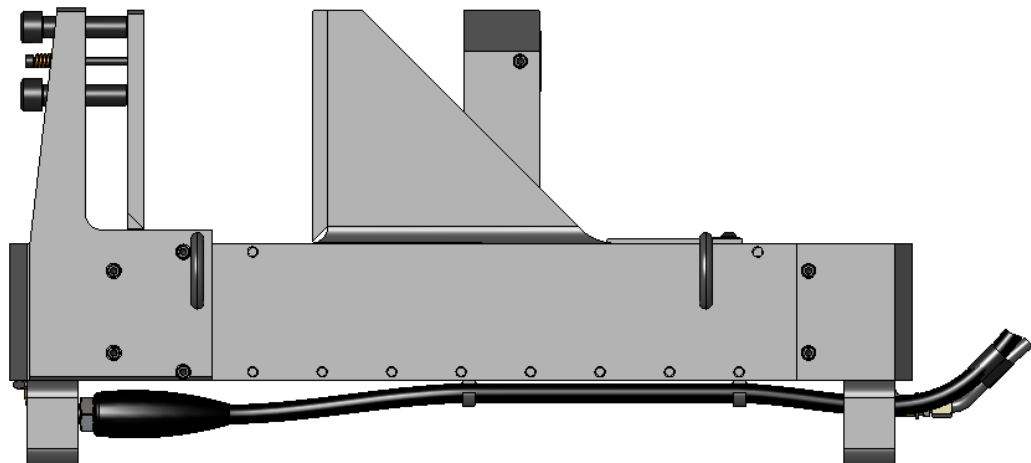

FTI OPERATIONS, MAINTENANCE, AND REPAIR MANUAL

Big Brute Hydraulic Offset Puller Unit

Part #2720-012
Revision F

October 2, 2018



Fatigue Technology (FTI) is a world-leading aerospace engineering and manufacturing company. FTI pioneered cold expansion technology (which provides solutions to fatigue problems associated with holes in metal structures) back in 1969 and has advanced this science to develop innovative bushing and fastener products. These proprietary products and associated tooling may be covered by patents or agreements owned by, or exclusively licensed to, Fatigue Technology. Use of tooling procured from other than a licensed source may constitute patent infringement.

The detailed tooling information in this manual was compiled and written by FTI. The tooling was designed specifically for use with FTI's Cold Expansion (Cx™) Systems. FTI cannot be held responsible for damage or injury as a result of operating this equipment if it is used for other than the process intended, with any other tooling not provided by FTI, or not used in accordance with the instructions contained in this manual. To avoid personal injury, please observe all safety precautions and instructions. FTI reserves the right to change specifications or configurations of equipment detailed in this manual as part of our ongoing technical and product improvement programs. If you have any questions about the use or serviceability of this equipment, please contact our Sales Department.

FTI's systems and processes are the subject matter of one or more of the following patents: 4,809,420, 4,885,829, 4,934,170, 5,083,363, 5,096,349, 5,103,548, 5,127,254, 5,129,253, 5,218,854, 5,245,743, 5,305,627, 5,341,559, 5,380,136, 5,405,228, 5,433,100, 5,468,104, 6,077,010, 6,183,180, 6,487,767, 6,792,657, 6,990,722, 7,024,908, 7,100,264; 1,061,276, 513,898, 692015124, 581,385, 69310828, 468,598, 69105390, 643,231, 69414946, 696,686, 785,366, 1032769, and other patents pending. These systems and processes are tooling critical and must be performed in accordance with FTI's specifications or controlling documents. To ensure proper results from FTI's Cold Expansion Systems and to be licensed to use FTI's patented processes, it is essential that FTI's complete integrated system of tooling be purchased and utilized. The use of tooling purchased from other than a licensed supplier could jeopardize fatigue life enhancement and may constitute patent infringement.

FTI reserves the right to change the specifications or configurations of tooling detailed in this manual as part of its ongoing technical and product information program. Should inconsistencies occur between your tooling and this manual, please contact our Sales Department.

ABOUT FATIGUE TECHNOLOGY

Fatigue Technology (FTI) has provided innovative solutions to fatigue problems in metal structures since 1969. Complete systems of tooling are used worldwide to enhance the fatigue life of holes in airframes, turbine engines, and other critical structures.

The FTI staff of professionals provides a full range of support services including:

- Application engineering
- Detailed project planning, implementation, and management
- On-site assistance, including training and tool room setup

The Sales Department is always available to assist with special fatigue enhancement requirements. Please contact FTI with questions at any time.

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SECTION 1.0: INTRODUCTION

This instruction manual contains information on the operation and maintenance of the Fatigue Technology (FTI) Big Brute Hydraulic Offset (BBHO) Puller Unit. To obtain optimum performance and many years of trouble-free service, operate the puller unit properly and carefully follow maintenance procedures.

Read this manual before operating the puller unit, and retain the manual for future reference. If requested, FTI will provide this manual in the language of the end-user.

1.1 ABOUT THE BIG BRUTE HYDRAULIC OFFSET PULLER UNIT

The BBHO puller unit is a self-contained offset puller designed for cold expanding holes over one inch in diameter. It is powered by the FT-200 PowerPak.

The BBHO can generate a minimum of 35,000 pounds of pull force and is activated by a remote foot pedal. The patented air logic safety circuit on the FT-200 PowerPak protects the operator by causing the mandrel to return to the ready position when the trigger on the BBHO is released.

The BBHO is available in various models to accommodate multiple material stackups, including “-V” models with high-visibility hose markings.

1.2 GENERAL DESCRIPTION

Hydraulic Fluid Requirements	U.S. MIL-SPEC #5606
Operating Hydraulic Pressure	10,000 psi (70 MPa)
Air Line Requirements	3/8-inch to 1/2-inch (.95 to 1.3cm) inside diameter
Air Flow Requirements (via PowerPak)	90 to 120 psi, 50 cfm (620 to 830 kPa, 0.023 m ³ /s)
Actuation	Pneumatic
Operation	Hydraulic
Compatible PowerPaks	FT-200
Pull Force Capacity:	
BBHO-30	35,000 pounds (155 kN)
BBHO-30A	35,000 pounds (155 kN)
BBHO-33B	39,000 pounds (170 kN)
BBHO-35B	39,000 pounds (170 kN)
BBHO-60C	60,000 pounds (260 kN)
Weight*:	
BBHO-30	200 pounds approximately (91kg)
BBHO-30A	200 pounds approximately (91kg)
BBHO-33B	200 pounds approximately (91kg)
BBHO-35B	200 pounds approximately (91kg)
BBHO-60C	240 pounds approximately (109kg)
Stackup Capacity:	
BBHO-30	5.0 inches (12.7cm)
BBHO-30A	5.1 inches (13.0cm)
BBHO-33B	5.1 inches (13.0cm)
BBHO-35B	5.1 inches (13.0cm)
BBHO-60C	7.1 inches (18.0cm)
Fail-safe	Air logic safety circuit halts mandrel retraction when trigger is released
Replacement Seal Kit	BBHO Seal Kit (BBHO-SK)

*A user-supplied suspension system might be required at the end use site. The requirement for a suspension system is based on the end user's workplace lifting and weight standards. A risk analysis for the suspension is necessary to maintain compliance to end user's standards or directives. All risks involved with suspension of the Big Brute Hydraulic Offset Puller Unit are the responsibility of the end user. User instructions and training regarding the suspension system are the responsibility of the end user.

SECTION 2.0: SAFETY

Consult the FT-200 PowerPak Operations, Maintenance, and Repair Manual for safety precautions before connecting the puller unit.

When used in accordance with these instructions, the puller unit is safe and easy to use. All general safety precautions associated with hydraulic and pneumatically operated power tools should be observed. Many of these are noted in this section.

Ultimately, operators are responsible for their own personal safety; however, the following general safety precautions should be observed:

CAUTION: The weight of this unit may require a suspension system per the end-user's workplace lifting standards.

1. Wear eye and ear protection when operating the puller unit.
2. Disconnect the air supply when:
 - Maintenance is performed
 - Repair work is performed
 - Hydraulic hose is disconnected
 - PowerPak is not in use
3. In the event of a ruptured or leaking hydraulic hose, **IMMEDIATELY RELEASE THE TRIGGER AND DISCONNECT THE AIR LINE** at the air coupler from the PowerPak (see Figure 2.0-1). **Never use your hands** to grasp a leaking hose under pressure. The force of escaping hydraulic fluid could cause serious injury. If hydraulic oil should penetrate the skin, medical attention must be sought immediately.
4. Keep hands away from the nosecap assembly while holding nosecap against the workpiece.
5. Release the puller unit trigger when the mandrel clears the workpiece or becomes stuck.
6. The end cap must always be in place while in use. Injury may occur if the end cap is removed during operation.
7. Before operating the pump, tighten all hose connections using the proper tools. Do not overtighten the connections. Connections need only be tightened securely and leak-free. Overtightening may cause premature thread failure or high-pressure fittings to split at pressures lower than their rated capacities.
8. Operators must read this manual in its entirety before using the Big Brute Hydraulic Offset. Eye and ear protection must be worn while operating the Big Brute Hydraulic Offset. Three safety stickers on the Big Brute act as a reminder to these instructions. The symbols are defined in Figure 2.0-2 (on the next page).
9. Do not use in potentially explosive atmospheres.



Figure 2.0-1
Location of Air Disconnect

Read manual before using

Always wear eye protection

Always wear ear protection



**Figure 2.0-2
Safety Stickers**

Hydraulic Hose Safety

10. Inspect the hydraulic hose for signs of wear (cuts, abrasions, or kinks) to the outer shell materials. Pump clean oil through the entire length. Pressurize the hose and check for leaks at the crimped connectors, between the hose material and the fitting, and between the fitting and the coupler.
11. **DO NOT** attempt to disconnect the hydraulic hose while it is under pressure.
12. **DO NOT** expose hoses to potential hazards such as extreme heat or cold, sharp surfaces, or heavy impact.
13. **DO NOT** allow hoses to kink, twist, curl, or bend so tightly that the oil flow within the hose is blocked or reduced. Periodically inspect the hose and fittings for wear or damage that could cause premature failure of the hose or fittings and possibly result in injury. Damaged hoses must be replaced immediately.
14. **DO NOT** use the hose to move attached equipment.
15. **DO NOT** remove strain reliever from hoses.
16. Hose strain relievers must be placed around hose fittings during use. Hoses with damaged strain relievers must be replaced immediately.
17. Hose material and coupler seals must be compatible with hydraulic fluid that meets the requirements of U.S. MIL-SPEC #5606.
18. Hoses must not come in contact with toxic materials such as creosote-impregnated objects and some paints. Keep couplers and hoses clean and free of paint. Hose deterioration due to chemical degradation may cause the hose to fail under pressure. Damaged hoses must be replaced immediately.
19. Before operating the pump, make sure all hose connections are tightened securely. **DO NOT** overtighten.
20. If hoses require replacement, contact the FTI Sales Department.

IMPORTANT: FTI completed a risk assessment on this unit at our factory. Any modifications done by a third party or the final user are excluded from that risk assessment. As a result, modifications done by a third party or the final user nullify the CE marking.

SECTION 3.0: PULLER UNIT OPERATING INSTRUCTIONS

Become familiar with these instructions before operating the puller unit.

3.1 **CONNECTING THE BIG BRUTE HYDRAULIC OFFSET TO THE FT-200 POWERPAK**

1. Connect the two air lines of the foot pedal to the air in/out connections of the FT-200 PowerPak.
2. Connect the air line from the Big Brute Hydraulic Offset (BBHO) to the “T” junction in the air line coming from the foot pedal.
3. Connect the hydraulic line of the BBHO to the hydraulic in/out connection of the FT-200 PowerPak.
4. For specific information on the PowerPak, refer to the FT-200 Operations, Maintenance, and Repair Manual.

Refer to Section 6.0 (Illustrated Parts Breakdown) for parts identification.

