reduce the risk of injury from a hot component, allow the surface to cool before touching.

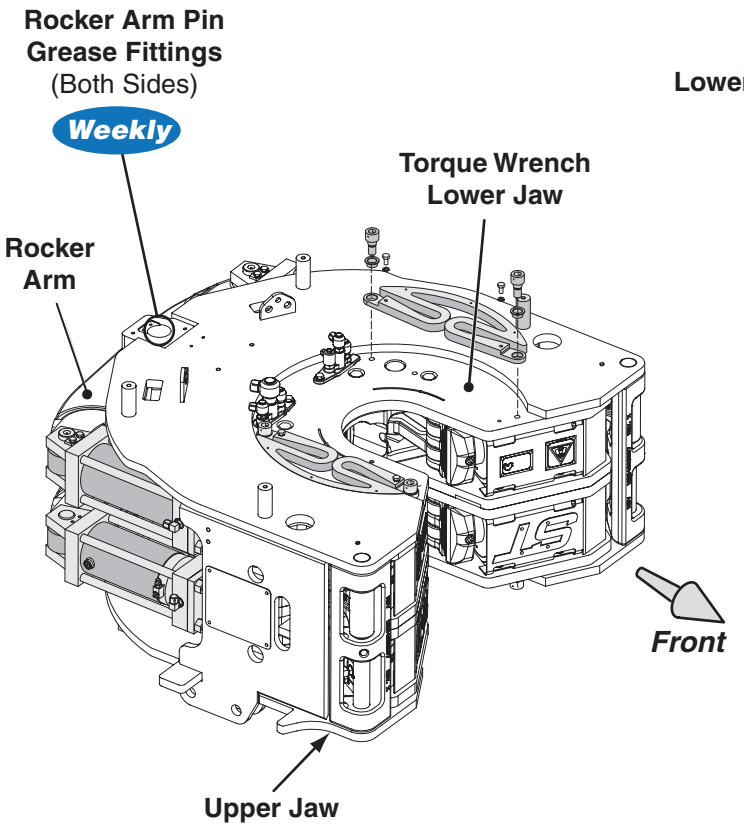
Each grease fitting is to be greased until clean grease is seen extruding from the related component.

Instructions

- Inspect all marked areas daily.
- Grease areas as indicated.

Top View of Torque Wrench Assembly





Bottom View of Torque Wrench Assembly

Figure 5-4. Lubrication (3 of 5)

Maintenance Schedule

Head Assembly Lubrication

Each grease fitting is to be greased until clean grease is seen extruding from the related component.

During operation, surfaces may become hot enough to cause bodily injury. To reduce the risk of injury from a hot component, allow the surface to cool before touching.

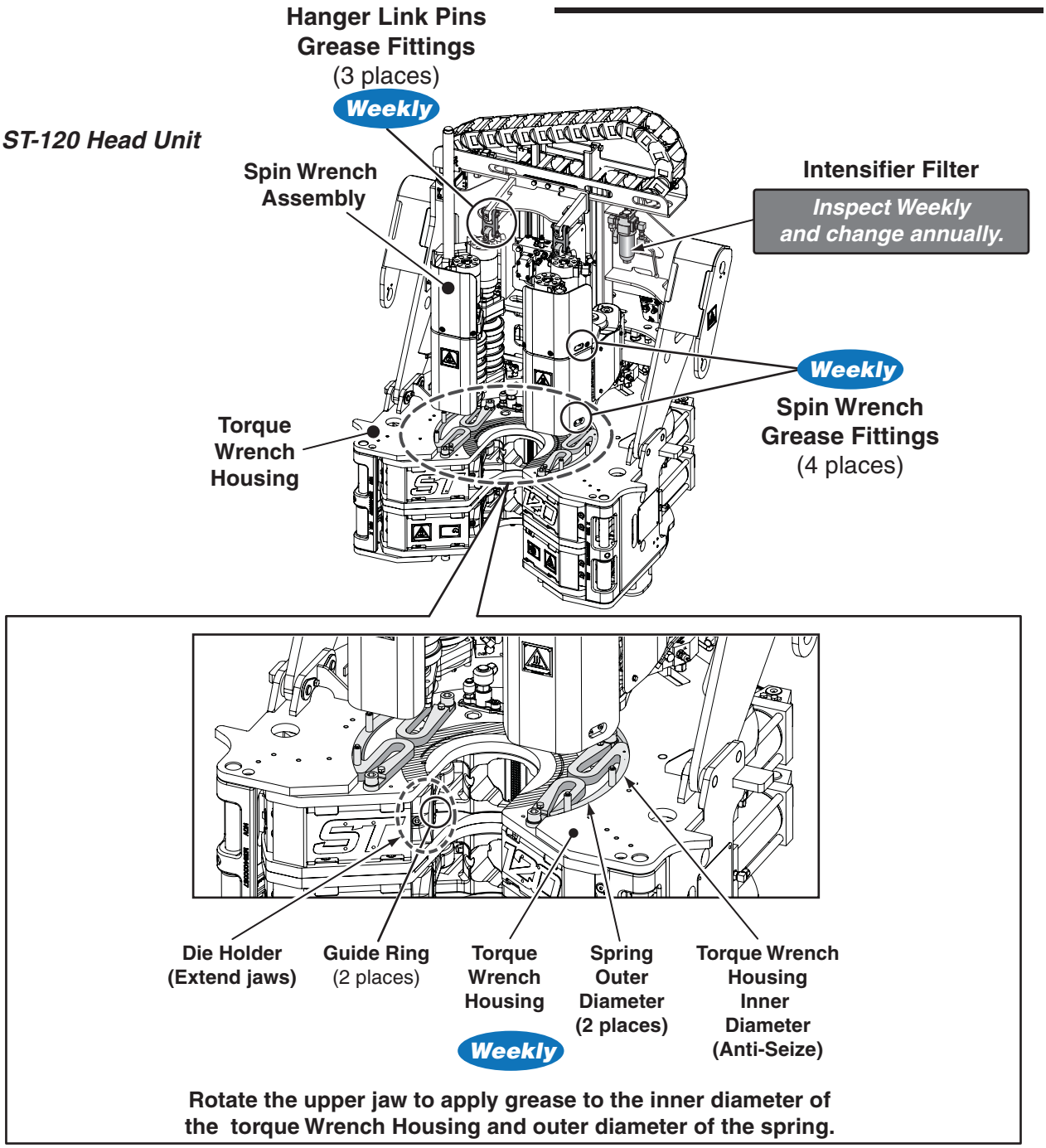


Figure 5-5. Lubrication (4 of 5)

