

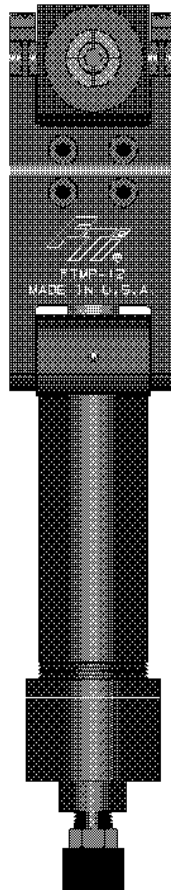
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## FTI OPERATIONS, MAINTENANCE AND REPAIR MANUAL

### FTMP-12 Midget Puller Unit

FTI Part #2720-021

September 2005



Fatigue Technology Inc. (FTI) is the supplier of Split Sleeve Cold Expansion™ (Cx™) Systems to the aerospace industry worldwide. These proprietary systems and associated tooling may be covered by patents or agreements owned by, or exclusively licensed to Fatigue Technology Inc. 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 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 Technical Sales Department.

FTI's Cold Expansion systems and processes are the subject matter of one or more of the following patents: 4,423,619, 4,425,780, 4,557,033, 4,809,420, 4,885,829, 4,934,170, 5,127,254, 5,083,363, 5,096,349, 5,103,548, 5,245,743, 5,218,854, 5,305,627, 5,405,228, 5,341,559, 5,380,136, 5,433,100, 5,468,104, 0131648, 86,344, 1,792,039, 513,898, 581,385, 69310828, 692015124; 131,648, 33 82069, 468,598, 69105390, 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.

## ABOUT FATIGUE TECHNOLOGY

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Fatigue Technology Inc. (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 toolroom setup

Complete inventory allows FTI to respond quickly to customers' requirements.

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



Burke F. Gibson  
President

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## SECTION 1.0 INTRODUCTION

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This instruction manual contains information on the specifications and parts of the Fatigue Technology Inc. (FTI) FTMP-12 Midget 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.

### 1.1 ABOUT THE FTMP-12 PULLER UNIT

The FTMP-12 is a small hydraulic puller unit specifically designed for use with the FTI Split Sleeve Cold Expansion™ (SsCx™) process. The FTMP-12 Puller Unit is designed to pull a mandrel through a hole utilizing the pre-lubricated stainless steel split sleeves used in this process.

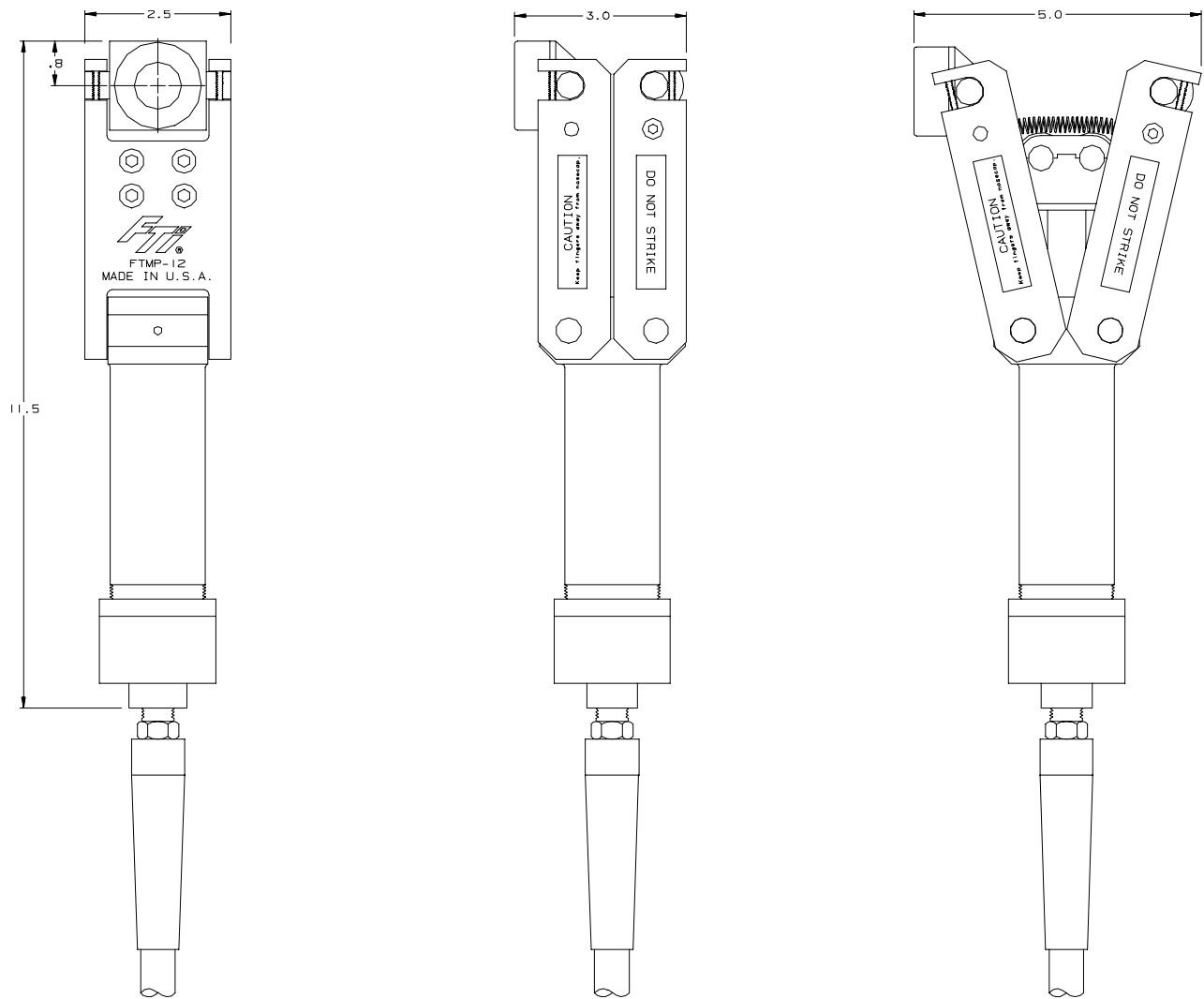
The FTMP-12 Puller has a maximum pull force of 8,000 pounds at 10,000 psi pump pressure. The FTMP-12 is capable of cold expanding holes up to 1/2 inch in diameter and 1.2 inches deep in aluminum and 3/8 inch in steel and titanium. For limited access hole sizes larger than 1/2 inch in diameter, please contact FTI's Technical Sales Staff for assistance and advice on other special restricted access tooling available.