3.2 **RETURNING THE MANDREL TO START POSITION AFTER PULLER UNIT OPERATION**

1. Release the air valve a quarter turn. See Figure 3.2-1.
2. Once the mandrel has returned to the start position, tighten the air valve before processing the next hole.

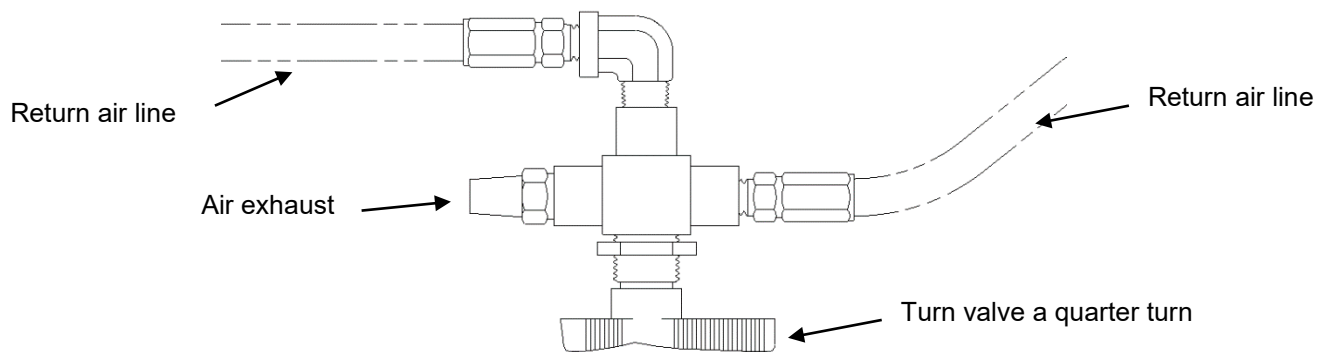


Figure 3.2-1
Mandrel Return, Air Valve

SECTION 4.0: MAINTENANCE

CAUTION: BEFORE PERFORMING ANY MAINTENANCE, DISCONNECT THE FT-200 POWER SUPPLY.

Follow these steps for maintenance:

4.1 *LUBRICATION*

Keep the BBHO lightly coated with a good 10-weight or lighter oil film at all times to inhibit corrosion.

4.2 *INSPECTION*

Periodically check for oil leaks at both the junction of the oil line and puller unit, and also from bad seals within the unit. Also periodically check for loose nuts, bolts, and screws on the BBHO.

SECTION 5.0: TROUBLESHOOTING

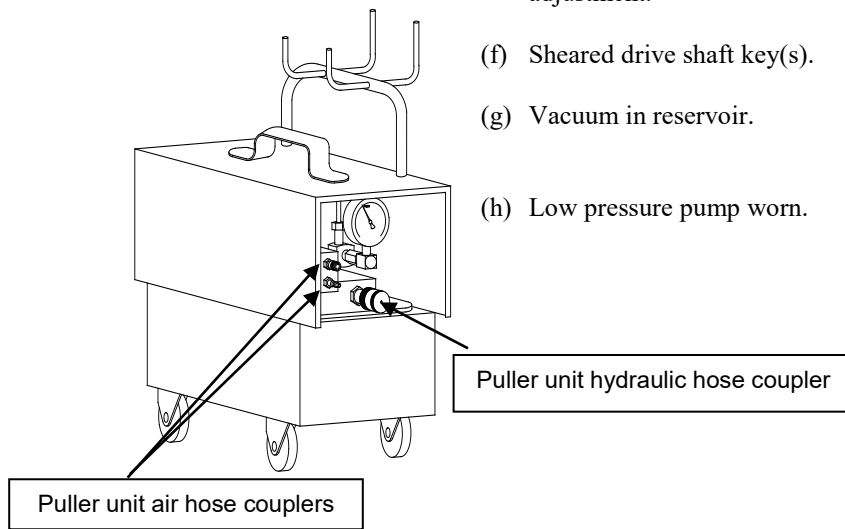
This section provides solutions to some basic trouble spots. If you cannot solve your maintenance or operational problems with the information provided in this section, contact the nearest FTI representative.

WARNING: To prevent injuries, any repair work or troubleshooting must be done by qualified personnel familiar with this equipment. Use the proper equipment when troubleshooting.

CAUTION: Disconnect the FT-200 power supply before performing any repair work.

Note: Refer to the parts list included with your PowerPak when using the troubleshooting guide.

<u>PROBLEM</u>	<u>CAUSE</u>	<u>SOLUTION</u>
5.1 POWERPAK IS NOT DELIVERING OIL OR DELIVERS ONLY ENOUGH OIL TO RETRACT THE MANDREL PARTIALLY OR ERRATICALLY		
	(a) Oil level too low.	(a) Fill reservoir to within 1/2 inch of filler plug with puller at the start position.
	(b) Air in hydraulic system.	(b) Bleed the system.
	(c) Air leak in suction line.	(c) At the junction of the intake tube and the pump housing, check and tighten the connection.
	(d) Dirt in pump or filter plugged.	(d) PowerPak filter should be cleaned and if necessary, the PowerPak should be dismantled and all parts inspected and cleaned.
	(e) Relief valve or low pressure unloading valve out of adjustment.	(e) Readjust if needed.
	(f) Sheared drive shaft key(s).	(f) Replace.
	(g) Vacuum in reservoir.	(g) Check for plugged vent in the vented filler cap.
	(h) Low pressure pump worn.	(h) Remove end cap from low pressure gear pump. Clean the PowerPak and replace any worn gears, shifting spool, body or end cap.



Note: Figure 5.1-1 shows the locations of the hose couplers on the FT-200 PowerPak.

Figure 5.1-1
FT-200 PowerPak*

*Drawing not to scale

PROBLEM

CAUSE

SOLUTION

5.2 PULLER RETRACTS ON FIRST TRIGGER ACTUATION, BUT WILL NOT RETURN TO START POSITION

- | | |
|--|--|
| <p>(a) The new puller unit requires lubrication through the piston and cylinder.</p> <p>(b) As above, AND the hydraulic hose is difficult to bend or coil (indicating unrelieved pressure built up in the hose).</p> | <p>(a) Cycle trigger several times to introduce hydraulic fluid into the cylinder.</p> <p>(b) Once hydraulic pressure has been introduced to the hydraulic hose, the pressure must be relieved before the coupler can be sufficiently tightened.</p> |
|--|--|

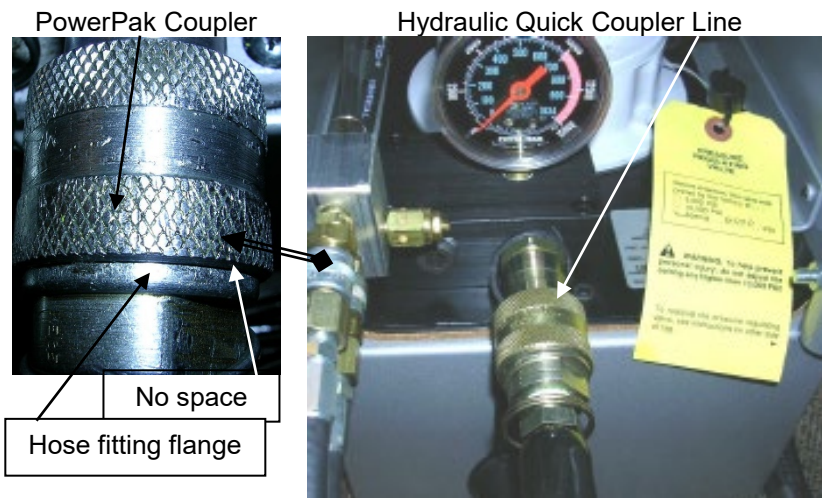


Figure 5.2-1
FT-200 Hydraulic Quick Coupler

Procedure for relieving hydraulic pressure:

1. Disconnect main air supply.
2. Disconnect coupler from PowerPak.
3. Connect Enerpac CT-604 Pressure Relief Tool to the coupler and bleed off hydraulic oil to relieve the built-up pressure. Figure 5.2-3 shows the Enerpac CT-604 Pressure Relief Tool.
4. Once pressure is relieved, coupler may be tightened and reinstalled onto PowerPak.
5. Re-attach air lines to get puller to return.
6. Check oil level in PowerPak reservoir.

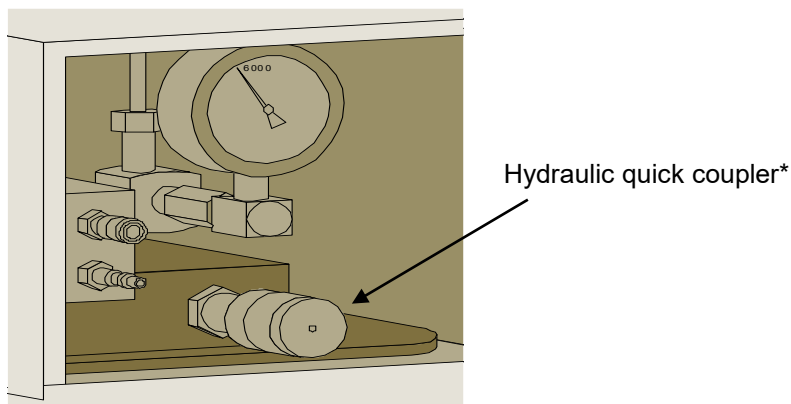


Figure 5.2-2
Location of FT-200 Hydraulic Quick Coupler



Figure 5.2-3
Enerpac CT-604 Pressure Relief Tool

*Drawing not to scale

PROBLEM**CAUSE****SOLUTION****5.3 POWERPAK WILL NOT GENERATE CONSTANT PRESSURE (HICCUPS)**

- (a) Trigger response valve requires adjustment. See Figure 5.3-1.

- (a) Adjustment procedure:
1. Loosen locknut on trigger response valve.
 2. Using a screwdriver, open screw counterclockwise until PowerPak will not start when puller trigger is depressed.
 3. Turn screw clockwise until:
 - PowerPak generates constant pressure when puller trigger is depressed, and
 - PowerPak starts instantly when puller trigger is depressed and stops instantly when released. When the puller trigger is depressed, the PowerPak should be run at the pre-set pressure until the trigger is released.
 4. Hold set screw in position and tighten locknut until snug.

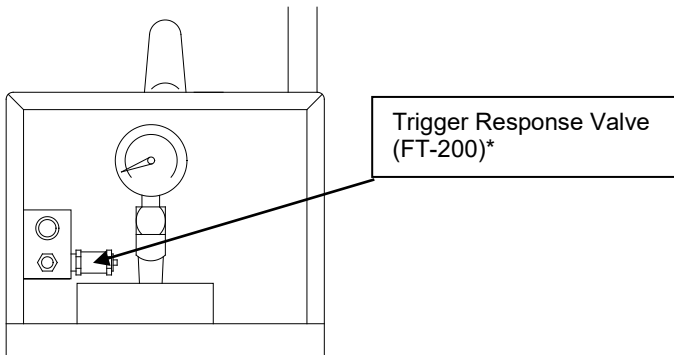


Figure 5.3-1
Location of FT-200 Trigger Response Valve

*Drawing not to scale

PROBLEM

CAUSE

SOLUTION

5.4 POWERPAK WILL NOT OPERATE OR MAINTAIN SUFFICIENT PRESSURE (6,000 PSI, 413.7 BAR)

(a) Hydraulic pressure requires adjusting (applicable to FT-200 PowerPak only). See Figure 5.4-1.

(a) Adjust PowerPak pressure valve:

1. Squeeze trigger on puller unit to activate PowerPak.
2. If pressure does not reach 6,000 psi (413.7 bar), loosen wingnut and turn hydraulic pressure control clockwise until pressure reaches 6,000 psi (413.7 bar).
3. Tighten locknut to secure available shop air.

(b) Inadequate air supply.

(b) Increase pressure or flow of available shop air.