Maintenance Schedule

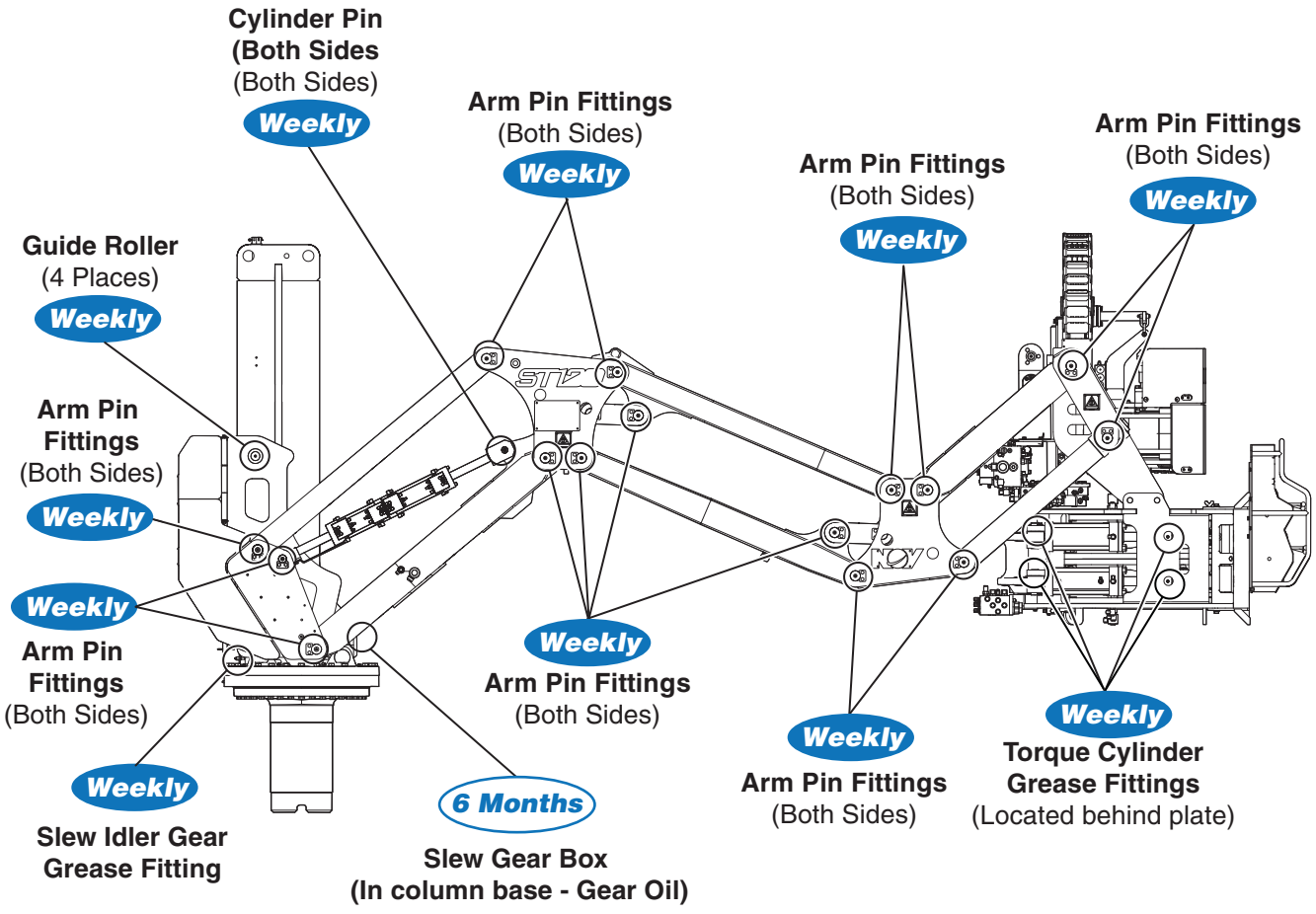
Arm Lubrication

During operation, surfaces may become hot enough to cause bodily injury. To reduce the risk of injury from a hot component, allow the surface to cool before touching.

Each grease fitting is to be greased until clean grease is seen extruding from the related component.

Instructions

- Inspect all marked areas daily.
- Grease areas as indicated.



ST-120 Side View (extended)

Figure 5-6. Lubrication (5 of 5)

Disassembly and Assembly

Precautions

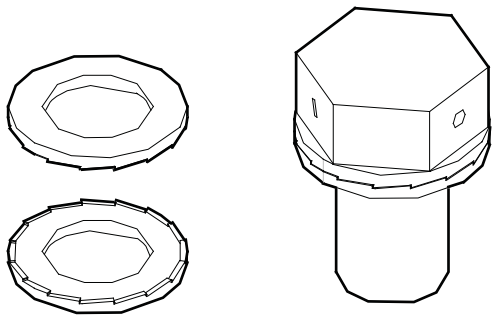
Transport hydraulic components to a safe, clean, dust-free service area before disassembling.

Disassembly procedures are performed when replacing damaged components that are causing a tool function to fail. Whenever performing a disassembly, practice preventive maintenance as follows:

- Clean and inspect all disassembled parts.
- Replace all worn and damaged parts before they can cause another failure.
- Install thread protectors on exposed threads.

Torque all fasteners to the limits given in DS00008, Design Specification Design Torque Standard, unless an alternative torque value is given in the procedure.

Do not re-use nord-lock washers after removing a bolt. Replace with properly assembled new nord-lock washer. See graphic below for assembly.



Disassembly and Assembly

Precautions

Release all hydraulic oil pressure before disconnecting hydraulic lines. Hydraulic oil under pressure can penetrate skin and cause serious injury.

Before opening the hydraulic system, thoroughly clean the work area. Maintain system cleanliness by promptly capping all disconnected lines. Dirt is extremely harmful to hydraulic system components and can cause equipment failure and subsequent injury to personnel.

Ensure all hydraulic lines are isolated and the ball valve is closed before any work is performed on the Iron Roughneck.

If air is introduced into the duplex extend cylinder, use extreme caution when extending the platform for the first time. As the load moves over the well center, the air will compress causing the support arm to extend rapidly. Support the unit with a tugger and a stand to the side until air is purged.

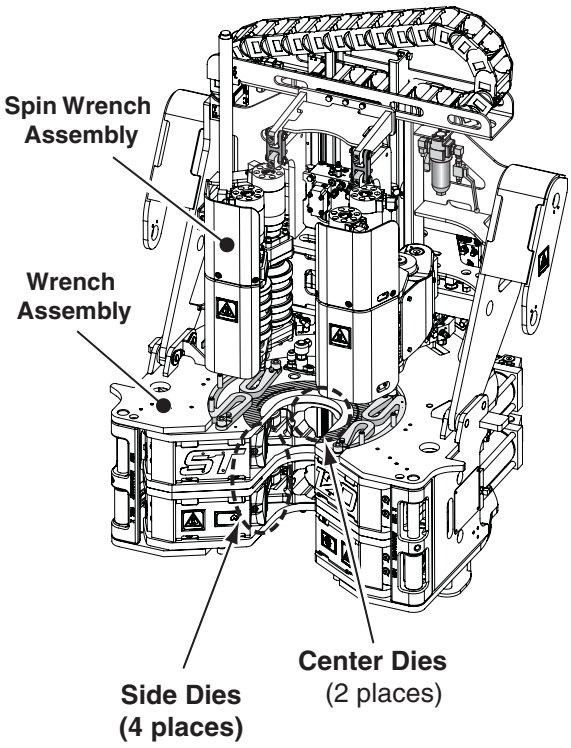
Maintenance should not be performed on the ST-120 Iron Roughneck while it is in an elevated position, even with the hydraulic power unit shut off and residual pressure bled from the system.

During operation, surfaces may become hot enough to cause bodily injury. To reduce the risk of injury from a hot component, allow the surface to cool before touching.

Disassembly and Assembly

Replacing Wrench Dies

ST-120 Head Unit



Procedure

- Install new dies in all die carriers.
- Replace screws with new ones if necessary.
- Clean and inspect parts and hardware for damage and wear. Replace damaged parts and hardware.

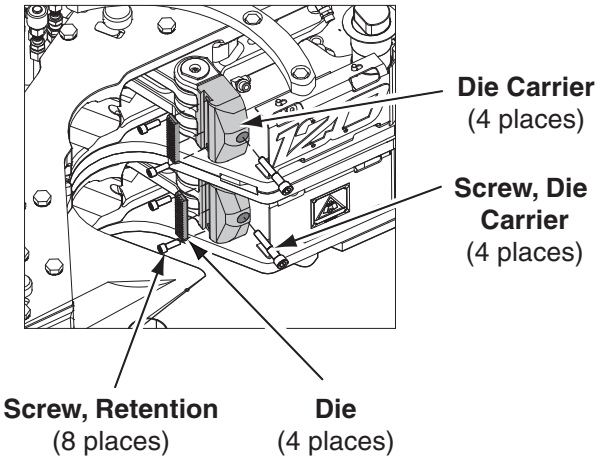
Once screws are removed die may slip out of die carrier. Secure die to avoid personal injury or equipment damage.

