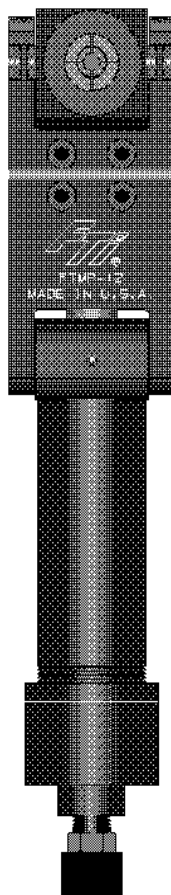

FTI OPERATIONS, MAINTENANCE AND REPAIR MANUAL

**FTMP-8 AND FTMP-12
Midget Puller Units**

**FTI Part #2720-021
Revision A**

November 18, 2011



Fatigue Technology (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. 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

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 toolroom setup

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

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 specifications and parts of the Fatigue Technology Inc. (FTI) 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 MIDGET PULLER UNIT

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

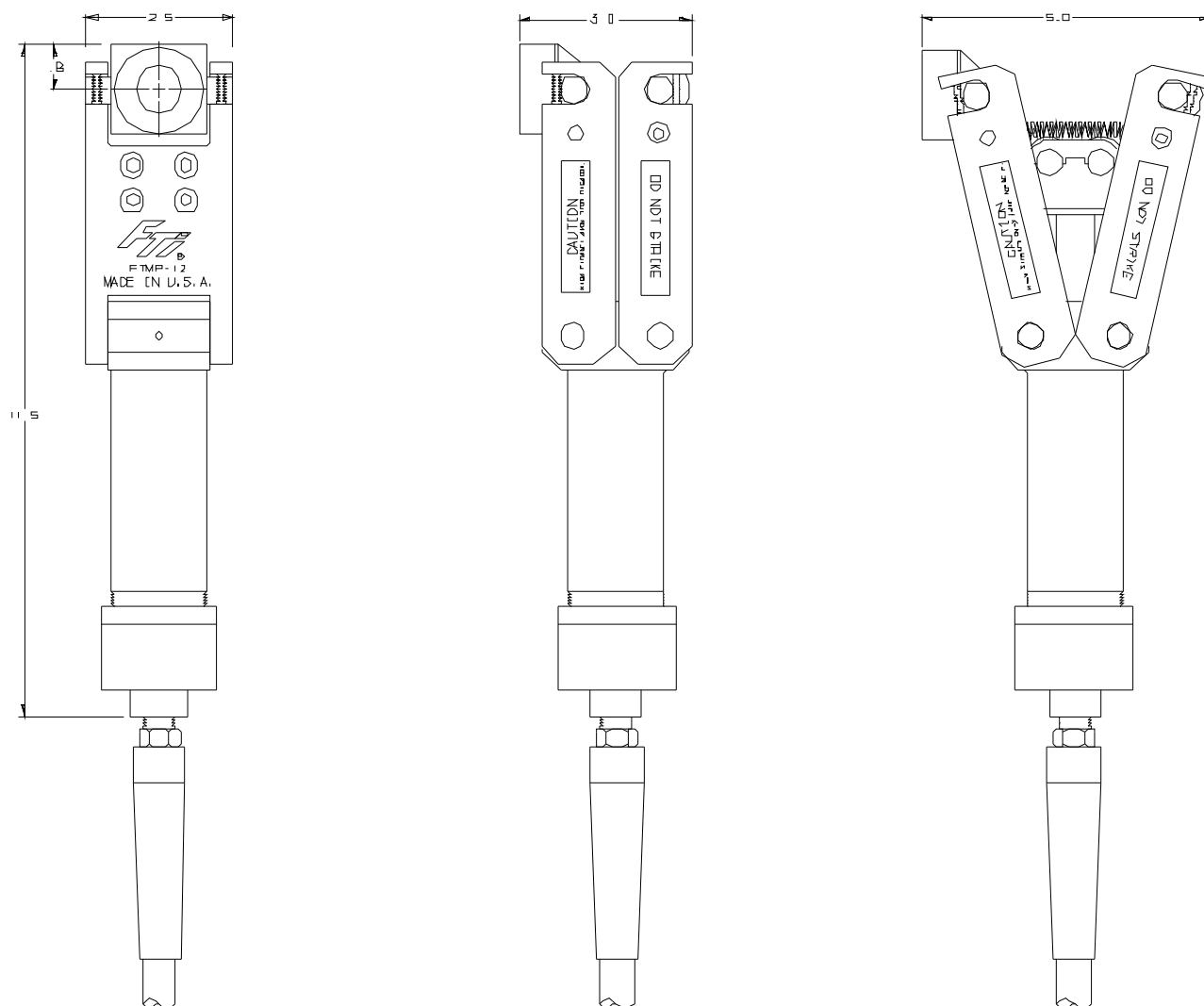
**Table 1.1-1
Midget Puller Unit Specifications**