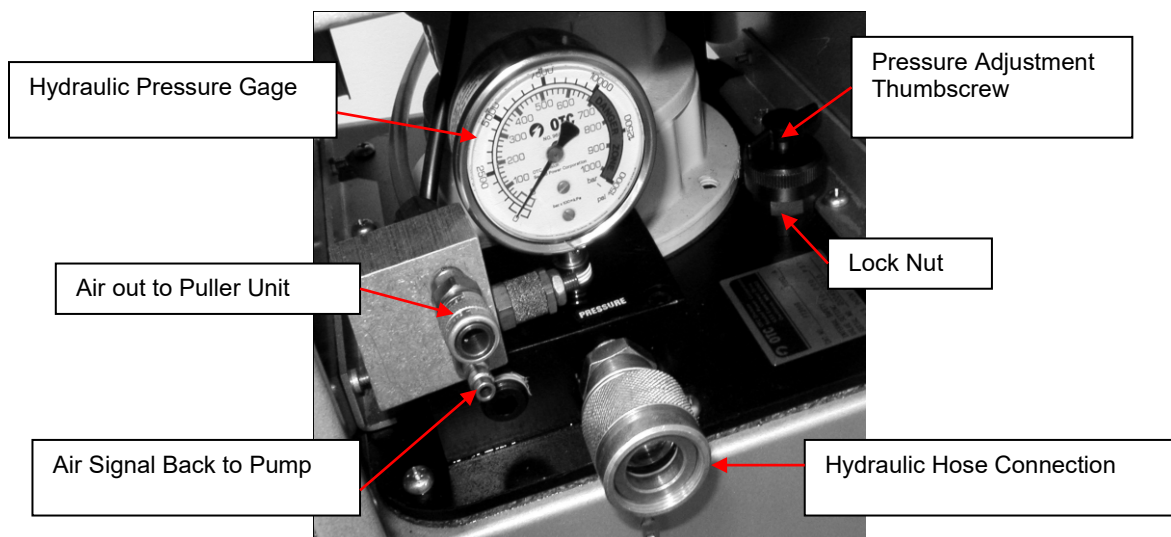
If the PowerPak will not generate or maintain sufficient pressure, the main air line pressure is too low or the PowerPak hydraulic pressure requires adjustment.

Air pressure requirements:

- 1/2-inch (12.7mm) inside diameter air line with 90 to 120 psi (6.2 to 8.3 bar) for the FT-200

Flow requirements:

- 40 to 50 cfm (1274.3 to 1415.9 liter/minute) for the FT-200



**Figure 5.4-1
FT-200 Pressure Gauge**

PROBLEM**CAUSE****SOLUTION****5.5 POWERPAK BUILDS PRESSURE BUT CANNOT MAINTAIN PRESSURE**

- | | |
|---|---|
| (a) Check to see if there are any external leaks. If no oil leakage is visible, the problem may be internal. (If using a double-acting cylinder, remove it from the system to ensure that the leak is not in the cylinder.) | (a) Reset leaking pipe fittings with pipe sealant. Reset or replace any faulty line fittings. |
| (b) Control valves leak. | (b) To test for a leaking control valve, lift the pump from the reservoir but keep the filter in the oil. Remove the drain line to see if the oil is leaking from the valve. If the valve is not leaking, the internal check valve could be leaking. Refer to the note concerning checking for oil leaks at the beginning of the Troubleshooting Guide. Clean, reseal, or replace flow control valve parts. If the internal check valve(s) are leaking, the PowerPak must be dismantled and the seat areas repaired, poppets replaced, etc. |
| (c) Leaking pressure switch seal. | (c) Repair or replace as needed. Repair or replace any faulty line fitting. |

PROBLEM**CAUSE****SOLUTION****5.6 POWERPAK WILL NOT BUILD FULL PRESSURE**

- | | |
|---|--|
| (a) Faulty pressure gage. | (a) Calibrate gage. |
| (b) Inadequate air pressure. | (b) Increase air pressure. |
| (c) External leaking. | (c) Seal any faulty pipe fitting with pipe sealant. |
| (d) Faulty external pressure regulator. | (d) Lift the PowerPak from the reservoir but keep the filter immersed in oil. Note the pressure reading when the relief valve begins to open up. If functioning normally, it should start to leak off at relief valve pressure. |
| (e) Internal leakage in puller unit. | (e) Remove the cylinder from the PowerPak. If the PowerPak builds full pressure, the cylinder is defective. |
| (f) Leaks in the flow control valve. | (f) Clean and reseal or replace parts. |
| (g) Inspect the PowerPak for internal leakage. Check high pressure PowerPak inlet or outlet ball checks. | (g) Same procedure as (d) above, but look for leaks around the entire inner mechanism. If there are no visible leaks, the high pressure PowerPak subassembly may be leaking. Remove all parts. Check the valve head assembly body for any damage to the seat area. Clean and reseal if necessary. Inspect for damage and replace parts if necessary, then re-assemble. |
| (h) Shifting spool seat and/or shifting spool poppet (located under high pressure PowerPak assembly) is worn. | (h) Clean and reseal or replace. |
| (i) Shifting spool O-ring (located within shifting spool bore) worn or broken. | (i) Remove O-ring and back-up washer (through low pressure PowerPak assembly end) with O-ring pick. Replace. |
| (j) Sheared key(s). | (j) Replace. |

PROBLEM**CAUSE****SOLUTION*****5.7 MANDREL WILL NOT RETRACT***

- | | |
|---|---|
| (a) Air line is not attached to coupler. | (a) Connect air line. |
| (b) Hydraulic line is not attached to hydraulic quick-coupler. | (b) Connect hydraulic line. |
| (c) Trigger response valve was not properly adjusted. | (c) While squeezing trigger, adjust the trigger response valve up and down until the desired sensitivity is obtained. |
| (d) Inadequate air pressure. | (d) Obtain air pressure at 90 to 120 psi and flow at 50 cfm. |
| (e) Flow check valve in coupler does not stay open in coupled position. | (e) Replace coupler. |

5.8 POWERPAK DELIVERS EXCESS OIL PRESSURE

- | | |
|--|---------------------|
| (a) Defective pressure gage. | (a) Calibrate gage. |
| (b) Pressure control valve not properly set. | (b) Reset valve. |

SECTION 6.0: ILLUSTRATED PARTS BREAKDOWN

6.1 REMOTE FOOT CONTROL ASSEMBLY DIAGRAM AND PARTS LIST

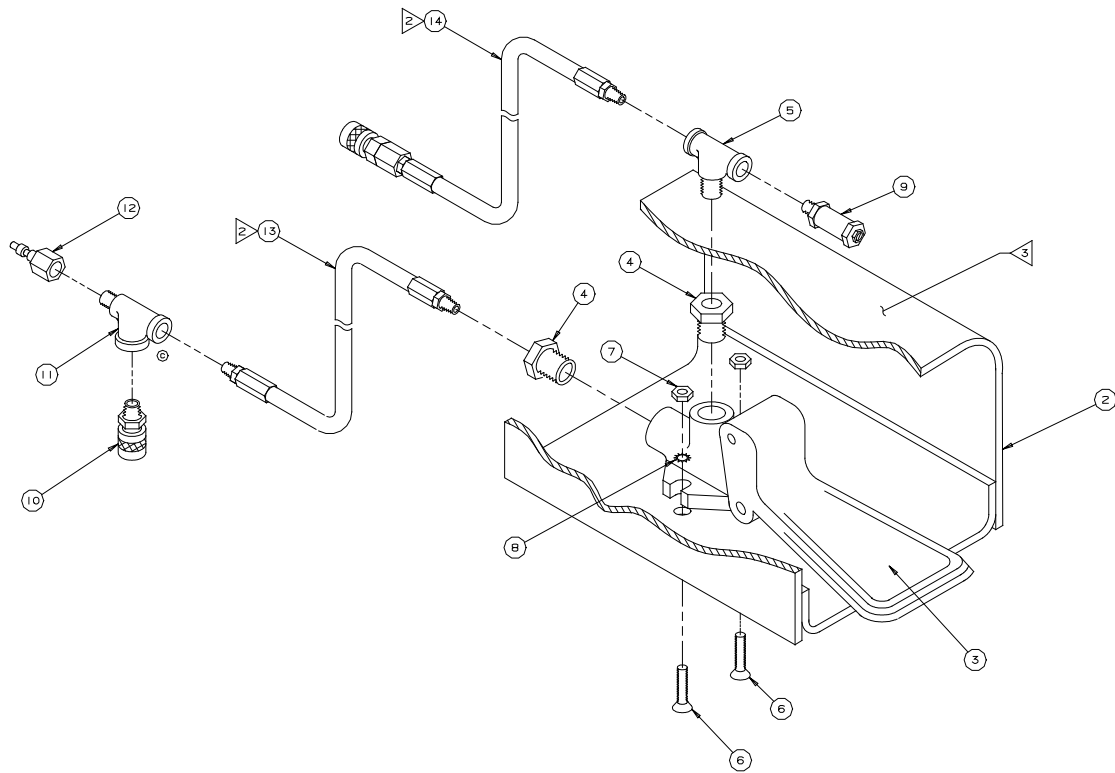


Figure 6.1-1
Remote Foot Pedal

Table 6.1-1
Remote Foot Control Parts List

Part Number	Piece Number	Description
2329-001	--	Assembly, Remote Foot Control
1045-098	2	Guard, Foot
1045-020	3	Valve, Pedal
1047-029	4	Bushing, 3/8 to 1/8 Pipe
1047-030	5	Tee, 1/8 Pipe Male Branch
1029-019	6	Screw, Flat Head Cap
1045-104	7	Nut, Hex
1045-106	8	Washer, Lock
1045-021	9	Control, 1/8-inch Speed
1047-031	10	Coupler, 1/8-inch Quick Disconnect
1047-032	11	Tee, 1/8-inch Street
1047-001	12	Coupler, 1/8-inch Quick Disconnect
2106-007	13	Assembly, Air Hose
2106-002	14	Assembly, Air Hose
1045-037	--	Tube, Heat Shrink