1. Actuate the torque wrench lever to extend the clamp cylinders.

Lock out hydraulics to disable equipment operation to avoid personal injury or equipment damage.

2. Remove hydraulic power.
3. Clean the area around die and die carriers.
4. Remove upper die retention screw and remove die. If die is stuck, remove the lower retention screw (and Center Die retaining plate) and drive die out.
5. Use a wire brush to clean die carrier.
6. Inspect and lightly grease die carrier. See *"Recommended Lubricants," page 5-3.*
7. Install new die, and apply center die retaining plate. Apply antiseize compound to retention screw and replace the retaining screw.
8. Torque screws to 57-81 ft.-lbs.

Side Dies *(4 places)*



Center Dies *(2 places)*

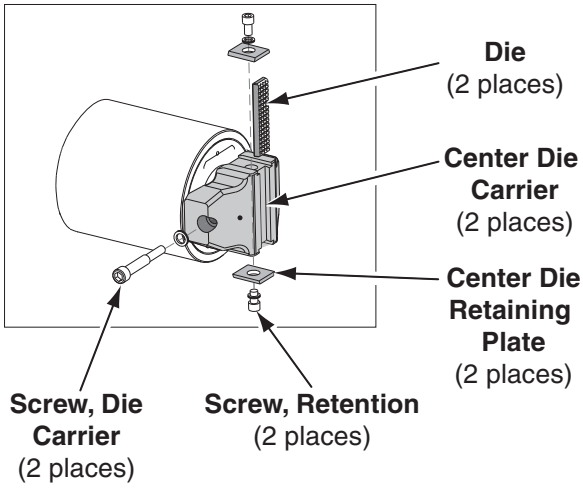


Figure 5-7. Replacing Wrench Dies

Disassembly and Assembly

Removing Torque Wrench

Lock out hydraulics to disable equipment operation to avoid personal injury and damage to the Iron Roughneck.

To remove the Torque Wrench, complete the following steps

1. Disconnect all hydraulic lines to all 4 torque cylinders.
2. Remove the pin keeper from the torque cylinders and remove the pivot pin to disengage the torque cylinder from the rocker arm.
3. Carefully follow these steps to bleed residual hydraulic pressure prior to maintenance of the torque wrench.
   a. Remove the pressure-bleed-fitting from Port Z of the Clamp Cylinder Manifold, which is located on the top of the Upper Jaw Assembly. Proceed in small increments of 1/2 turn counter clockwise at a time. (See Figure 5-8, Torque Wrench Assembly Top View).
   b. Wipe away any fluid and do not continue until overflow has stopped.
   c. After completely relieving the trapped pressure, close the port with the pressure bleed fitting.
   d. Ensure that the bleed fitting is properly torqued prior to resuming maintenance on the Iron Roughneck.
4. Disconnect the hydraulic lines from the swivel fittings located on the top of the upper jaw and beneath the lower jaw.
5. Remove the grounding frames.
6. Attach a lifting eye to the top of the upper jaw and lift slightly with a crane.
7. Slide out the upper jaw from the torque wrench frame.
8. Attach a lifting eye to the top of the lower jaw and lift slightly with a crane.
9. Slide out the lower jaw from the torque wrench frame.

Safely release hydraulic pressure from Port Z of the hydraulic circuit in the Torque Wrench's Upper Jaw Assembly prior to performing maintenance on the Torque Wrench Assembly. Carefully follow step 3 of this procedure, using caution to ensure that the pressure is completely released.

Disassembly and Assembly

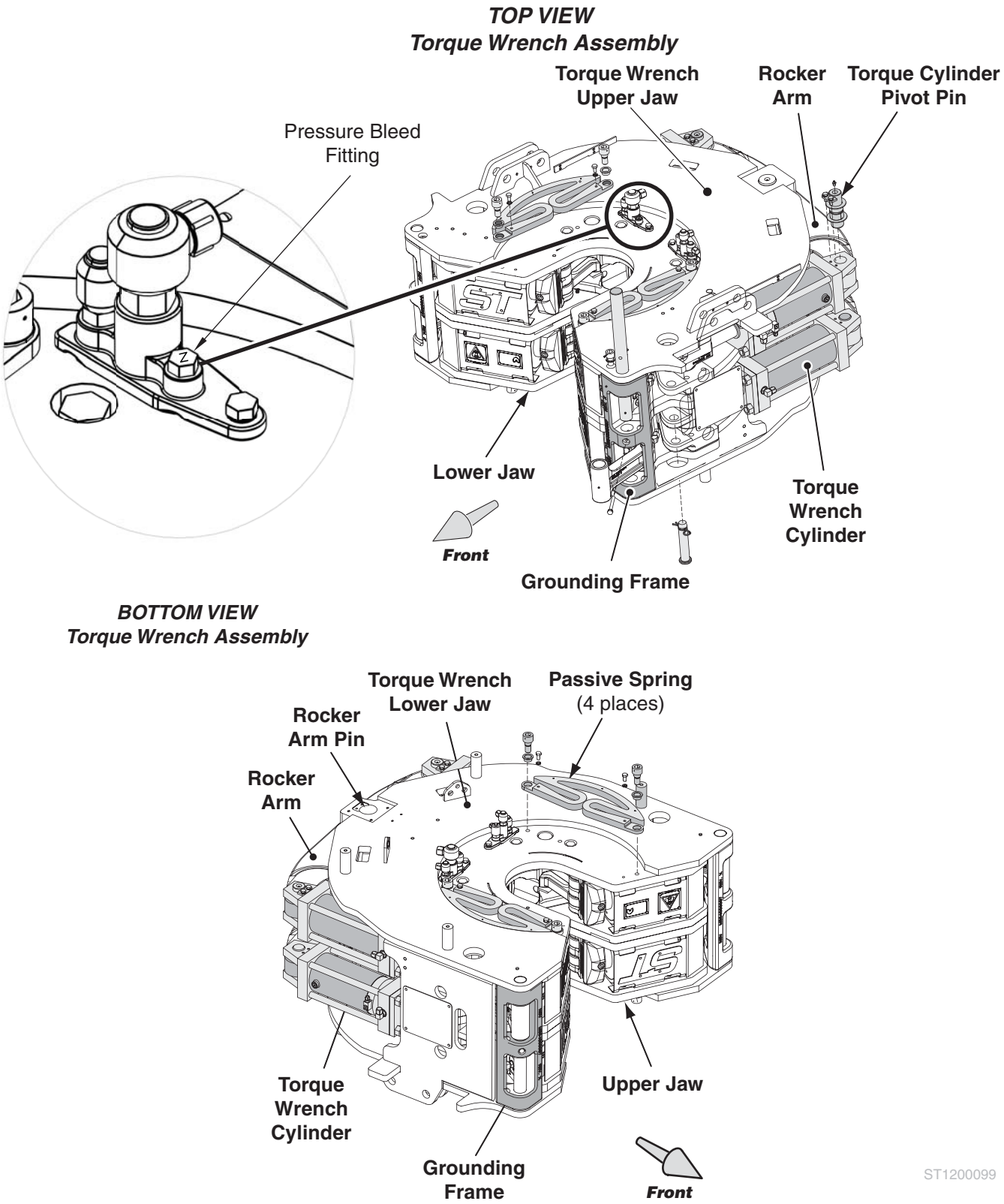
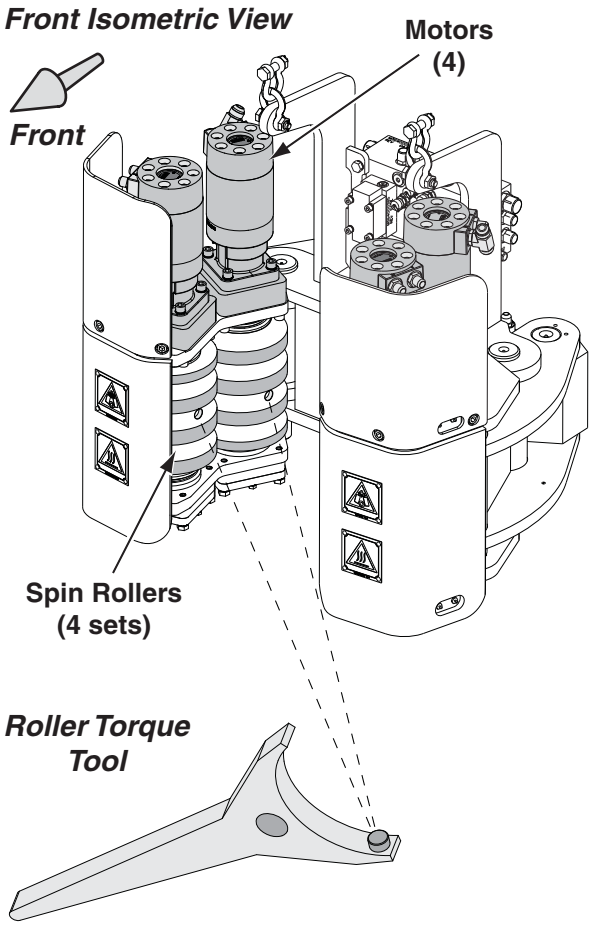
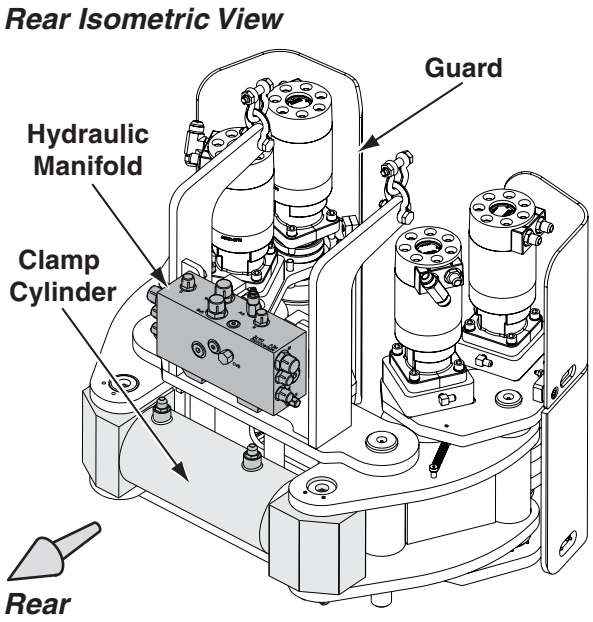