The FTMP-12 has a fail-safe air control system when used with the remote trigger and FT-20 PowerPak that causes the puller retraction to be interrupted whenever the operator releases finger pressure on the trigger or in the event of air or hydraulic hose failure. The FTMP-12 Midget Puller can be used with the FT-20 PowerPak and FTP-19 Hand Pump. **Due to the faster speed of application of the FT-200 PowerPak, do not use the FT-200 with the FTMP-12 Midget Puller.**

### 1.2 GENERAL SPECIFICATIONS

PSI Rating at Maximum Pull Force .....	10,000 psi
Pull Force Capacity .....	8,000 lbs
Air Line Requirements (with FT-20 PowerPak) .....	3/8 inch to 1/2 inch ID
Air Flow Requirements (with FT-20 PowerPak) .....	45 cfm
Weight .....	15 lbs
Stackup Capacity .....	1.2 inches
Hole Diameter Capacity:	
Aluminum .....	1/2 inch
Steel .....	3/8 inch
Titanium .....	3/8 inch
Actuation .....	Mechanical / Pneumatic
Operation .....	Hydraulic
Air and Hydraulic Hose Length .....	10 feet
Hand Pump .....	Optional (FTP-19)
Compatible Hydraulic Pumps .....	FT-20 PowerPak or FTP-19 Hand Pump
Replacement Seal Kit .....	Contact FTI for details

### 1.3 FTMP-12 GENERAL DIMENSIONS



**Figure 1-1**  
**FTMP-12 Dimensions**

## SECTION 2.0 SAFETY

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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.

FTI cannot be responsible for damage or injury resulting from unsafe product use, lack of maintenance or incorrect product and system application. Contact FTI Technical Sales Department when in doubt as to safety precautions or applications. Follow all safety precautions to avoid personal injury or property damage during the system operation. Ultimately, the operator is responsible for personal safety; however, the following general safety precautions should be observed.

### 2.1 GENERAL PRECAUTIONS

1. Wear eye protection when operating the puller unit.
2. Never use your hands to grasp a leaking hose under pressure. The force of escaping hydraulic fluid could cause serious injury.
3. **DO NOT** attempt to disconnect the hydraulic hose while it is under pressure.
4. **DO NOT** expose hoses to potential hazards such as extreme heat or cold, sharp surfaces or heavy impact.
5. **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 for wear or damage which could cause premature failure of the hose and possibly result in injury.
6. **DO NOT** use the hose to move attached equipment.
7. Hose material and coupler seals must be compatible with hydraulic fluid that meets the requirements of US MIL-SPEC #5606.
8. Hoses must not come in contact with toxic materials such as creosote-imprinted 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.
9. Keep oil lines clean: when coupler halves are disconnected, always screw on a dust cap. Use every precaution to guard against entry of dirt. Dirt and foreign matter may cause pump or puller failure.
10. Before operating the pump, make sure all hose connections are tightened securely. **DO NOT** over tighten.
11. Keep hands away from nosecap assembly while holding nosecap against workpiece.
12. In severe restricted access applications, keep hands clear of the backside of the Puller.