6.2 BBHO-30 PULLER UNIT ASSEMBLY DIAGRAM AND PARTS LIST

See Parts List, Page 16

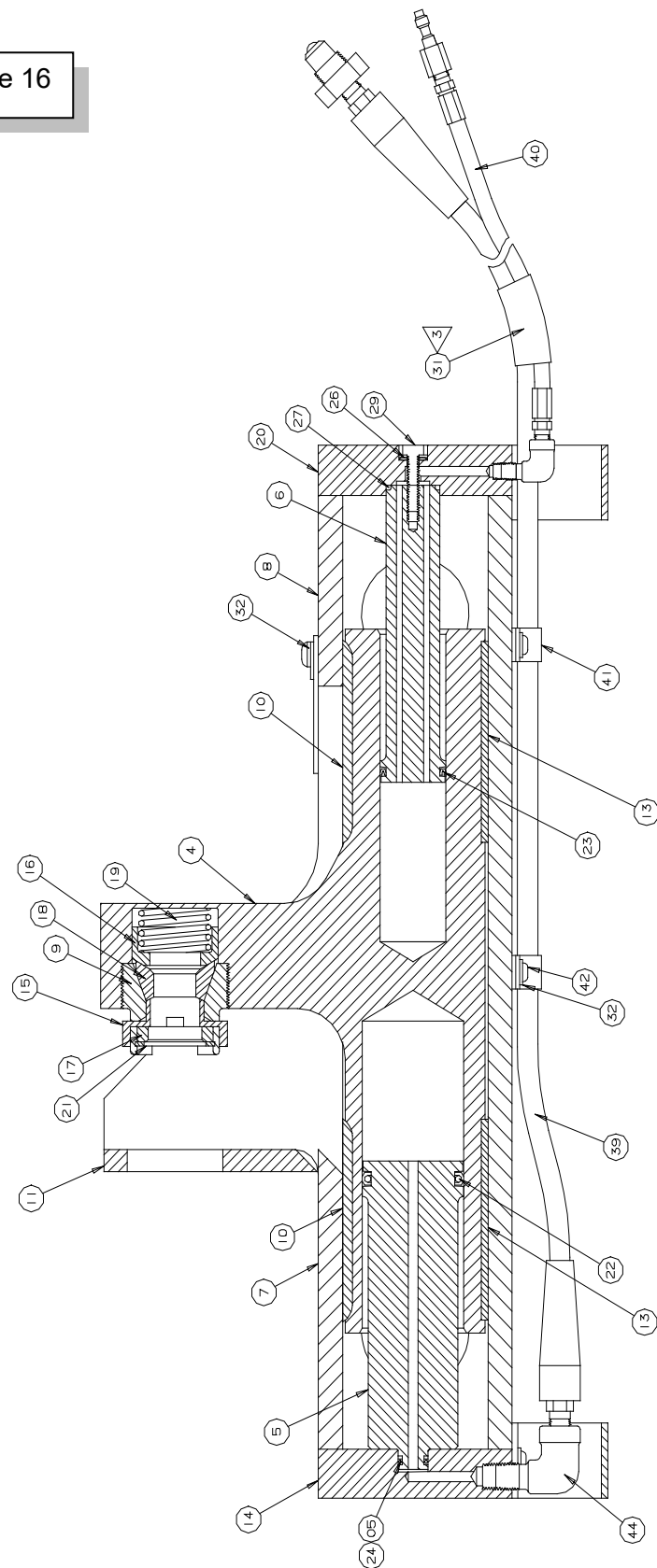


Figure 6.2-1
BBHO-30 Side View

Table 6.2-1
BBHO-30 Puller Unit Parts List

Part Number	Piece Number	Description
2286-001	--	Assembly, BBHO-30 Puller
2226-001	2	Housing (Right Side)
2160-001	3	Housing (Left Side)
2227-001	4	Slide
2290-001	5	Piston, Hydraulic
2291-001	6	Piston, Pneumatic
2292-001	7	Plate, Front Cover
2293-001	8	Plate, Back Cover
2245-001	9	Casing
2246-001	10	Bearing, Upper
2247-001	11	Plate, Backup
2144-001	13	Bearing, Lower
2300-001	14	Cover, Front
2306-001	15	Release, Jaw
2307-001	16	Follower, Jaw
2308-001	17	Ring, Retaining
2309-002	18	Jaws
1005-005	19	Spring
2312-001	20	Cover, Back
1045-016	21	Ring, Snap
1046-031	22	Seal, Crown
1046-032	23	Seal, K
1046-027	24	O-Ring
1046-028	25	Ring, Backup
1046-033	26	Seal, Stato
1046-034	27	O-Ring
1035-020	28	Screw, Flat Head Cap
1035-008	29	Screw, Socket Head Cap
1035-018	30	Screw, Flat Head Cap
2638-001	31	Tube, Heat Shrink
1045-040	32	Washer (Type B Plain)
2311-001	33	Clamp, Guard
2310-001	34	Guard, Neoprene
2326-001	35	Plate, Bottom
2320-001	36	Bar, Lifting
1047-016	37	Elbow, Street
2330-001	38	Eyebolt, Modified
2107-002	39	Assembly, Hydraulic Hose
2106-008	40	Assembly, Air Hose
1045-017	41	Clamp, Hose
1035-033	42	Screw, Button Head Cap
2331-001	43	Guard, Fitting
1047-017	44	Fitting, Elbow
1035-034	52	Screw, Button Head Cap
2944-002	See Figure 3.2-1	Air Valve, BBHO
2329-001	See Figure 6.1-1	Assembly, Remote Foot Control
1187-770	--	Pressure Relief Tool (Not included)

See Parts List, Page 16

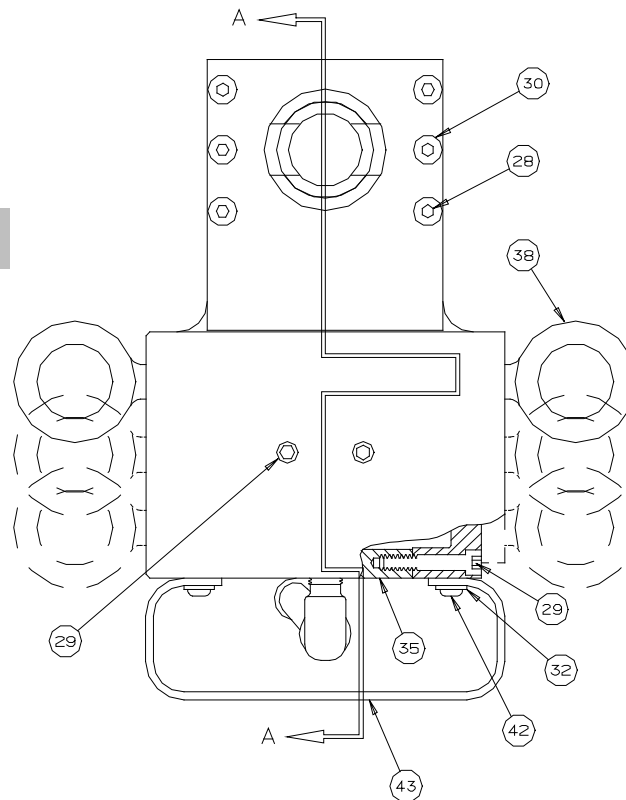


Figure 6.2-2
BBHO-30 Front View

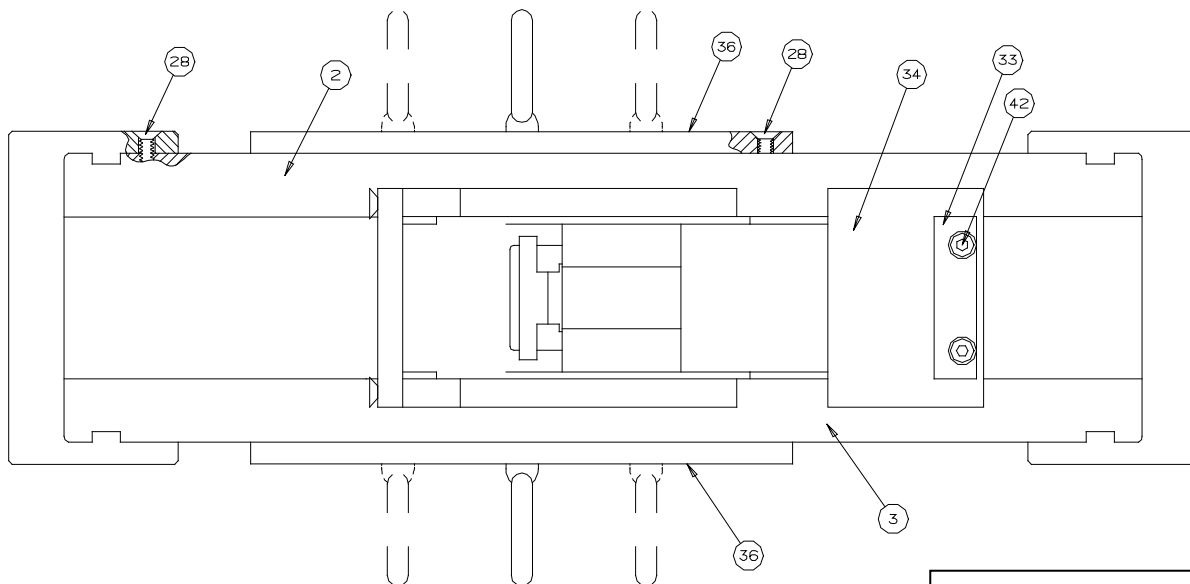


Figure 6.2-3
BBHO-30 Top View

See Parts List, Page 16

6.3 BBHO-30A PULLER UNIT ASSEMBLY DIAGRAM AND PARTS LIST

See Figures 6.3-1, 6.3-2, and 6.3-3, and Table 6.3-1 on the following pages, for the BBHO-30A Puller Unit.

See Parts List, Page 19

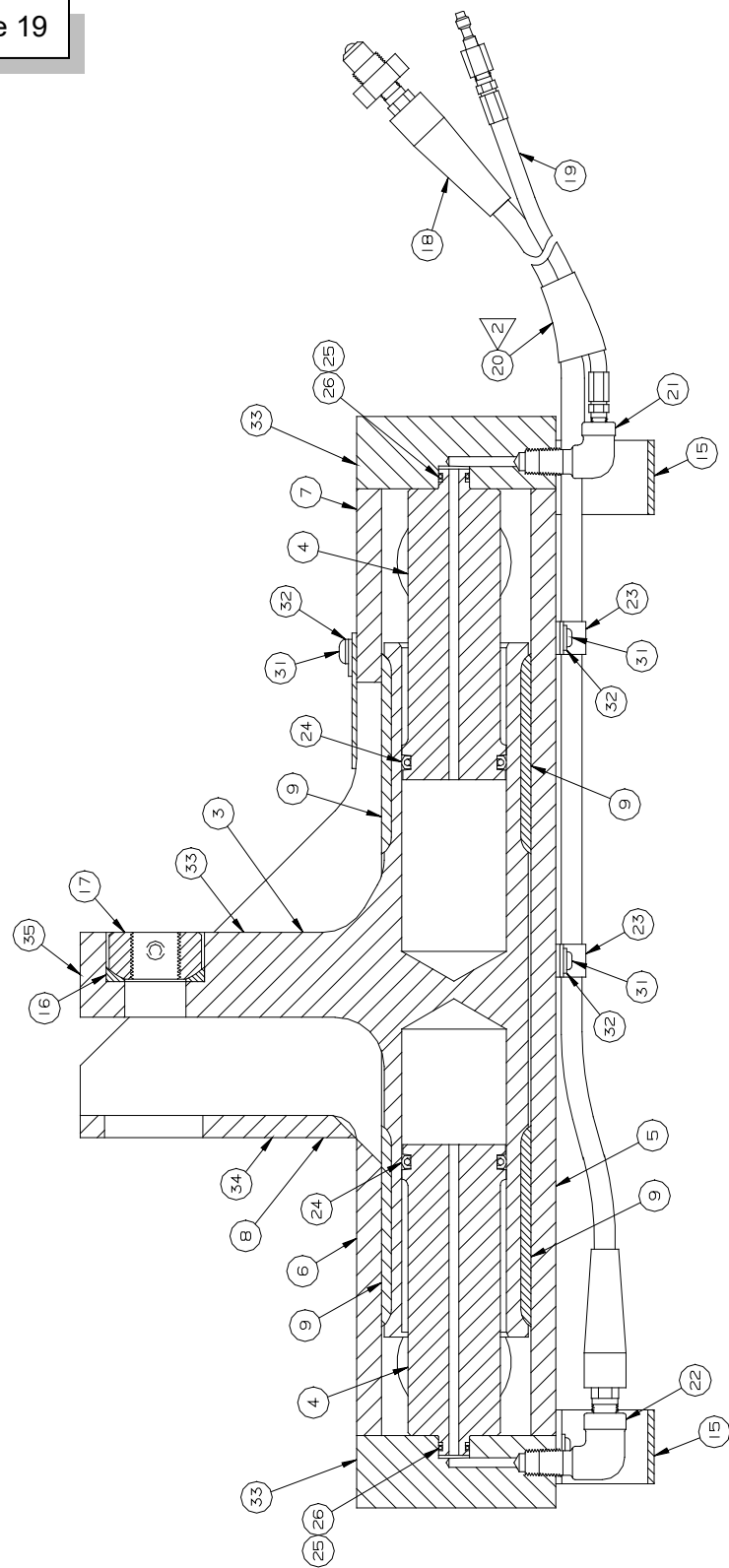


Figure 6.3-1
BBHO-30A Side View

Table 6.3-1
BBHO-30A Puller Unit Parts List

Part Number	Piece Number	Description
2804-001	*	Assembly, BBHO-30A Puller
2226-002	1	Housing, Right
2160-002	2	Housing, Left
2227-002	3	Slide
2290-002	4	Piston
2326-002	5	Plate, Bottom
2292-002	6	Plate, Front
2293-002	7	Plate, Back
2247-002	8	Plate, Face
2246-001	9	Bearing
2300-002	10	Cover, End
2311-002	11	Clamp, Guard
2310-002	12	Guard, Neoprene
2330-001	13	Eyebolt, Modified
2320-001	14	Bar, Lifting
2331-002	15	Guard, Fitting
2802-001	16	Washer, Spherical
2803-001	17	Adapter, Threaded
2107-002	18	Assembly, Hydraulic Hose
2106-008	19	Assembly, Air Hose
2638-001	20	Tube, Heat Shrink
1047-054	21	Fitting, Elbow
1047-017	22	Fitting, Elbow
1045-017	23	Clamp, Hose
1046-031	24	Seal, Crown
1046-027	25	O-Ring
1046-028	26	Ring, Backup
1035-020	27	Screw, Flat Head Cap
1035-008	28	Screw, Socket Head Cap
1035-007	29	Screw, Socket Head Cap
1035-018	30	Screw, Flat Head Cap
1035-033	31	Screw, Button Head Cap
1045-040	32	Washer (Type B Plain)
1009-184	33	Label
1009-185	34	Label
1009-242	35	Label
1035-009	36	Screw, Socket Head Cap
1035-034	37	Screw, Button Head Cap
2944-002	See Figure 3.2-1	Air Valve, BBHO
2329-001	See Figure 6.1-1	Assembly, Remote Foot Control
1187-770	--	Pressure Relief Tool (not included)