Figure 5-8. Removing the Torque Wrench

Replacing Spin Rollers





- **Minimum allowable Spin Roller diameter is 6.9" (equates to 1/8" radial wear).**
- Replace Spin Rollers with all new rollers at the same time.
- Replace screws with all new screws if necessary.
- Clean and inspect parts and hardware for damage and wear. Replace damaged parts and hardware.

Parts may slip from the Spin Wrench Assembly once they are loosened. Secure parts and place in a clean, safe location to avoid personal injury or equipment damage.

Lock out hydraulics to disable equipment operation and avoid personal injury and equipment damage.

Procedure

1. Remove the Plug from the lower cover plate.
2. Use the Roller Torque Tool to keep rollers from turning.
3. Remove the large support screw inside the cover plate.
4. On the bottom of the Cover Plate, remove screws to release and remove the Cover Plate, Lower Drive Hub, and Lower Bearing Assembly.
5. Remove Spin Rollers.
6. Clean the Spin Wrench Assembly.
7. Install new Rollers interlaced as shown. Rollers must interlace with opposing Roller Assembly.
8. Use Roller Torque tool to keep rollers from turning.
9. Install Cover Plate, Lower Drive Hub, and Lower Bearing Assembly.
10. Slightly oil washer, and install it and the large support screw in the bottom of the Lower Bearing Assembly.
11. Torque bolt to 430 ft.-lbs.

While the Spin Rollers are disassembled, worn or damaged Bearing Assemblies and other Spin Wrench Assembly parts should be replaced.

Figure 5-9. Replacing Spin Rollers

Disassembly and Assembly

Replacing Spin Roller

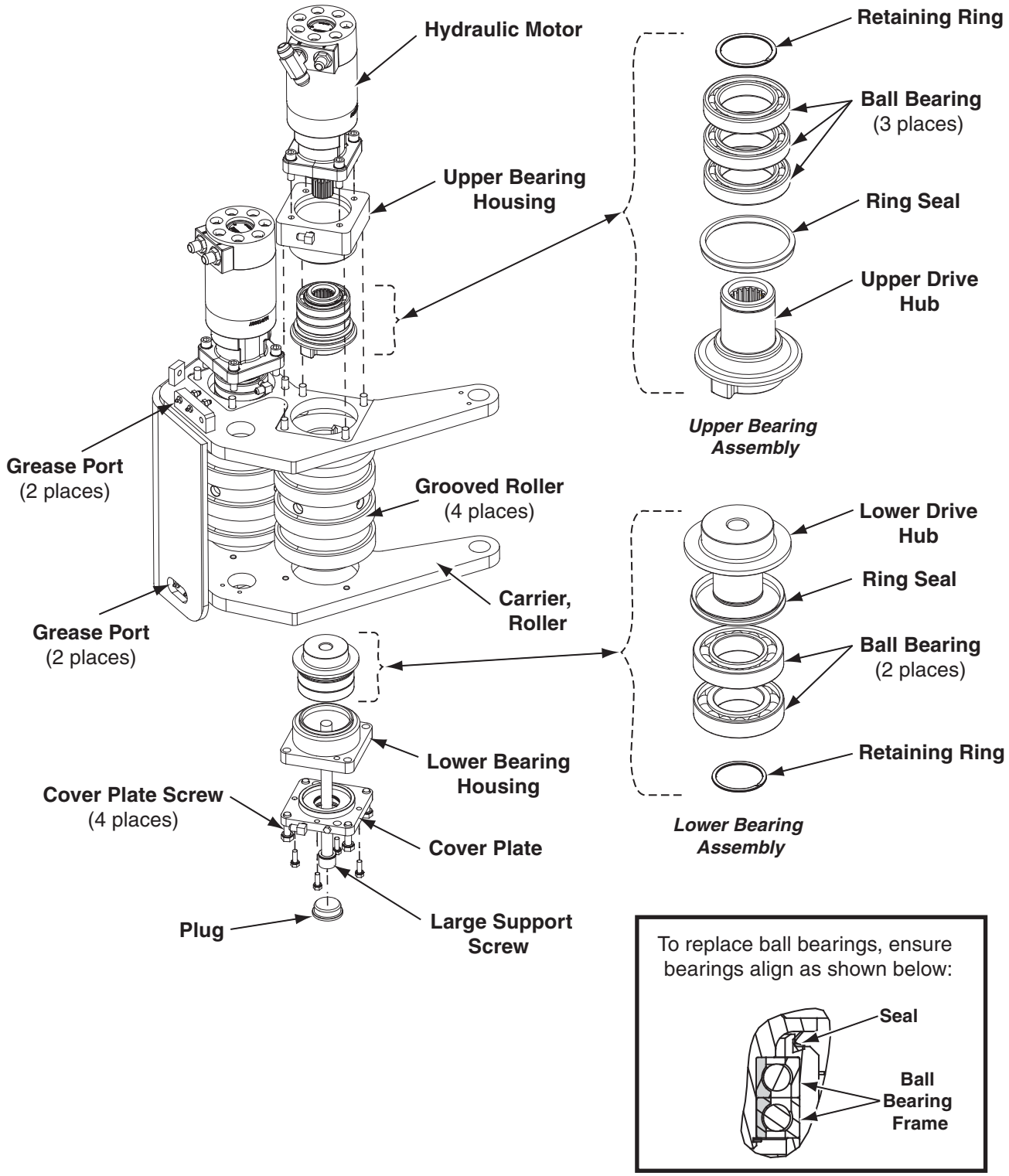
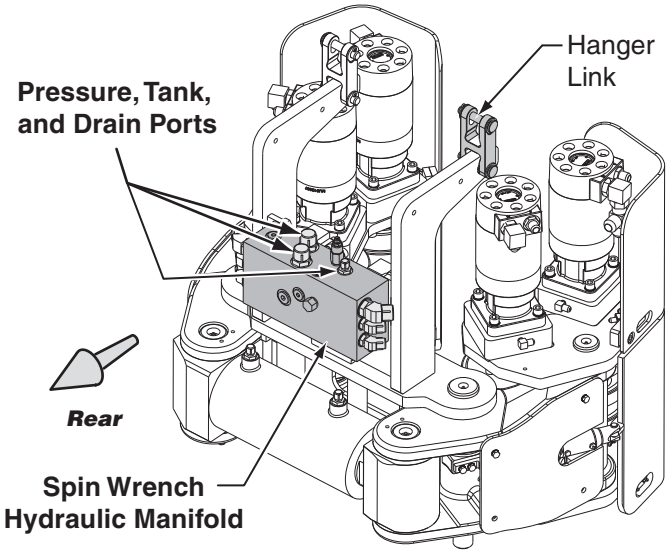