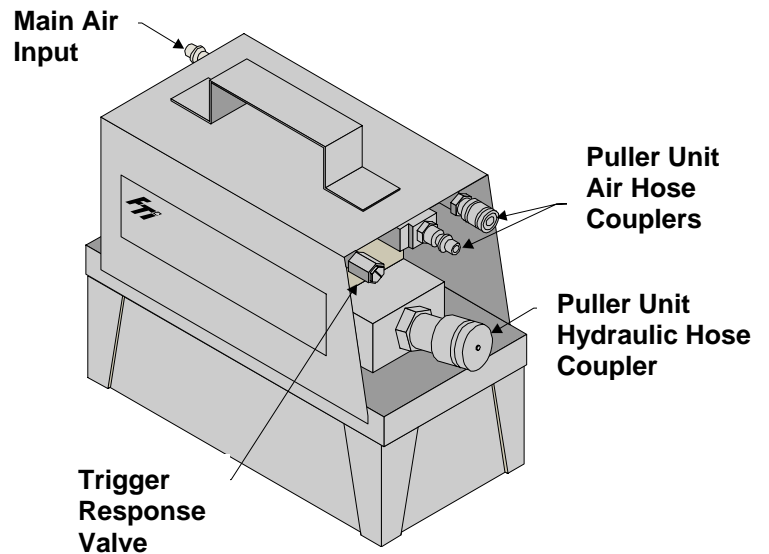
## 2.2 PRECAUTIONS WHEN USING THE FTMP-12 WITH THE FTP-19 HAND PUMP

1. The FTP-19 Hand Pump is rated to 10,000 psi. **DO NOT** use with equipment rated at a lower pressure.
2. **DO NOT** over tighten any connections. All connections should be snug and leak-free. Excessive tightening will cause strain on the threads and castings, which could cause fitting failure at pressures below rated capacity.

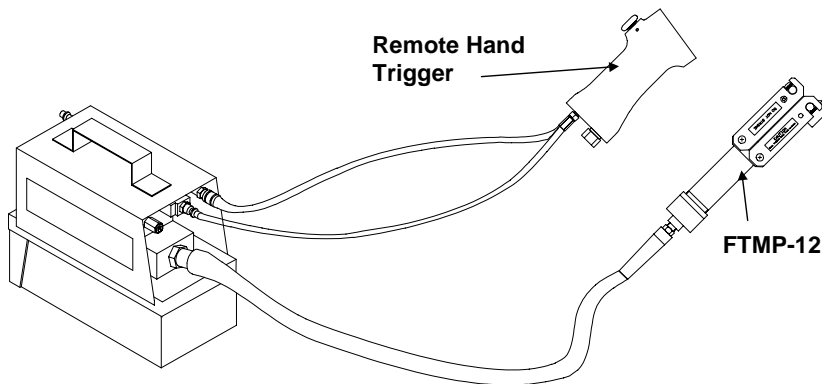
## 2.3 PRECAUTIONS WHEN USING THE FTMP-12 WITH THE FT-20 HYDRAULIC POWERPAK

**NOTE:** When used with the FT-20 PowerPak, the FTMP-12 is operated with a remote trigger (hand or foot operated, see Figure 2-2) to activate the PowerPak. Please contact the FTI Technical Sales Department if you are unsure about operation of the puller unit with a remote trigger.

1. Disconnect the air supply when:
  - Maintenance is to be performed,
  - Hydraulic hose is disconnected, or
  - PowerPak is not in use.
2. In the event of a ruptured or leaking hose, immediately release the trigger and disconnect the air line at the air coupler from the PowerPak (see Figure 2-1).
3. Release puller unit remote trigger when mandrel clears the workpiece or becomes stuck in the material.



**Figure 2-1**  
**FT-20 Air Disconnect**



**Figure 2-2**  
**PowerPak/Puller/Hand Trigger Setup**

## SECTION 3.0 PULLER UNIT OPERATING INSTRUCTIONS

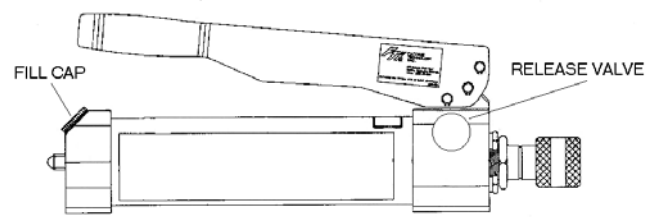
**CAUTION:** The nature of the tooling setup with the FTMP-12 and FTP-19 hand pump is such that two people will normally be involved in the operation. It is important to establish good communication between people involved to prevent inadvertent or premature operation of the puller unit. Failure to do so could result in personal injury or damage to the structure.