* Complete Assembly

See Parts List, Page 19

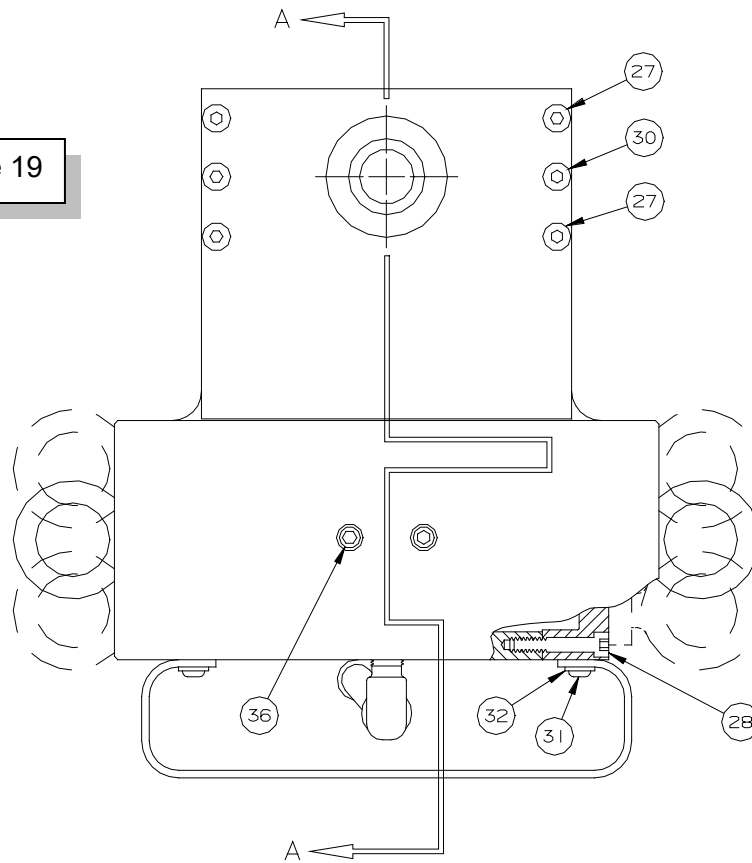


Figure 6.3-2
BBHO-30A Front View

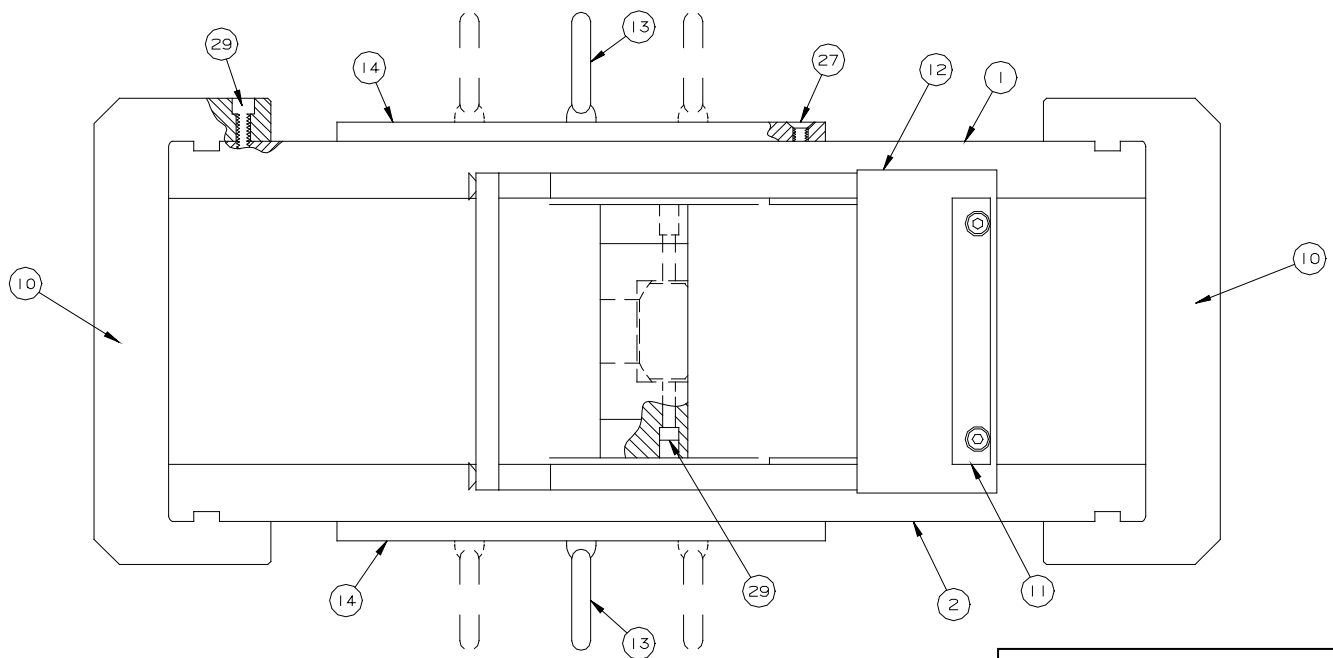


Figure 6.3-3
BBHO-30A Top View

See Parts List, Page 19

6.4 BBHO-33B PULLER UNIT ASSEMBLY DIAGRAM AND PARTS LIST

See Figures 6.4-1, 6.4-2, and 6.4-3, and Table 6.4-1 on the following pages for the BBHO-33B Puller Unit.

See Parts List, Page 22

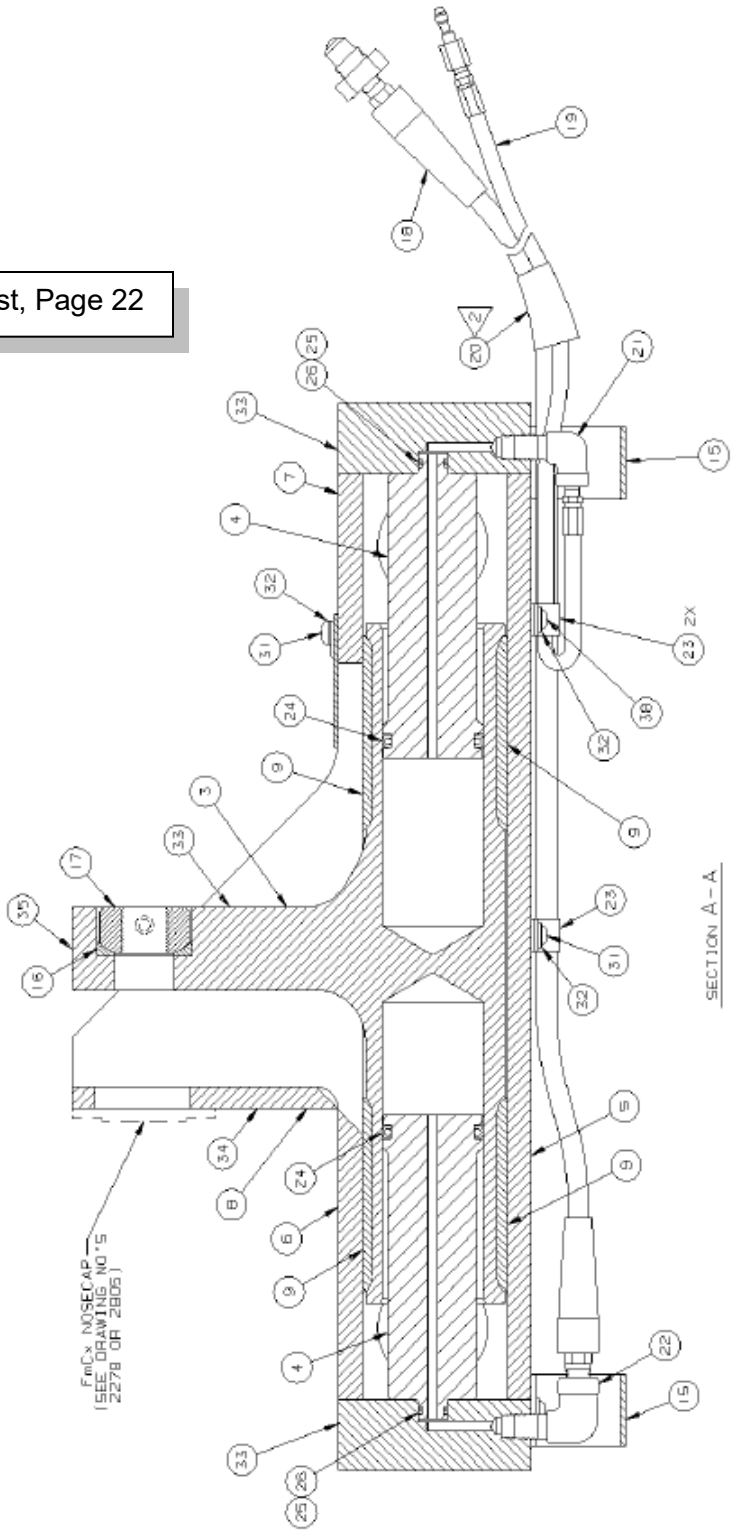


Figure 6.4-1
BBHO-33B Side View

Table 6.4-1
BBHO-33B Puller Unit Parts List

Quantity	Part Number	Piece Number	Description	Reference Information
*	5318-001	*	Assembly, BBHO-33B Puller	
1	2226-004	1	Housing, Right	
1	2160-003	2	Housing, Left	
1	2227-003	3	Slide	
2	5480-001	4	Piston	
1	2326-002	5	Plate, Bottom	
1	2292-002	6	Plate, Front	
1	2293-003	7	Plate, Back	
1	2247-002	8	Plate, Face	
8	2246-001	9	Bearing	
1	2300-002	10	Cover, End	
1	2311-002	11	Clamp, Guard	
1	2310-003	12	Guard, Neoprene	
2	2330-001	13	Eyebolt, Modified	
2	2320-001	14	Bar, Lifting	
2	2331-002	15	Guard, Fitting	
1	2802-001	16	Washer, Spherical	
1	2803-001	17	Adapter, Threaded	
1	2107-002	18	Assembly, Hydraulic Hose	
1	2106-003	19	Assembly, Air Hose	20 Feet
8	2638-001	20	Tube, Heat Shrink	3 Inches Long
1	1047-054	21	Fitting, Elbow	2102-4-2 (10070)
1	1047-017	22	Fitting, Elbow	TP-304 (16580)
3	1045-017	23	Clamp, Hose	CL-12 (10070)
2	1046-124	24	Seal, Crown	CP-328 (16650)
2	1046-027	25	O-Ring	AN6227-9 (16650)
2	1046-028	26	Ring, Backup	MS28782-9 (16650)
8	1035-020	27	Screw, Flat Head Cap	1/4-20UNC 2A x 3/4 Long
28	1035-008	28	Screw, Socket Head Cap	1/4-20UNC 2A x 1-1/4 Long
10	1035-007	29	Screw, Socket Head Cap	1/4-20UNC 2A x 1 Long
2	1035-018	30	Screw, Flat Head Cap	1/4-20UNC 2A x 1/2 Long
7	1035-033	31	Screw, Button Head Cap	1/4-20UNC 2A x 1/2 Long
8	1045-040	32	Washer (Type B Plain)	1/4 (Narrow)
3	1009-184	33	Label	Do Not Strike
1	1009-185	34	Label	Caution
1	1009-242	35	Label	Caution
4	1035-009	36	Screw, Socket Head Cap	1/4-20UNC 2A x 1-1/2 Long
1	2300-004	37	Cover, Back	
1	5480-002	38	Piston, Back	
1	1035-034	39	Screw, Button Head Cap	1/4 x 5/8 Long
1	2944-002	See Figure 3.2-1	Air Valve, BBHO	BBHO-AVS-2
1	2329-001	See Figure 6.1-1	Assembly, Remote Foot Control	
0	1187-770	--	Pressure Relief Tool	Not included

* Complete Assembly



Note: Items flagged thus are included as part of assembly, but are not installed into puller unit.