Figure 5-10. Spin Wrench Assembly - Disassembled

Disassembly and Assembly

Removing the Spin Wrench

ST-120 Spin Wrench Assembly Rear View



Procedure

Lock out hydraulics to disable equipment operation and avoid personal injury and equipment damage.

1. Disconnect the hydraulic connections to the spin wrench manifold.
2. On the bottom of the spin wrench assembly, remove the spring and the spring perch from the spin wrench hinge pin.
3. Using a crane, support the weight of the spin wrench.
4. Disconnect the spin wrench hanger link from the hanger.
5. Lift and remove the spin wrench.

ST-120 Spin Wrench Front Isometric View

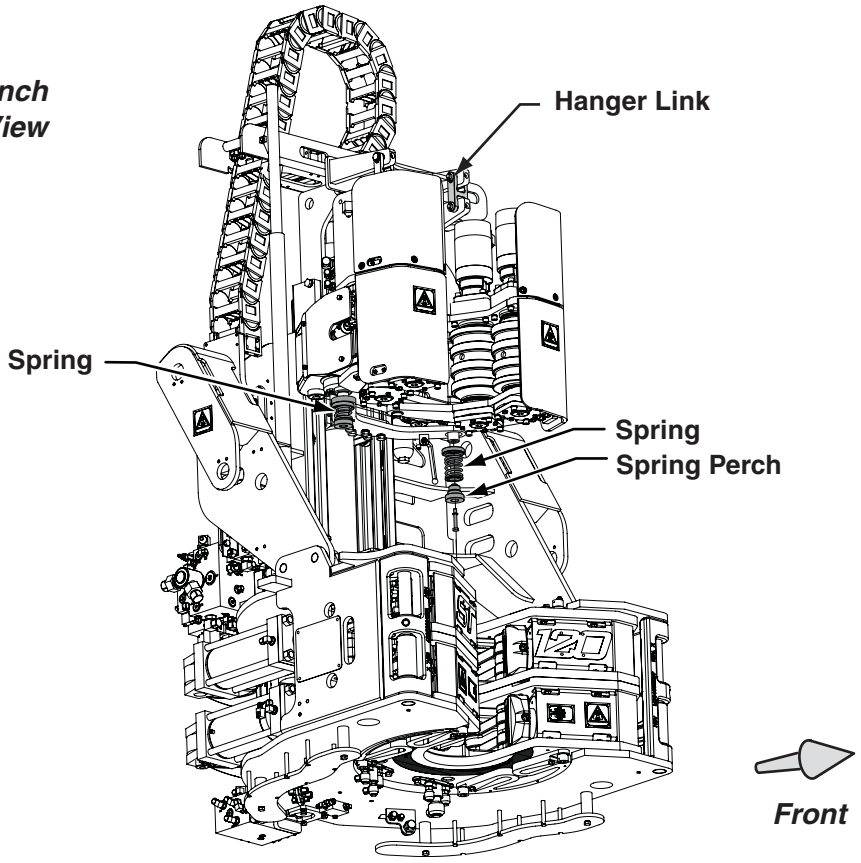


Figure 5-11. Removing the Spin Wrench

Part Maintenance

Changing Intensifier Hydraulic Filter

Lock out hydraulics to disable equipment operation and avoid personal injury and equipment damage.

Procedure

1. Turn off main ball valve and bleed residual pressure.
2. Turn off intensifier ball valve.
3. Remove hydraulic filter cap.
4. Replace filter element.
5. Install hydraulic filter cap.