Become familiar with these instructions before operating the puller unit.

### 3.1 PULLER UNIT SETUP PROCEDURE AND OPERATION WITH FTP-19 HAND PUMP

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

1. Inspect all threads and fittings of hand pump for signs of wear or damage and replace them if necessary.
2. Check oil level of the hydraulic pump. The pump should have enough oil to complete the cold working process in one operation. For instructions on how to check the oil level and how to add oil, refer to Section 4.0 (Puller Unit Maintenance).
3. Uncoil the hose assembly of the puller unit, and inspect all threads, couplings and hoses for damage and degradation.
4. Remove the thread protectors from the hydraulic fittings and thread the hydraulic hose fitting from the puller unit (female) onto the hydraulic fitting of the FTP-19 Hand Pump (male). **Make sure the fittings are pushed tightly together to ensure the check valves are fully open before engaging the threaded nut.**



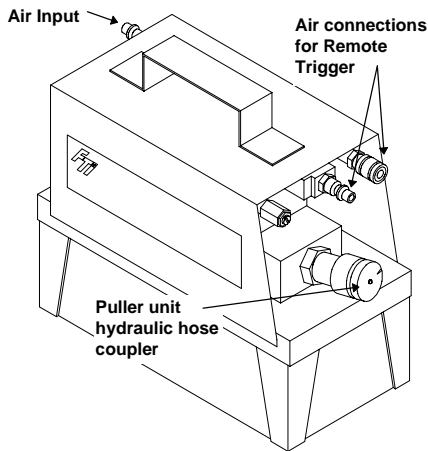
**Figure 3-1  
FTP-19 Hand Pump**

#### Actuation of Puller Using FTP-19 Hand Pump

1. Once the Puller is in place, turn the pump release valve clockwise (Refer to Figure 3-1) and close fingertight.
2. Apply pressure to the system by cycling the pump handle on the FTP-19 (the FTP-19 can be operated in the horizontal or vertical position). The mandrel will gradually be pulled through the hole as pressure increases with each stroke.
3. When the mandrel is completely through the hole, return the Puller to its original position by turning the release valve located near the front of the hand pump counter-clockwise and squeezing the jaws of the Puller together manually.

### 3.2 PULLER UNIT SETUP PROCEDURE AND OPERATION WITH FT-20 POWERPAK

1. Inspect all threads and fittings of the PowerPak for signs of wear or damage and replace them if necessary.

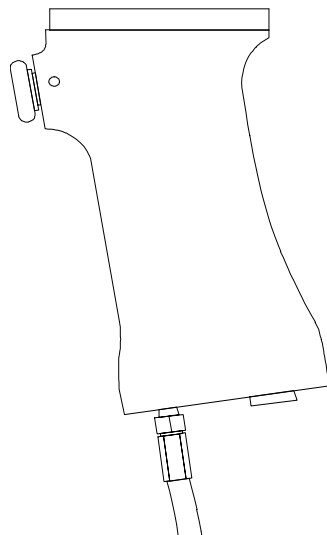


**Figure 3-2  
FT-20 Connections**

2. Uncoil the hose assembly of the puller unit, and inspect all threads, couplings and hoses for damage and degradation.
3. Remove the thread protectors from the hydraulic fittings and thread the hydraulic hose fitting from the puller unit (female) onto the hydraulic fitting of the FT-20 PowerPak (male). **Make sure the fittings are pushed tightly together to ensure the check valves are fully open before engaging the threaded nut.**
4. Connect the male/female AIR quick-disconnects from the remote hand trigger to the FT-20 PowerPak.
5. Remove the thread protectors from the air inlet on the back of the PowerPak. Connect the female quick disconnect of a 3/8 inch or 1/2 inch ID shop air line onto the male air inlet of the PowerPak.
6. Test shop air supply to ensure that air is clean, dry and between 90 and 120 psi at 45 cfm.

### Actuation of Puller Using FT-20 PowerPak

1. The Puller can be activated only when connected to an FTI FT-20 PowerPak and remote hand or foot trigger.
2. Activate the Puller by depressing the remote trigger. Hydraulic pressure is transmitted through the hose to the arms of the Puller which causes the arms to separate, pulling the mandrel through the sleeve in the hole.
3. Release the trigger to discontinue the pull cycle and return the Puller to its original position by squeezing the jaws together manually.
4. If the Puller fails to operate as detailed above, refer to Section 5.0 (Troubleshooting).



**Figure 3-3  
Remote Hand Trigger**

## SECTION 4.0 PULLER UNIT MAINTENANCE

The Puller requires routine checking of the unit and periodic preventative maintenance to ensure safe, trouble-free operation. No special maintenance is required. The following maintenance actions are suggested.