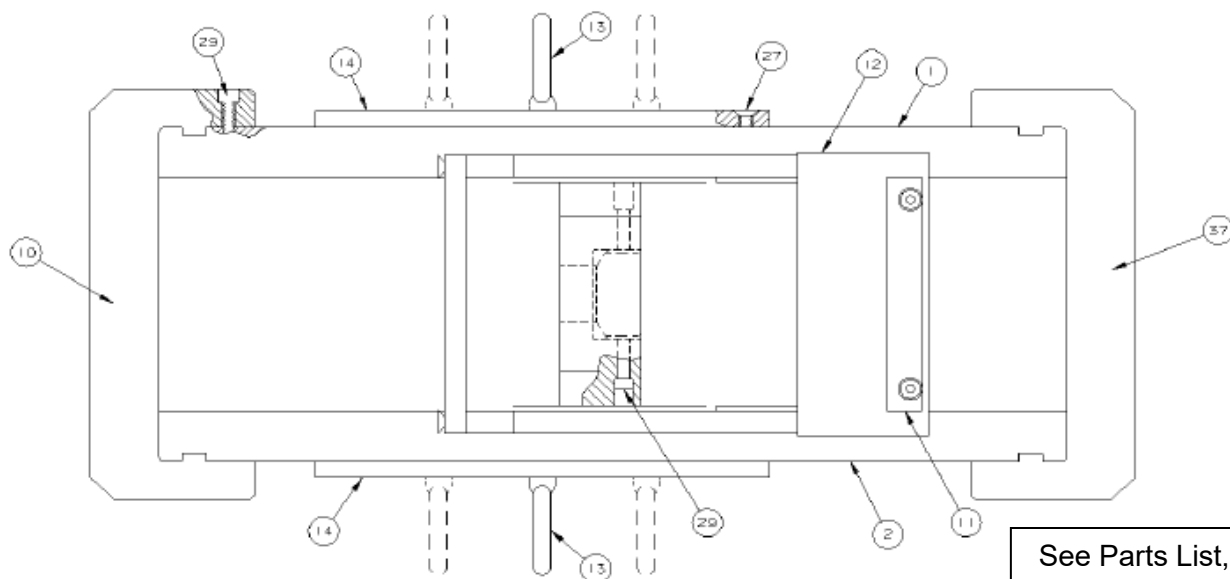


Figure 6.4-2
BBHO-33B Top View

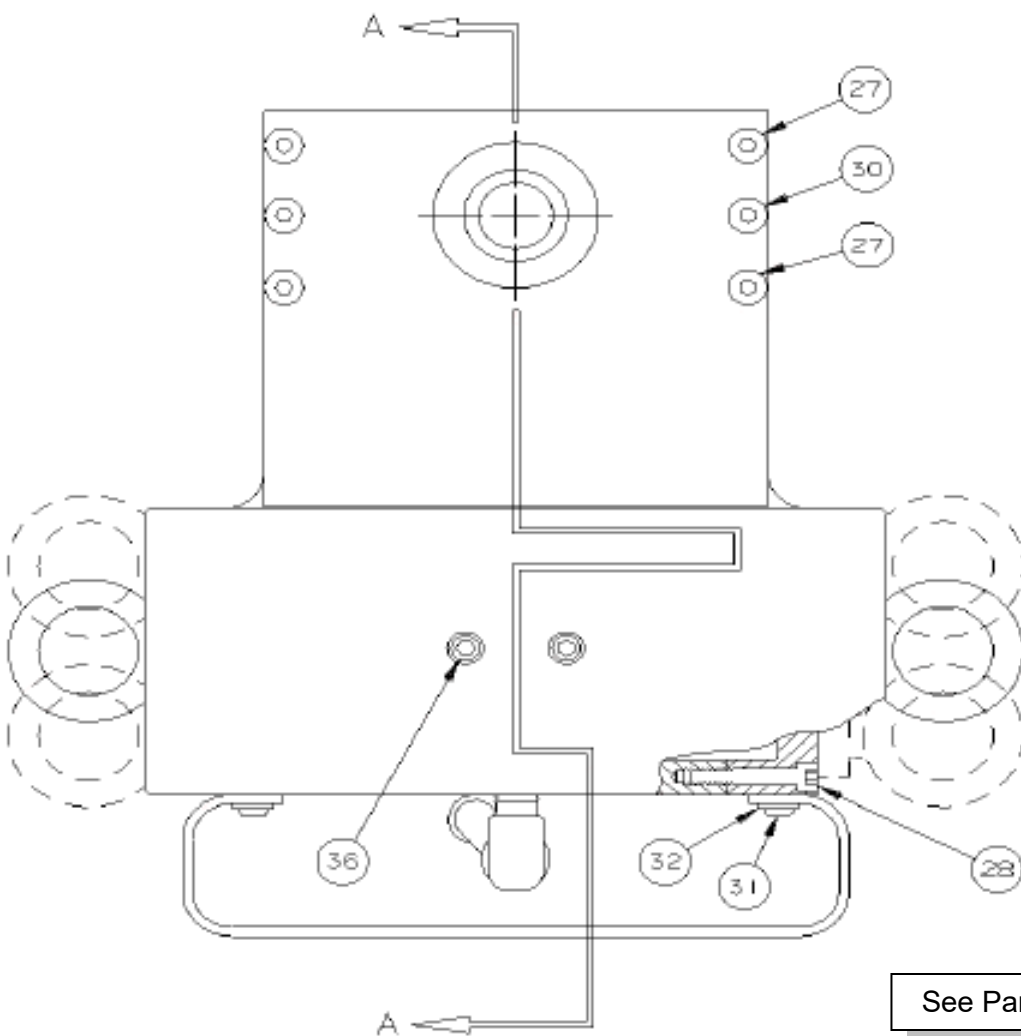


Figure 6.4-3
BBHO-33B Front View

6.5 BBHO-35B PULLER UNIT ASSEMBLY DIAGRAM AND PARTS LIST

See Figures 6.5-1, 6.5-2, and 6.5-3, and Table 6.5-1 on the following pages for the BBHO-35B Puller Unit.

See Parts List, Page 25

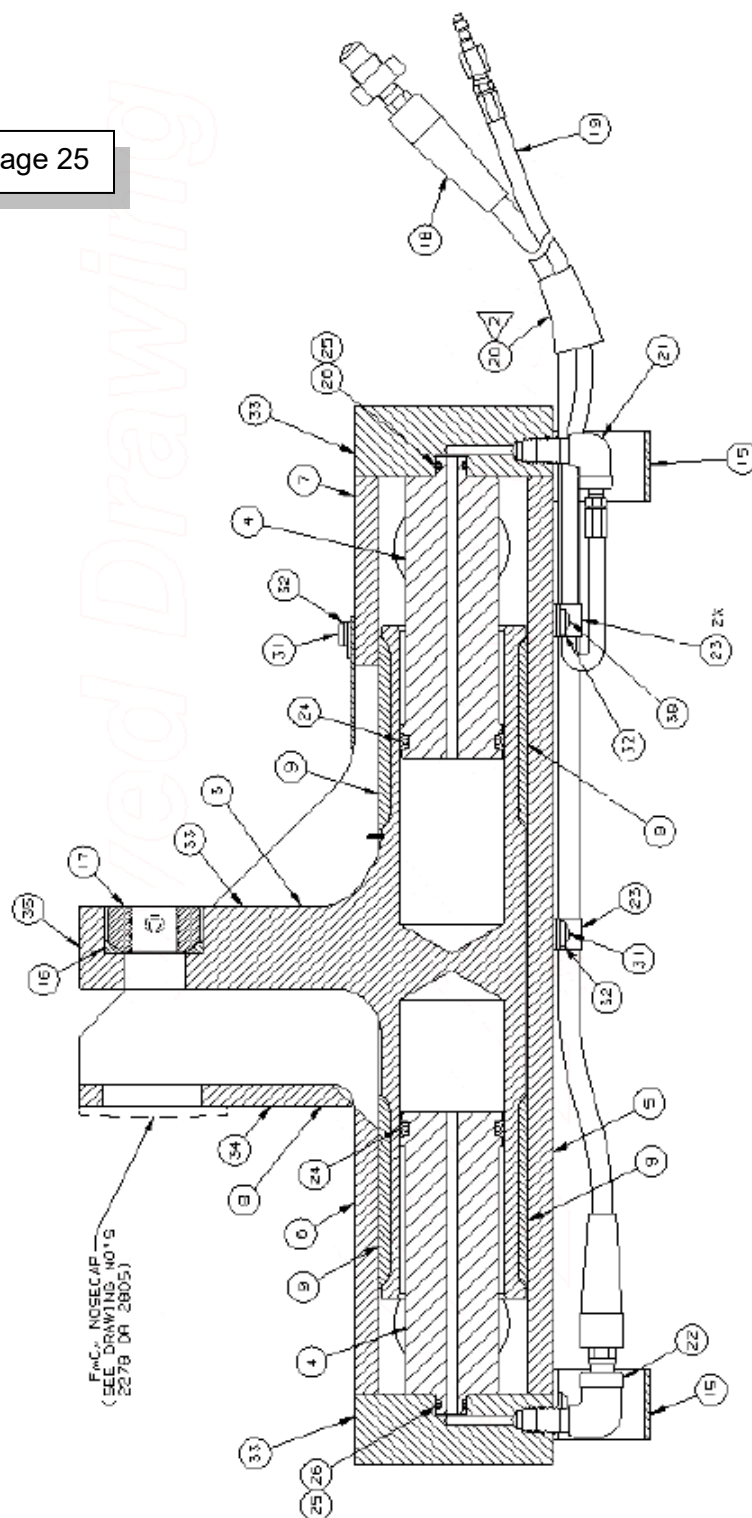


Figure 6.5-1
BBHO-35B Side View

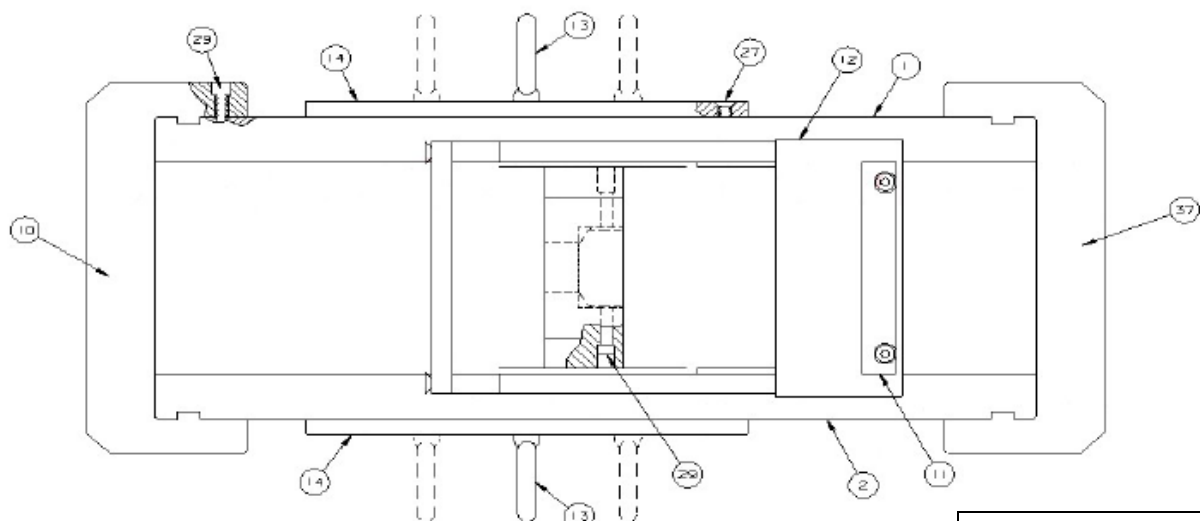
Table 6.5-1
BBHO-35B Puller Unit Parts List