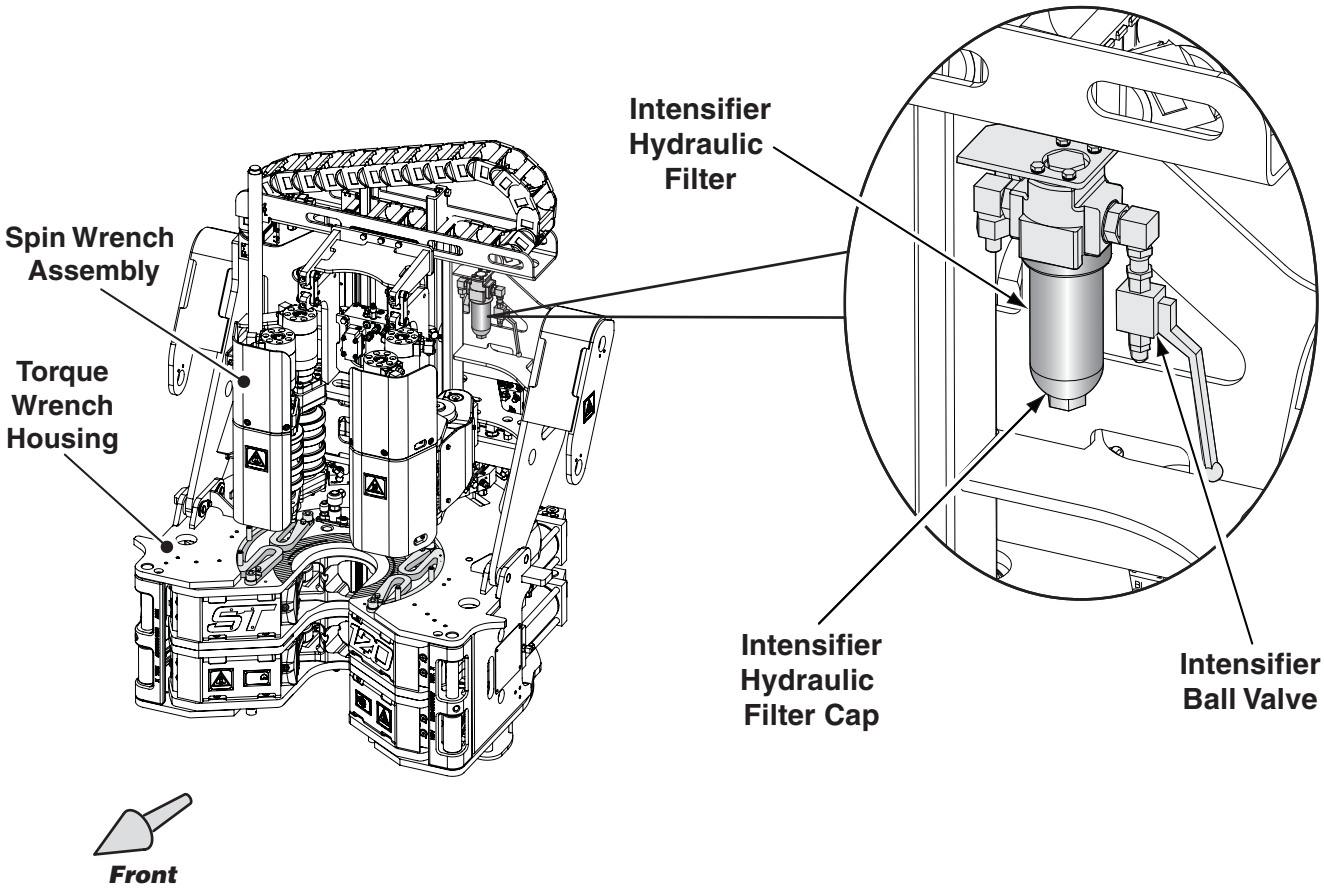


Figure 5-12. Changing Intensifier Hydraulic Filter

Part Maintenance

Changing Inlet Hydraulic Filter

Lock out hydraulics to disable equipment operation and avoid personal injury and equipment damage.

Procedure

1. Turn off main ball valve and bleed residual pressure.
2. Remove hydraulic filter cap.
3. Replace filter element.
4. Install hydraulic filter cap.

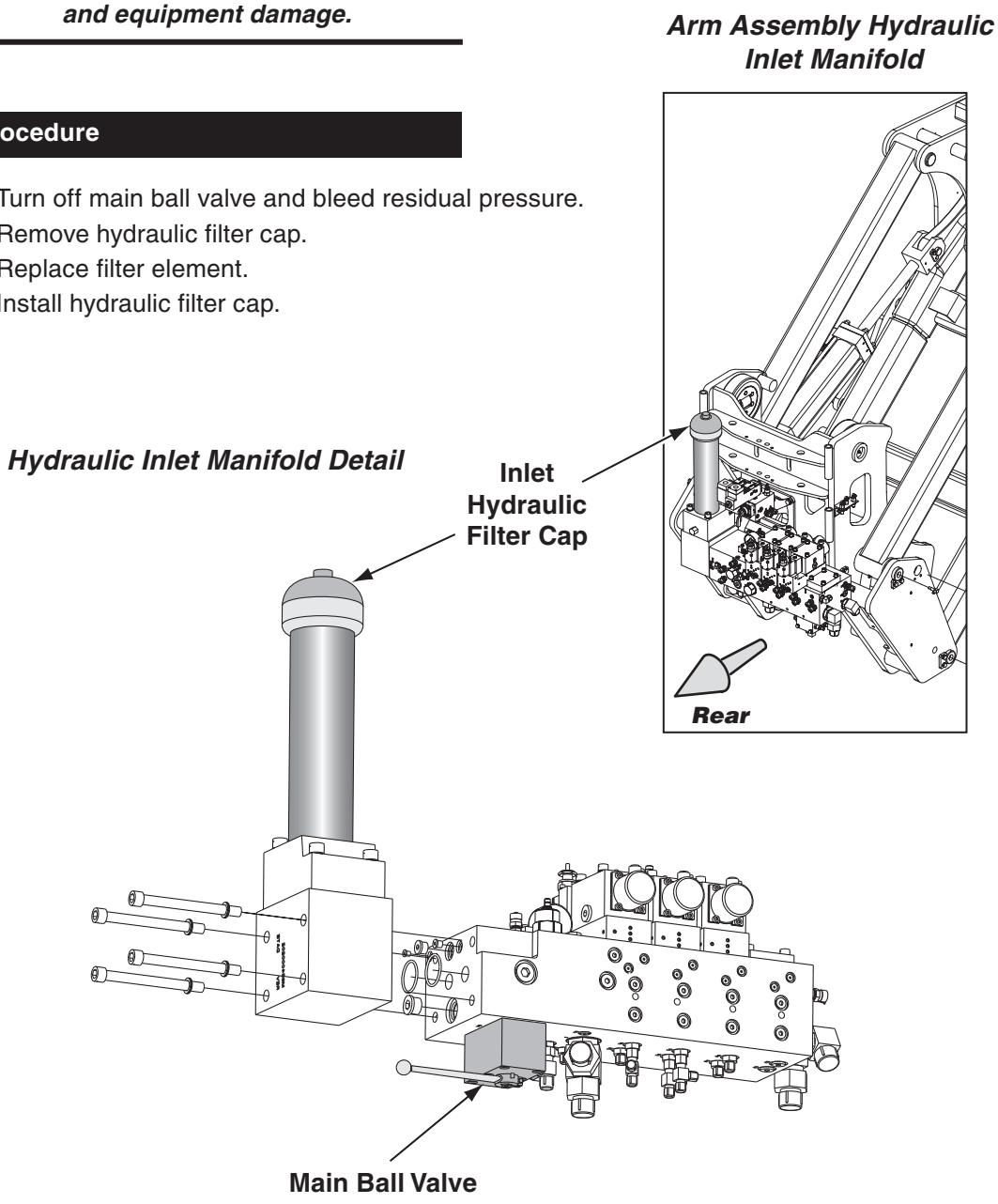


Figure 5-13. Changing Inlet Hydraulic Filter

Changing Oil

Before performing any hydraulic or mechanical work on the tool, ensure the hydraulic ball valve located on the rear of the ST-120 Iron Roughneck is in the OFF position and bleed residual pressure by actuating SW lever in either SPIN IN or SPIN OUT.

Changing Oil Guidelines

- Gear oil must be drained and changed after the first 50/100 hours of operation and subsequently after every 2500 hours or in any case each year. The following list provides oil change information.
- Oil changes must be carried out after first 50/100 hours of operation and subsequently after every 2500 hours or at least every 12 months.
- Oil change intervals may be modified, depending on actual operating conditions.
- During oil change, we recommend that the inside of the gear case is flushed out with flushing fluid recommended by lubricant manufacturer.
- Pay attention to oil and gear temperature during oil change, to avoid the risk of scalding.
- Oil should be changed when hot to prevent build up of sludge deposit.
- It is advisable to check oil level at least once per month. If more than 10% of total oil capacity has to be added, check hydraulic hoses and connections for oil leaks.
- Do not mix oils of different types even if they are from the same manufacturer.
- Never mix mineral oil and synthetic oils.
- Be conscious of the pollution hazard due to oil.

Changing Oil

Changing Brake and Gearbox Oil

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Never perform maintenance on the ST-120 Iron Roughneck while it is in an elevated position, even with the hydraulic power unit shut off and the residual pressure bled from the system. Failure to adhere to this warning may lead to severe personal injury or death.

Lock out hydraulics to disable equipment operation and avoid personal injury and damage to the equipment.

To change brake and gearbox oil, complete the following steps:

1. Ensure that the ST-120 Iron Roughneck is fully lowered and the Arm Assembly is locked out. For detailed information, see Locking Out Arm Assembly procedure, page 4-14.

The drain and fill ports can be easily accessed from the front of the column with the unit fully lowered.