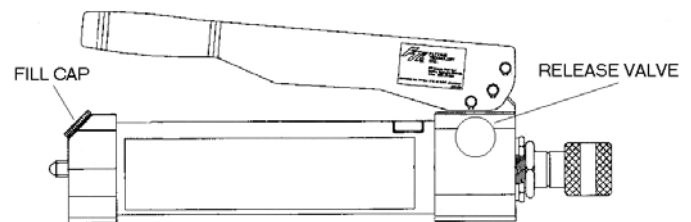
**CAUTION:** Before attempting any maintenance operations on the Puller, disconnect the PowerPak from the air supply or disconnect the Puller from the PowerPak or hand pump.

### 4.1 GENERAL CLEANING

1. Periodically clean the outer surfaces of the puller unit and PowerPak.
2. When not in use, ensure the thread protectors are re-installed.
3. Keep all hose connections free of metal chips, dirt and grime.

### 4.2 CHECKING AND FILLING HYDRAULIC FLUID IN THE FTP-19

1. Open the pump release valve to release pressure in the system.
2. Place the pump on a level surface and remove the fill cap.
3. Oil should be full to the bottom of the filler hole.
4. If oil is low, fill with appropriate oil (see Section 1.2) up to the bottom of the filler hole. See Figure 4-1.
5. Close the fill cap and hand tighten.
6. If pump was very low on oil or you are replacing oil, cycle the pump several times before using with the Puller.



**Figure 4-1**  
**FTP-19 Hand Pump**

### 4.3 LUBRICATION

1. There is no internal lubrication requirement for the puller unit.
2. Whenever the Puller is to be stored for any length of time, maintain a thin coat of 10-weight oil on the outside of black oxide surfaces.

### 4.4 INSPECTION

1. Periodically inspect the threaded fittings for cracks, leaks or other damage. Repair and replace as necessary.

## 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, please contact your nearest FTI representative (see back of cover).

### 5.1 TROUBLESHOOTING WITH CONNECTION TO THE FTP-19 HAND PUMP

1. Puller will not retract.

Pump release valve open.

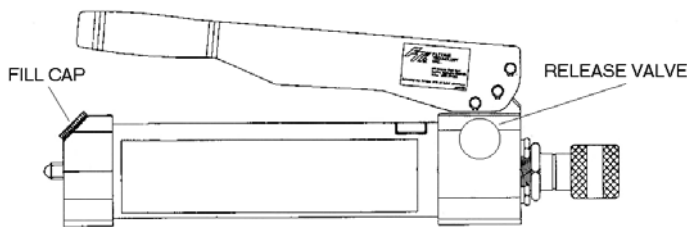
Close the release valve.

No oil in the pump.

Check the oil level in the pump. Level should be up to the mark on the rear cap (refer to Section 4.2).

Air bound.

Release air:



a. Invert cylinder.

b. Open the pump release valve and as the plunger retracts, the air in the system will be replaced by oil.

c. Close the release valve.

**Figure 5-1**  
**FTP-19 Hand Pump**

Couplers not fully tightened.

Pressure must be relieved from the system before the couplers can be tightened. To relieve pressure, turn the release valve counterclockwise. Once the pressure is relieved, check all couplers to make sure they are tight and not leaking.

Blocked hydraulic line.

Uncouple the hydraulic hose and drain off oil. Reconnect the hose to the pump and refill the pump to level on rear cap.

Pump not operating.

Check all connections to the Puller. Check to make sure release valve is closed and the fill cap is on tight.

PROBLEM	CAUSE	SOLUTION
2. Puller retracts only part way.	Oil level in pump is low.	Check the oil level and fill if required (refer to Section 4.2).
	Air trapped in cylinder.	Bleed air in the cylinder: <ol style="list-style-type: none"> <li>a. Invert the cylinder.</li> <li>b. Open the pump release valve and as the plunger retracts, the air in the system will be replaced by oil.</li> <li>c. Close the release valve.</li> </ol>
3. Puller advances in spurts.	Air in hydraulic system.	Follow same procedure as above.
4. Puller advances slower than normal.	Restricted hydraulic line or fitting.	Check the hydraulic line to make sure it is not kinked, being pinched around a corner or caught under a sharp object. If the hose has been pinched, inspect for damage and replace if necessary.
	Leaking connection.	Check the following connections: <ol style="list-style-type: none"> <li>a. Couplers connecting the Puller to the pump.</li> <li>b. Hose connection to puller unit.</li> <li>c. Release valve setting (should be in closed position).</li> <li>d. Fill cap (should be closed fingertight).</li> </ol>
5. Puller advances but will not hold pressure.	Loose coupler.	Tighten coupler after relieving pressure in the system.
	Pump malfunctioning.	Check setup and actuation procedure (Section 3.1) again. If pump still malfunctions, contact FTI's Technical Sales Staff for instructions.
	Puller seals leaking.	Replace the seals (call FTI for assistance).