Quantity	Part Number	Piece Number	Description	Reference Information
*	5318-001	*	Assembly, BBHO-35B Puller	
1	2226-003	1	Housing, Right	
1	2160-003	2	Housing, Left	
1	2227-003	3	Slide	
2	5480-001	4	Piston	
1	2326-002	5	Plate, Bottom	
1	2292-002	6	Plate, Front	
1	2293-003	7	Plate, Back	
1	2247-002	8	Plate, Face	
8	2246-001	9	Bearing	
1	2300-002	10	Cover, Eng	
1	2311-002	11	Clamp, Guard	
1	2310-003	12	Guard, Neoprene	
2	2330-001	13	Eyebolt, Modified	
2	2320-001	14	Bar, Lifting	
2	2331-002	15	Guard, Fitting	
1	2802-001	16	Washer, Spherical	
1	2803-001	17	Adapter, Threaded	
1	2107-002	18	Assembly, Hydraulic Hose	
1	2106-003	19	Assembly, Air Hose	20 feet
8	2638-001	20	Tube, Heat Shrink	3 inches long
1	1047-054	21	Fitting, Elbow	2102-4-2 (10070)
1	1047-017	22	Fitting, Elbow	TP-304 (16580)
3	1045-017	23	Clamp, Hose	CL-12 (10070)
2	1046-124	24	Seal, Crown	CP-328 (16650)
2	1046-027	25	O-Ring	AN6227-9 (16650)
2	1046-028	26	Ring, Backup	MS28782-9 (16650)
8	1035-020	27	Screw, Flat Head Cap	1/4-20UNC 2A x 3/4 long
28	1035-008	28	Screw, Socket Head Cap	1/4-20UNC 2A x 1-1/4 long
10	1035-007	29	Screw, Socket Head Cap	1/4-20UNC 2A x 1 long
2	1035-018	30	Screw, Flat Head Cap	1/4-20UNC 2A x 1/2 long
7	1035-033	31	Screw, Button Head Cap	1/4-20UNC 2A x 1/2 long
8	1045-040	32	Washer (Type B Plain)	1/4 (Narrow)
3	1009-184	33	Label	Do Not Strike
1	1009-185	34	Label	Caution
1	1009-242	35	Label	Caution
4	1035-009	36	Screw, Socket Head Cap	1/4-20UNC 2A x 1-1/2 long
1	2300-003	37	Cover, Back	
1	1035-034	38	Screw, Button Head Cap	1/4 x 5/8 long
1	2944-002	See Figure 3.2-1		
1	2329-001	See Figure 6.1-1	Assembly, Remote Foot Control	
0	1187-770	--	Pressure Relief Tool	Not included

* Complete Assembly

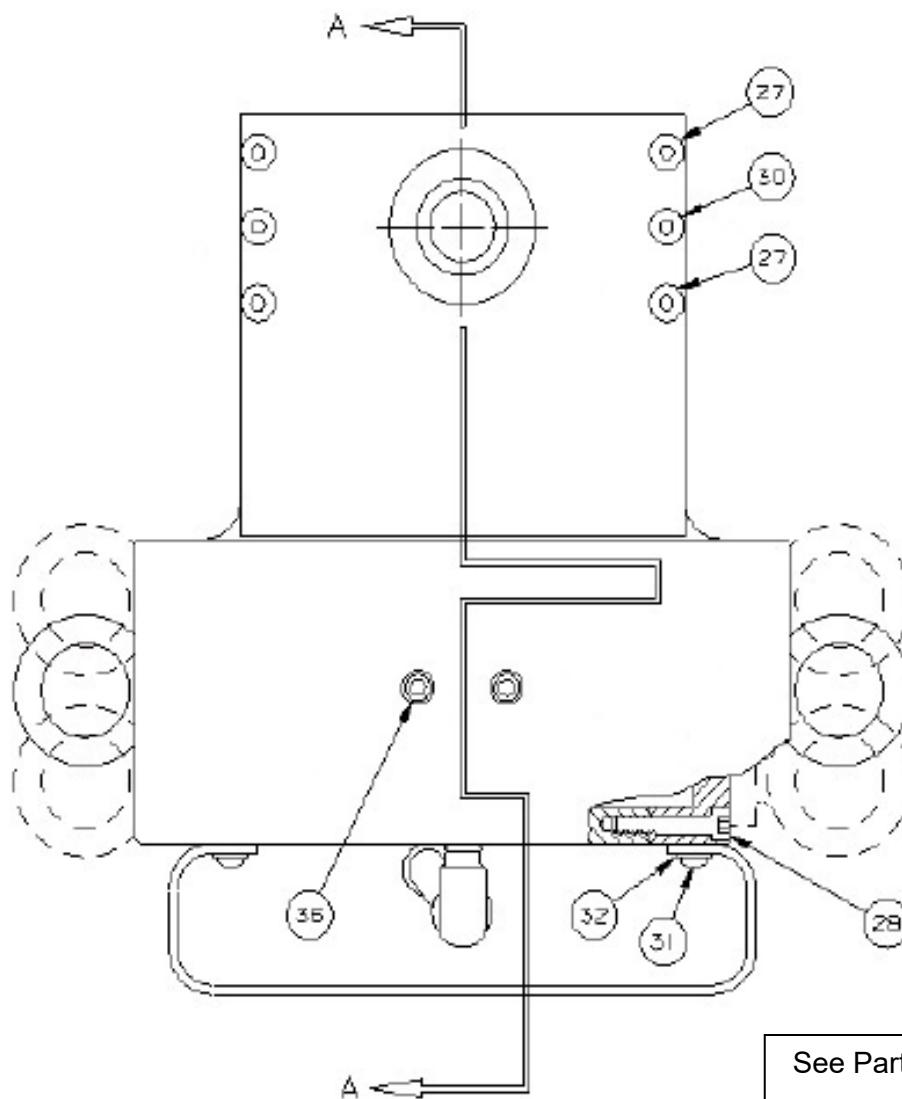
⬠ Note: Items flagged thus are included as part of assembly, but are not installed into puller unit.

1



**Figure 6.5-2
BBHO-35B Top View**

See Parts List, Page 25



**Figure 6.5-3
BBHO-35B Front View**

See Parts List, Page 25

6.6 BBHO-60C PULLER UNIT ASSEMBLY DIAGRAM AND PARTS LIST

See Figures 6.6-1 through 6.6-4 and Table 6.6-1 on the following pages for the BBHO-60C Puller Unit.