2. To ease oil drainage, remove the constant vented breather from both oil expansion tanks located in the column assembly.
3. Turn the hydraulic ball valve located on the rear of the ST-120 to the OFF position.
4. Bleed residual pressure by actuating SW lever in either SPIN IN or SPIN OUT.
5. Carefully remove Plug A from the gearbox and Plug A from the brake,
6. Once all the oil is drained and the gear case is flushed, install the gearbox Plug A and the brake Plug A.
7. Remove the gearbox Plug B and brake Plug B and fill with recommended oil. See "Recommended Lubricants" on page 5-3.

For illustrated view of this procedure, see Figure 5-14, Changing Brake and Gearbox Reservoir Oil.

Changing Brake and Gearbox Oil

When changing brake and gearbox reservoir oil in the ST-120 Iron Roughneck, it is very important to refer back to the proper procedure for locking out the Arm Assembly. See “Locking Out the Arm Assembly,” page 4-14.

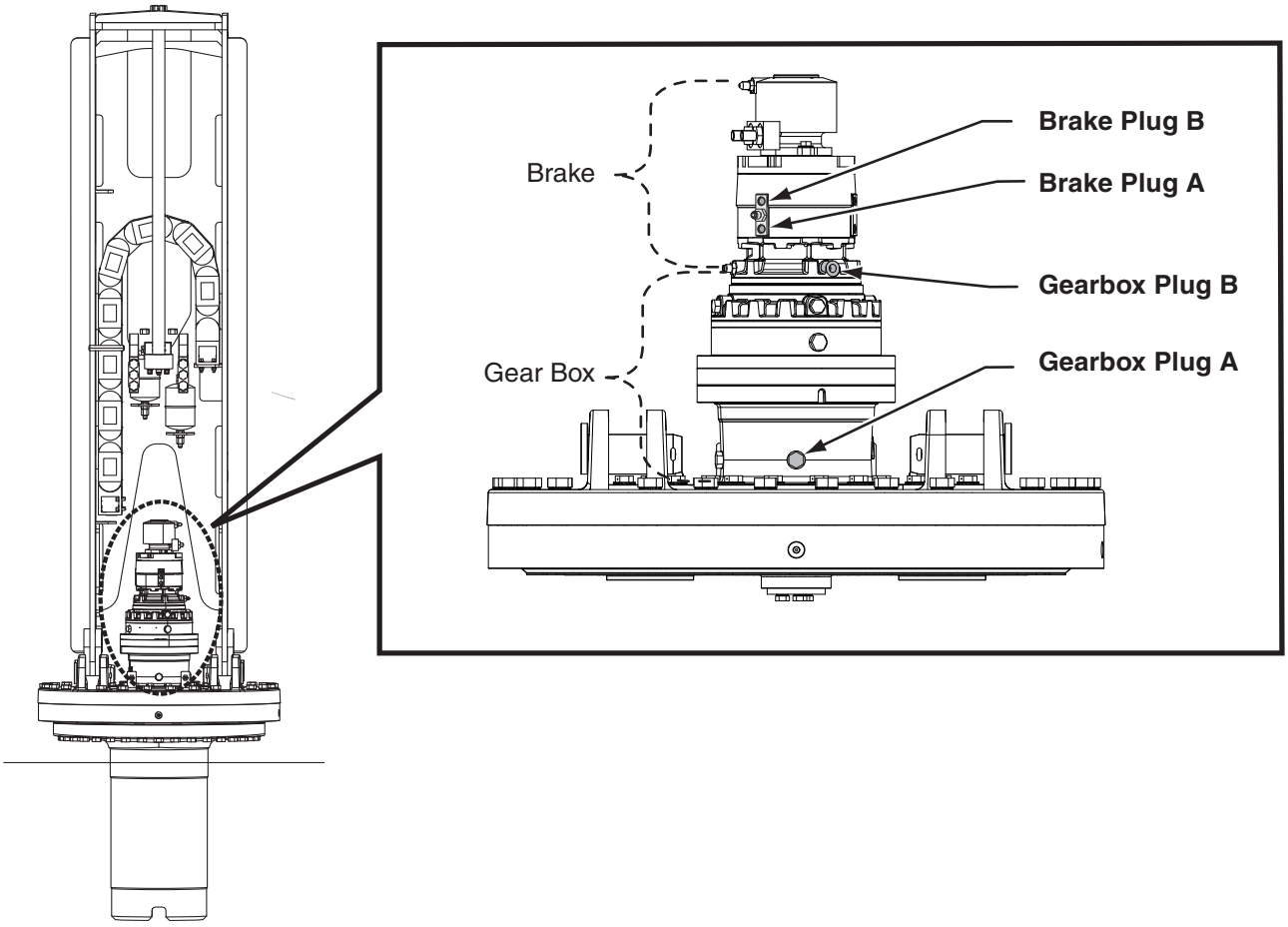


Figure 5-14. Changing Brake and Gearbox Reservoir Oil

Changing Oil

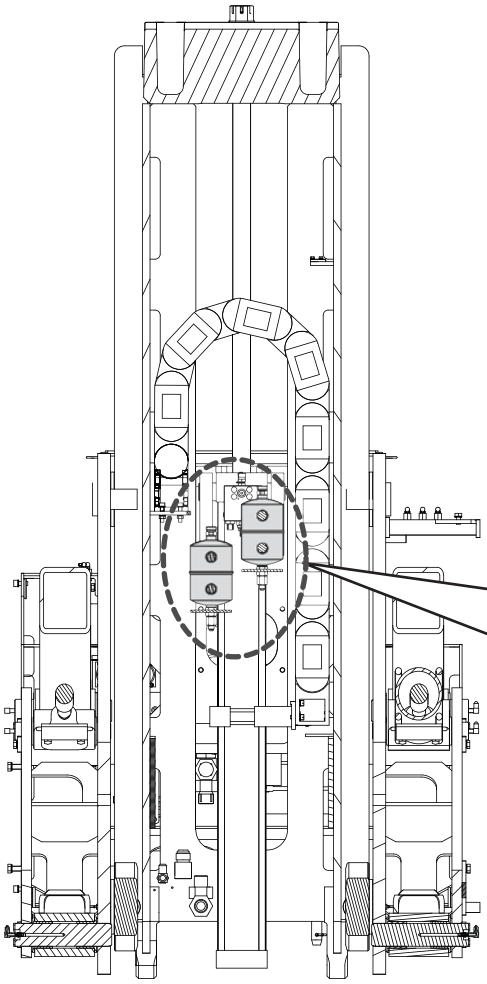
Changing Brake and Gearbox Oil

Changing System Hydraulic Expansion Tanks Oil

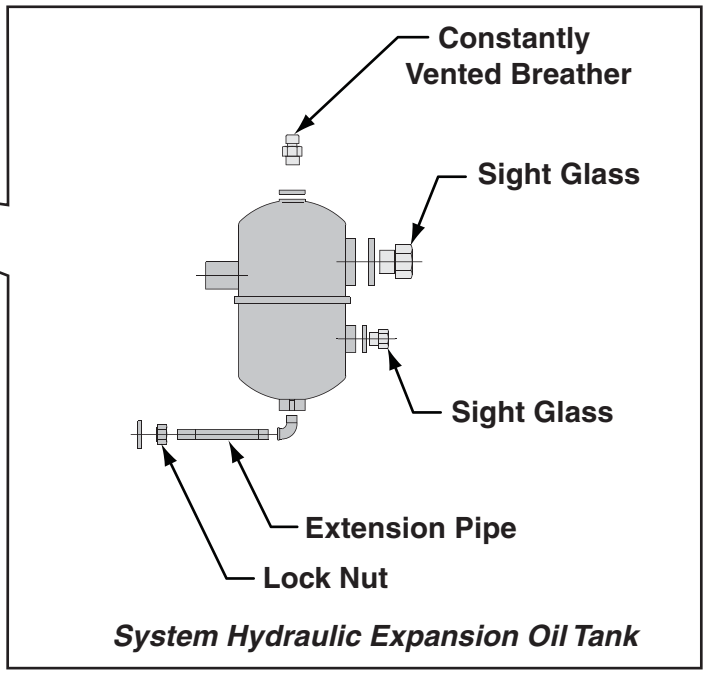
Procedure (Continued)

When adding oil to expansion tank, allow time for fluid to make it's way to the gearbox and brake.