**PROBLEM****CAUSE****SOLUTION**

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	Leaking connection.	Check the following connections:  a. Couplers connecting the Puller to the pump.  b. Hose connection to the puller unit.  c. Release valve setting (should be in closed position).  d. Fill cap (should be closed fingertight).
6. Puller leaks oil.	Pump malfunctioning.	Check setup and actuation procedure (Section 3.1) again. If pump still malfunctions, contact FTI's Technical Sales Staff for instructions.
	Incorrect system setup.	Disconnect the system and reconnect, following the steps in Section 3.1.
	Worn or damaged seals.	Replace the seals (contact FTI for assistance).
	Loose connection.	a. Couplers connecting the Puller to the pump.  b. Hose connection to the puller unit.  c. Release valve setting (should be in closed position).  d. Fill cap (should be closed fingertight).

<b>PROBLEM</b>	<b>CAUSE</b>	<b>SOLUTION</b>
7. Puller will not retract or retracts slower than normal.	Internal Puller damage.	DO NOT use Puller if there is any damage to its internal parts. Immediately contact FTI's Technical Sales Staff for assistance.
	Pump release closed.	Open release.
	Coupler not fully closed.	Pressure must be relieved from the system before couplers can be tightened. To relieve pressure, turn release valve counterclockwise. Close couplers to stop leaking.
	Blocked hydraulic line.	Check hydraulic line to make sure it is not kinked, being pinched around a corner or caught under a sharp object. If hose has been pinched, inspect for damage and replace if necessary.
	Broken retraction spring.	Replace.
	Pump reservoir over-filled.	Open fill cap and check level of hydraulic oil in the reservoir. Oil should be filled to the bottom of the filler hole.  DO NOT use Puller if there is any damage to its internal parts.
8. Puller will not fully retract.	Puller damaged internally.	Immediately contact FTI's Technical Sales Staff for assistance.
	Weak retraction spring.	Replace.
	Pump reservoir over-filled.	Open fill cap and check level of hydraulic oil in the reservoir. Oil should be filled to the bottom of the filler hole.
	Partially blocked hydraulic line.	Check hydraulic line to make sure it is not kinked, being pinched around a corner or caught under a sharp object. If hose has been pinched, inspect for damage and replace if necessary.

## 5.2 TROUBLESHOOTING WITH CONNECTION TO THE FT-20 POWERPAK

<b>PROBLEM</b>	<b>CAUSE</b>	<b>SOLUTION</b>
<b>Uncontrolled if Printed</b>		

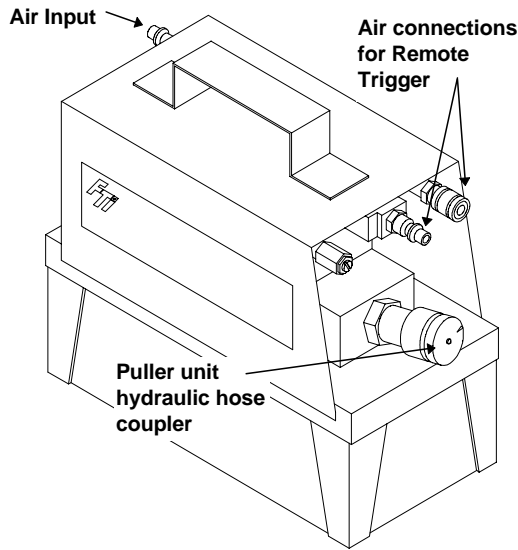
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| 1. FT-20 PowerPak fails to activate when remote trigger is depressed. | One or more of the key or hydraulic lines has not been securely connected. |
|---|--|

Check that the main air supply has not been interrupted.

**NOTE:** Should difficulties originate in the PowerPak, consult the specific PowerPak Operations, Maintenance and Repair Manual.

Check the following hose connections:

- a. Main air line quick disconnect fitting from shop air system to PowerPak.
- b. Hydraulic quick couplings connecting the hoses to the PowerPak manifold, and the Puller to the hydraulic hoses.



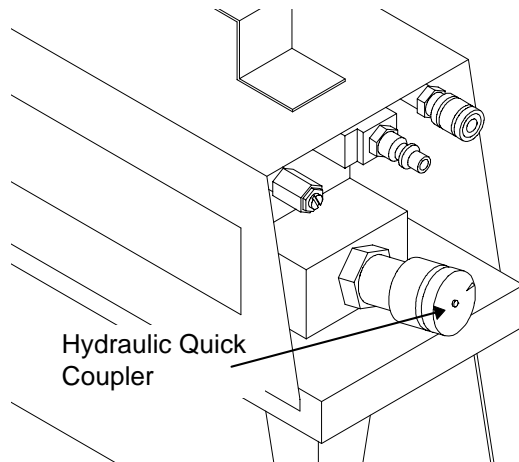
**Figure 5-2  
FT-20 PowerPak**

**CAUTION:** Hydraulic oil under extreme pressure may cause serious injuries if not handled carefully. For technical assistance, please contact FTI's Technical Sales Department.