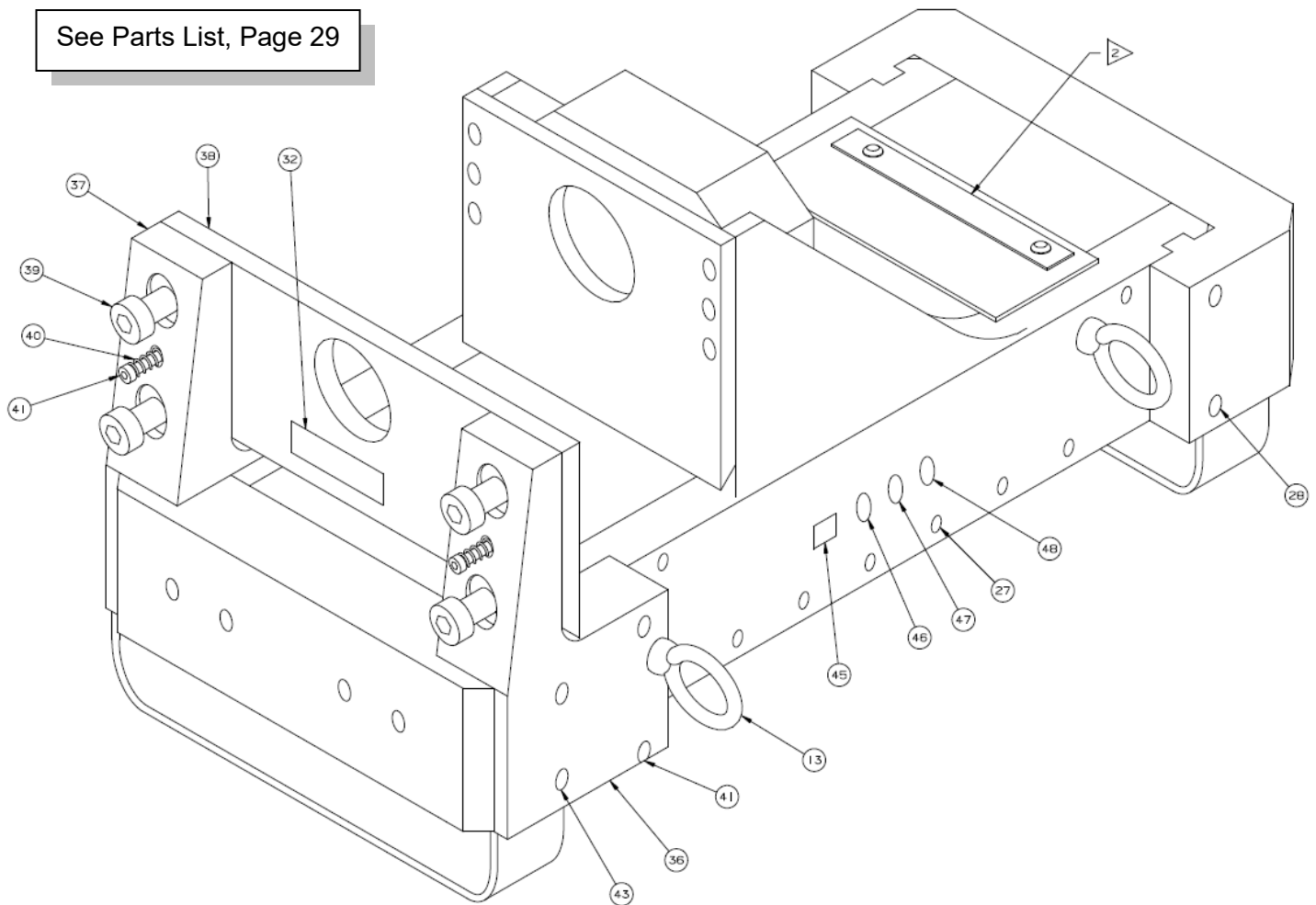


Figure 6.6-1
BBHO-60C Complete Assembly Isometric View

See Parts List, Page 29

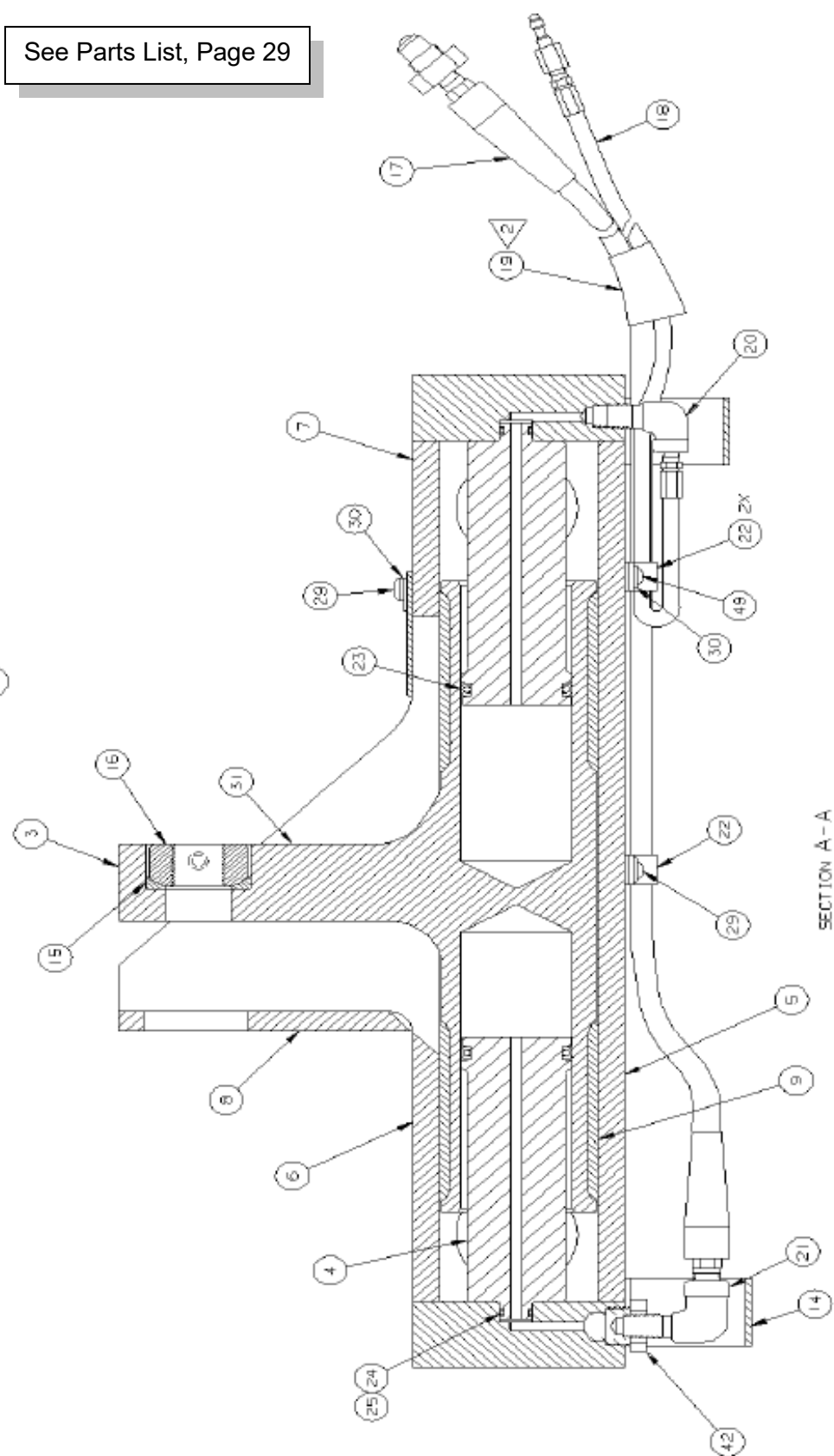

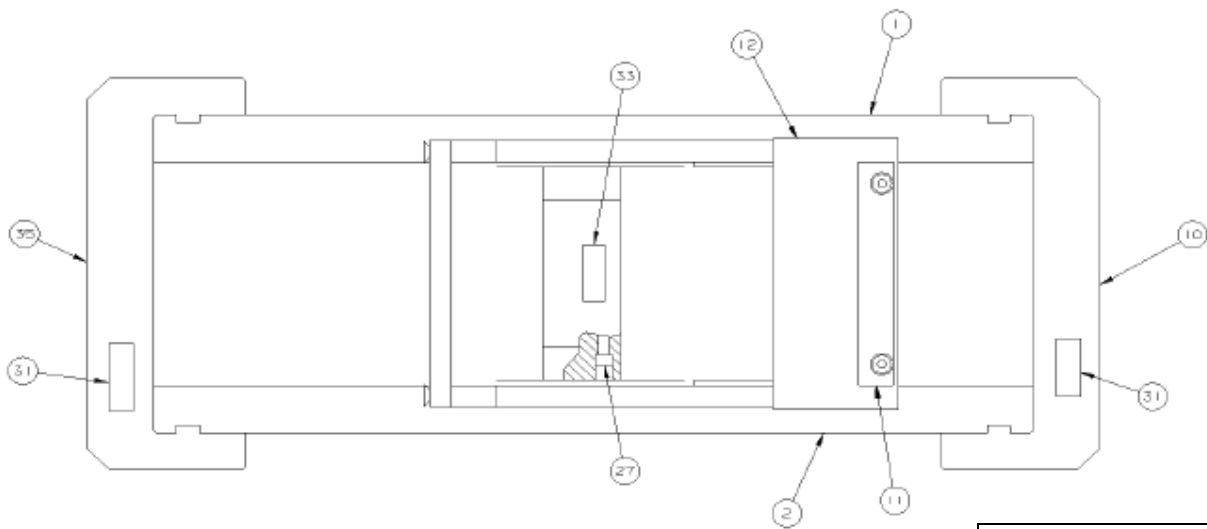


Figure 6.6-2
BBHO-60C Side View

Table 6.6-1
BBHO-60C Puller Unit Parts List

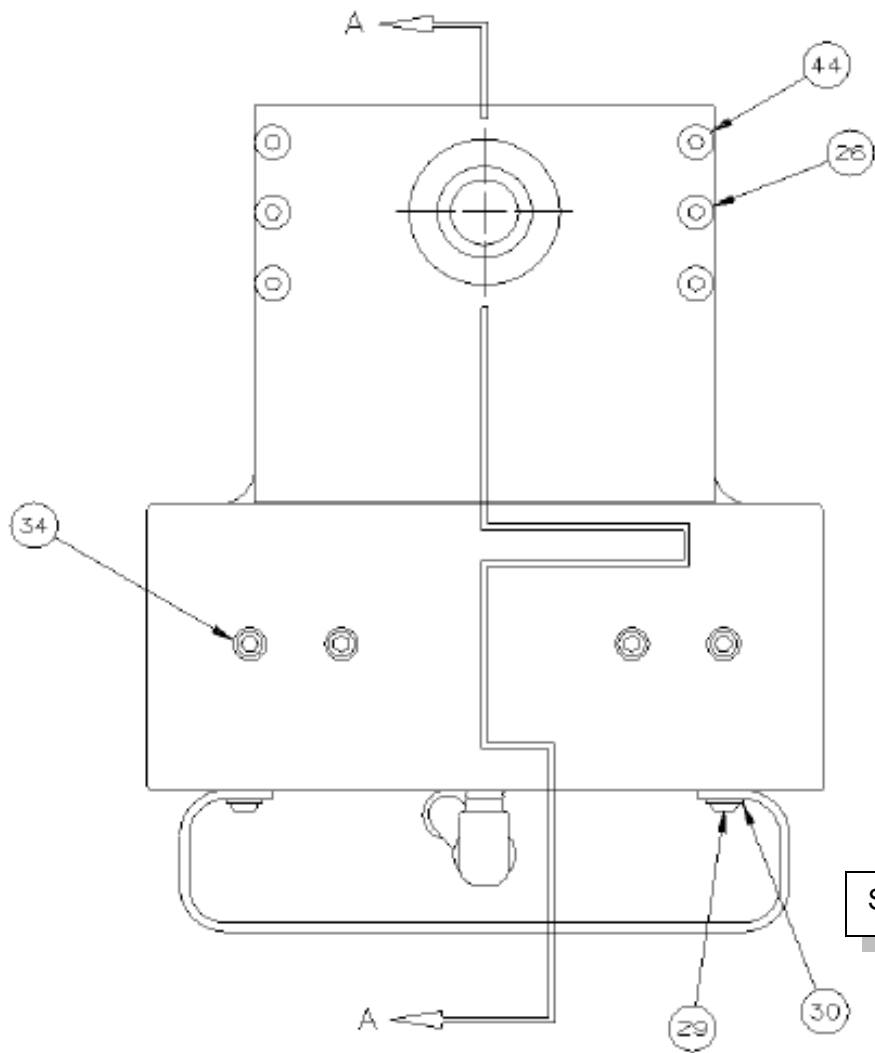
Quantity	Part Number	Piece Number	Description	Reference Information
1	3349-001	1	Housing, Right	
1	3348-001	2	Housing, Left	
1	3333-001	3	Slide	
3	2290-003	4	Piston	
1	3342-001	5	Plate, Bottom	
1	3339-001	6	Plate, Front	
1	3338-001	7	Plate, Back	
1	3340-001	8	Plate, Face	
8	2246-001	9	Bearing	
1	3343-001	10	Cover, Return End	
1	3341-001	11	Clamp, Guard	
1	2310-004	12	Guard, Neoprene	
4	2330-001	13	Eyebolt, Modified	
1	2331-003	14	Fitting, Guard	
1	2802-001	15	Washer, Spherical	
2	2803-002	16	Adapter, Threaded	
1	2107-002	17	Assembly, Hydraulic Hose	20 feet
1	2106-003	18	Assembly, Air Hose	20 feet
8	2638-001	19	Tube, Heat Shrink	
1	1047-054	20	Fitting, Elbow	1/8 to 1/4 Street
1	1047-017	21	Fitting, Elbow	1/4 Pipe Street
3	1045-017	22	Clamp, Hose	CL-12
3	1046-031	23	Seal, Crown	CP-327
3	1046-027	24	O-Ring, Piston	
3	1046-028	25	Ring, Backup	
2	1035-018	26	Screw, Flat Head Cap	1/4-inch x 1/2 LG
28	1035-008	27	Screw, Socket Head Cap	1/4-inch x 1-1/4 LG
4	1035-007	28	Screw, Socket Head Cap	1/4-inch x 1 LG
7	1035-003	29	Screw, Button Head Cap	1/4-inch x 1/2 LG
8	1045-040	30	Washer (Type B Plain)	1/4 Narrow
3	1009-184	31	Label	Do Not Strike
1	1009-185	32	Label	Caution
1	1009-242	33	Label	Caution
6	1035-010	34	Screw, Socket Head Cap	1/4-inch x 1-3/4 LG
1	3344-001	35	Cover, Pressure End	
1	3345-001	36	Support, Left	
1	3346-001	37	Support, Right	
1	3336-001	38	Plate, Backup	
4	1059-003	39	Screw, Socket Head Cap	5/8-inch x 1-1/2 LG
2	1005-015	40	Spring	SS .045 Wire
6	1035-013	41	Screw, Socket Head Cap	1/4-inch x 2-1/2 LG
1	1187-186	42	Reducer	1/2 to 1/4 SS NPT
4	1035-009	43	Screw, Socket Head Cap	1/4-inch x 1-1/2 LG
4	1035-020	44	Screw, Flat Head Cap	1/4-inch x 3/4 LG
1	1166-001	45	Label, CE	
1	1187-105	46	Label, Ear Protection	
1	1187-106	47	Label, Eye Protection	
1	1187-107	48	Label, Read Manual	
1	1035-034	49	Screw, Button Head Cap	1/4-inch x 5/8 LG
1	2329-001	See Figure 6.1-1	Assembly, Remote Foot Control	
1	2944-002	See Figure 3.2-1	Air Valve, BBHO	BBHO-AVS-2
0	1187-770	--	Pressure Relief Tool	Not included

 Note: Items flagged thus are included as part of assembly, but are not installed into puller unit.



**Figure 6.6-3
BBHO-60C Top View**

See Parts List, Page 29



**Figure 6.6-4
BBHO-60C Front View**

See Parts List, Page 29