8. Fill expansion tanks with oil until the specified height. (See top sight glass on side of the expansion tank.)
9. Install the breather plug on the tanks.



Column Rear View (Cross Section)



System Hydraulic Expansion Oil Tank

Figure 5-15. Brake and Gear Box Expansion Oil Tanks Maintenance

Troubleshooting

This section describes general troubleshooting methods and provides tables for troubleshooting specific problems or components.

Make sure all hydraulic lines are isolated and the inlet ball valve is closed before any work is performed on the Iron Roughneck.

Whenever hoisting, lowering and operating the iron roughneck, ensure all personnel and equipment are clear of the operating area. Failure to follow this warning may result in personal injury or equipment damage.

When troubleshooting the Iron Roughneck, make sure the hydraulic pressure is 2,500 psi at the inlet of the manifold. Check the back pressure of the tank line and ensure it does not exceed 100 psi.

1. Ensure that all hoses and QDs are properly connected.
2. Check manifold, fittings, QDs, and hoses for leaks or damage.
3. Ensure the tool is lubricated per Chapter 5, titled “Maintenance,” section “Lubricating the Iron Roughneck” on page 5-8.

Mandatory things to check prior to operating the Iron Roughneck include the following:

1. Ensure that the Iron Roughneck is fully inserted in the floor socket or the floor base as appropriate.
2. Ensure all QDs are fully engaged.
3. Ensure the operating pressures are correct.
4. Verify the condition of the filter.
5. Check all fittings for leaks.

Lubricate entire Iron Roughneck and check the condition of the filter per *Chapter 5, titled "Maintenance*, “Lubricating the Iron Roughneck” on page 5-8.

Troubleshooting the Iron Roughneck

Troubleshooting Tables

Symptom	Probable Cause	Remedy
Tool runs slowly.	Hydraulic quick disconnect on supply or return lines not fully shouldered	Tighten until fully shouldered.
	Power unit not delivering full flow	Check power supply flow while spin out valve is actuated. Flow should be 45 GPM minimum.
	Power unit return line filter dirty	Replace filter element of HPU.
	Pressure filter dirty	Replace filter element of ST-120.
Vertical positioning assembly moves in one direction only or does not move at all.	Power supply not operating, or pressure too low	Re-establish hydraulic power.
	Lift cylinder damaged or dirty	Clean or repair cylinder.
	Binding of carriage guide in column	Lubricate or replace side rollers.
	Pilot pressure is set too low	Check pressure and adjust.
Does not maintain vertical position	Counterbalance valve out of adjustment	Replace, or adjust counterbalance valve to maintain vertical position.
	Lift cylinder leak	Replace seals.
Tool does not rotate (slew).	Base assembly quick disconnect couplings are not connected	Fully connect all base assembly quick disconnect couplings.
Tool does not extend	Obstruction	Ensure storage pin is removed. Ensure arm lock plate is not locking the arm.

Troubleshooting the Iron Roughneck

Troubleshooting Tables

Symptom	Probable Cause	Remedy
Torque cylinders do not makeup.	Torque valve set too low	Increase setting.
	Torque valve or pressure reducing valve stuck closed, dirty, or damaged	Check valves, clean or replace.
	Torque cylinders already at end of stroke	Recycle the upper jaw for another bite.
	Torque valve damaged	Check, clean, or replace.
Torque cylinders do not breakout.	Torque setting pressure reducing valve stuck closed, dirty or damaged	Check valves, clean, or replace.
	Torque setting is too low	Increase torque setting.
Torque cylinders drift in makeup direction.	Sticking or worn main operating valve	Disassemble valve, inspect for contamination or wear, and repair or replace.
Torque cylinder does not move or moves slowly.	Dirty return filter in power supply	Replace filter element.
Torque gage does not indicate pressure during makeup	Dirty inlet port or gage	Clean inlet port or replace gage.
	Torque cylinders reached end of stroke and actuated dump valve	Reset for additional stroke.
	Gage damper closed	Open damper located on top front of gage (rotate counterclockwise).
Torque gage does not return to zero.	Gage not adjusted to zero	Rotate zero adjust knob on back of gage case. Recheck torque setting.
	High tank line pressure	Check and correct.
	Defective gage	Replace.

Troubleshooting the Iron Roughneck

Troubleshooting Tables

Symptom	Probable Cause	Remedy
Jaws slip on tool joint.	Worn or broken dies	Replace dies.
	Hydraulic pressure too low	Make sure the pressure at the manifold is set to 2,500 psi.
	Intensifier not operating	Ensure the intensifier ball valve is on and inspect and replace as necessary.
	Dirty intensifier filter	Check and/or replace.
	Defective intensifier	Check that intensifier is doubling pressure to the clamp circuit.
Upper torque wrench body lifts while cycling in makeup or breakout mode.	Interference between upper and lower body sets	Check and remove interference.
Torque wrench clamp cylinders too slow or uneven.	Check valves on manifold contaminated or defective	Clean, repair, or adjust valves.
	Lack of lubrication	Lube all grease fittings.
	Flow Divider not operating properly	Check for damaged line and/or flow divider and replace as necessary.

Symptom	Probable Cause	Remedy
Spin Wrench assemblies do not clamp or unclamp and/or motors do not run.	Flow restricted	Locate cause or restriction and correct.
	Power supply defective	Check power supply.
Spin Wrench Assemblies or motor creep with valve in neutral position.	Leaking or sticky valve	Return valve to center position manually. If problem persists, inspect valve spool for wear or contamination. Repair or replace.
	High tank line pressure	Check and correct.
Motor runs irregularly.	Contaminated motor	Repair motor or replace.
	Bent shaft	Repair motor or replace.

Troubleshooting the Iron Roughneck

Troubleshooting Tables

Symptom	Probable Cause	Remedy
Spin rollers do not turn with motor running, or have insufficient power.	Damaged motor spline	Check motor spline.
	Motor seal blown	Replace motor seals.
	Flow restricted to motor	Locate cause of restriction and correct.
	Defective roller bearings	Replace bearings.
	Defective motor	Repair motor.
	Motor Drive shaft broken	Replace motor.
Loss of power, torque.	Power supply not operating	Check power supply pressure gage for indication. Ensure that supply pressure remains high with operating valve energized.
	Restricted hydraulic lines	Check for pinched, clogged, or otherwise obstructed hydraulic lines. Clear obstruction.
	Worn cylinder seals	Replace seals.
Drill pipe or collars rub against Spin Wrench motor during spinning.	Spin rollers worn excessively	Replace spin rollers.
Spin rollers slip.	Insufficient clamping pressure	Check pressure at manifold set to 2,500 psi. Check for leaks in clamping lines and replace as required.
	Defective seal on spin clamp cylinder piston	Replace seal.
	Slippery connection	Clean connection.
	Spin rollers worn	Replace spin rollers.
	Grease on Spin Rollers. Spin Wrench clamp should be held while spinning	Remove grease.
Spin Wrench does not thread compensate.	Accumulator pre-charge	Check nitrogen pre-charge on accumulator. Add nitrogen as required to 100 psi.

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