- |   |  |
|---|--|
| 2. Puller retracts on first trigger actuation, but will not return to start position. | The hydraulic quick coupler line has not been completely tightened at the PowerPak manifold. |
|---|--|

Once the hydraulic pressure has been introduced to the hydraulic hose, the pressure must be relieved before the coupler can be sufficiently tightened.

Relieve the pressure using the following procedure:

**PROBLEM****CAUSE****SOLUTION**

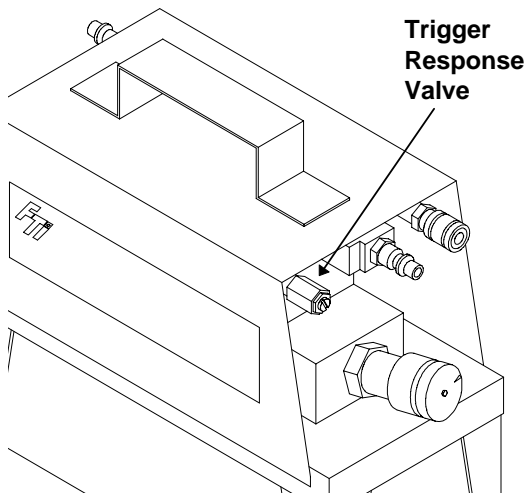
**Figure 5-3**  
**Hydraulic Quick Coupler (FT-20)**

- a. Disconnect the main air supply.
- b. Disconnect the coupler from PowerPak.
- c. Wrap the fitting with a rag to absorb the oil and slowly turn the coupler off the hydraulic hose to allow oil to bleed out.
- d. Once the pressure is relieved, the coupler may be tightened and reinstalled to the PowerPak.
- e. Reattach air lines to allow the Puller to return.

3. PowerPak will not generate constant pressure (hiccups).

Trigger response valve requires adjustment.

Adjust the trigger response valve using the following procedure:



**Figure 5-4**  
**Trigger Response Valve (FT-20)**

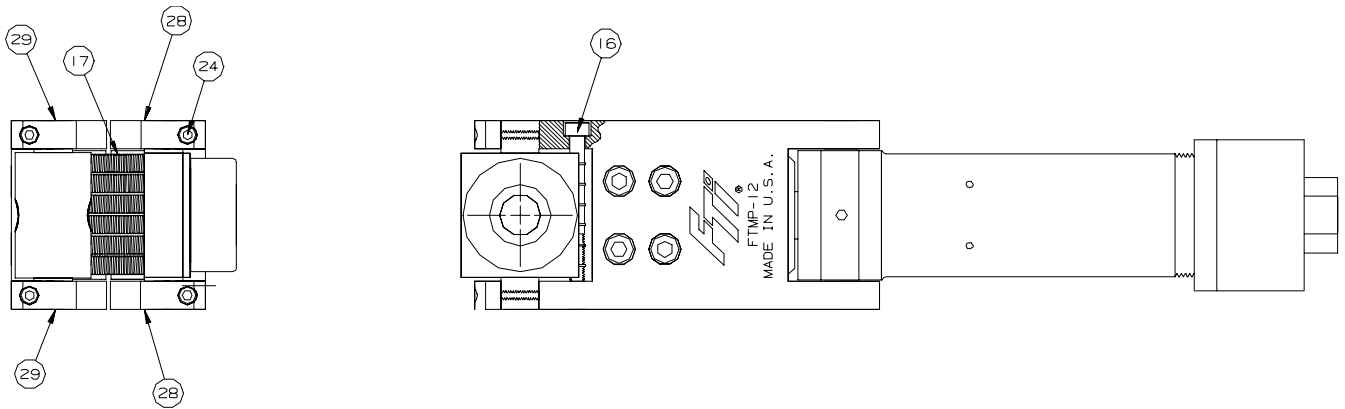
- a. Loosen the locknut on the trigger response valve.
- b. Using a screwdriver, open valve counterclockwise until PowerPak will not start when trigger is depressed.
- c. Turn screw clockwise until:
  - 1) PowerPak generates constant pressure when trigger is depressed.
  - 2) PowerPak starts instantly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

**PROBLEM****CAUSE****SOLUTION**

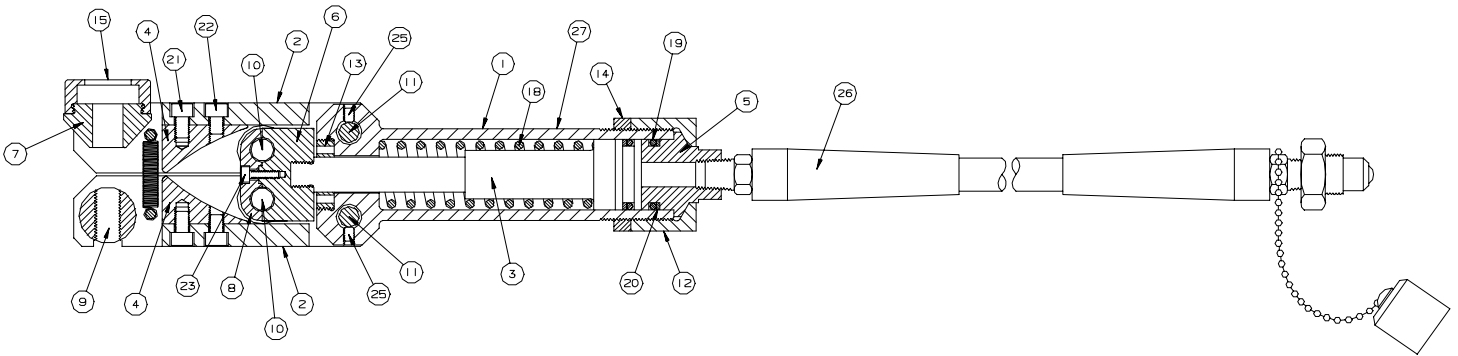
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|---|---|---|
| 4. The mandrel sticks in the hole when the Puller is activated. | Not enough pressure used to generate pull forces. | Use the following procedure to analyze the problem:<br><br>a. Check the oil level in the PowerPak (refer to FT-20 Manual).<br><br>b. Re-activate the Puller and leave the trigger depressed until the PowerPak generates full pressure (10,000 psi) and the air motor stalls.<br><br>c. If mandrel remains stuck at 10,000 psi, immediately disengage the mandrel from the Puller. Push the mandrel out using an impact hammer. Contact FTI's Technical Sales Department for additional assistance. |
|---|---|---|

## SECTION 6.0 ILLUSTRATED PARTS BREAKDOWN

### 6.1 FTMP-12 PULLER UNIT PARTS ILLUSTRATION



**Figure 6-1**  
**FTMP-12 Puller Unit Parts Illustration**  
**Front View**



**Figure 6-2**  
**FTMP-12 Puller Unit Parts Illustration**  
**Side View**

6.2 FTMP-12 PULLER UNIT PARTS LIST

Table 6-1  
FTMP-12 Puller Unit Parts List

Piece No.	Qty.	FTI Part No.	Description	Reference Information
-	-	2926-001	Assembly, FTMP-12	FTMP-12
1	1	2904-001	Cylinder, FTMP	
2	2	2906-001	Arm, FTMP	
3	1	2925-001	Assembly, FTMP Piston	
4	2	2927-003	Wedge, FTMP	
5	1	2919-001	Sleeve, FTMP Endcap	
6	1	2916-001	Block, FTMP Roller	
7	1	2921-001	Adapter, Nosecap	
8	2	2917-001	Cover, FTMP Block	
9	1	2920-001	Adapter, FTMP Mandrel	
10	2	2907-001	Roller, FTMP	
11	2	2922-001	Pin, FTMP Arm	
12	1	2918-001	Cap, FTMP End	
13	1	2923-001	Guide, FTMP Piston	
14	1	2120-006	Lockring, FTMP	
15	1	2148-001	Nosecap	
16	2	1029-012	Screw, Socket Head Cap	10-32UNF 2A x 2-1/4 Long
17	6	1064-005	Spring, Tension	LE-022C-6SS
18	1	1005-017	Spring, Compression	LHC-156M-755
19	1	1046-025	O'Ring	AN6227B-19
20	1	1046-026	Ring, Backup	MS28782-19
21	4	1036-002	Screw, Socket Head Cap	1/4-28UNF 2A x 3/8 Long
22	4	2998-001	Screw, Mod. Socket Head Cap	1/4-28UNF 2A x 5/16 Long
23	2	1026-003	Screw, Socket Head Cap	8-32UNF 2A x 1/2 Long
*24	4	1045-220	Screw, Socket Head Cap	6-32UNF 2A x 7/8 Long
25	2	1045-027	Screw, Set	10-32UNF 2A x 1/4 Long
26	1	2107-001	Assembly, Hydraulic Hose	IWHH-10
27	1	1009-094	Label, "FTI"	
28	2	1009-185	Label, "WARNING"	
29	2	1009-184	Label, "DO NOT STRIKE"	
-	1	2720-021	Manual, FTMP-12	

\*This item was revised to 1045-404, 8-32UNC-2B x 3/4 long on Revision F and higher.