Midget Puller Type	Maximum Pull Force (lb.)	Maximum Hole Diameter in Aluminum (in.)	Maximum Hole Diameter in Titanium and Steel (in.)	Maximum Mandrel Stackup (in.)	Stroke (in.)
FTMP-8	8,000	0.500	0.375	0.8	1.6
FTMP-12	8,000	0.500	0.375	1.2	2.0

1.2 GENERAL SPECIFICATIONS

PSI Rating at Maximum Pull Force	10,000 psi
Pull Force Capacity	8,000 lbs
Hydraulic Fluid Characteristics	Power Team Hydraulic Oil ASTM 215; or U.S. Mil-Spec #5606; FTI Part Number 1045-154
Weight.....	15 lbs
Stackup Capacity:	
FTMP-8.....	0.8 inches
FTMP-12.....	1.2 inches
Hole Diameter Capacity:	
Aluminum	1/2 inch
Steel	3/8 inch
Titanium.....	3/8 inch
Actuation.....	Mechanical
Operation.....	Hydraulic
Hydraulic Hose Length	10 feet
Compatible Hydraulic Pump.....	FTP-19 Hand Pump
Replacement Seal Kit.....	Contact FTI for details

1.3 FTMP-8 AND FTMP-12 GENERAL DIMENSIONS



**Figure 1.3-1
Midget Puller Dimensions**

SECTION 2.0 SAFETY

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 MIDGET PULLER 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.

SECTION 3.0 MIDGET PULLER UNIT OPERATING INSTRUCTIONS

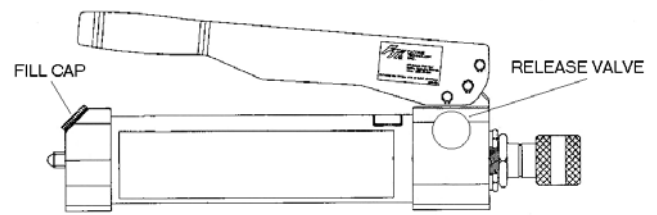
CAUTION: The nature of the tooling setup with the Midget Puller and FTP-19 hand pump is such that two people will normally be involved in the operation. It is important to establish good communication between people involved to prevent inadvertent or premature operation of the puller unit. Failure to 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 3.1-1
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.

SECTION 4.0 MIDGET 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.

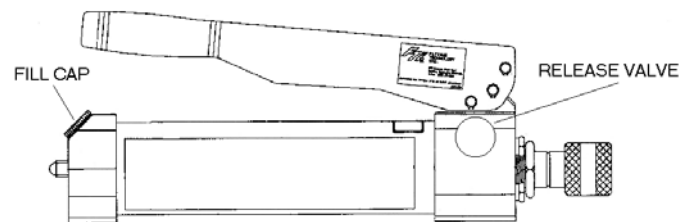


Figure 4.2-1
FTP-19 Hand Pump

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.

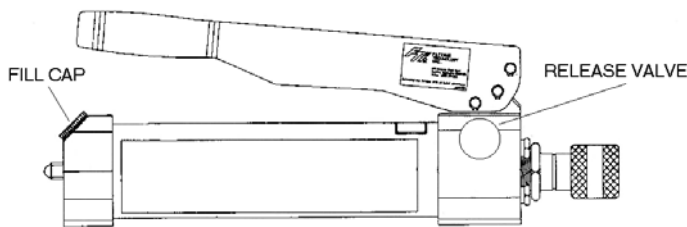
Close the release valve.

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 5.1-1
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"> a. Invert the 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.
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"> a. Couplers connecting the Puller to the pump. b. Hose connection to puller unit. c. Release valve setting (should be in closed position). d. Fill cap (should be closed fingertight).
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**

	Leaking connection.	Check the following connections: <ul style="list-style-type: none">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.	<ul style="list-style-type: none">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).

PROBLEM	CAUSE	SOLUTION
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.
8. Puller will not fully retract.	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.
	Puller damaged internally.	DO NOT use Puller if there is any damage to its internal parts. 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.

SECTION 6.0 ILLUSTRATED PARTS BREAKDOWN

6.1 MIDGET PULLER UNIT PARTS ILLUSTRATION

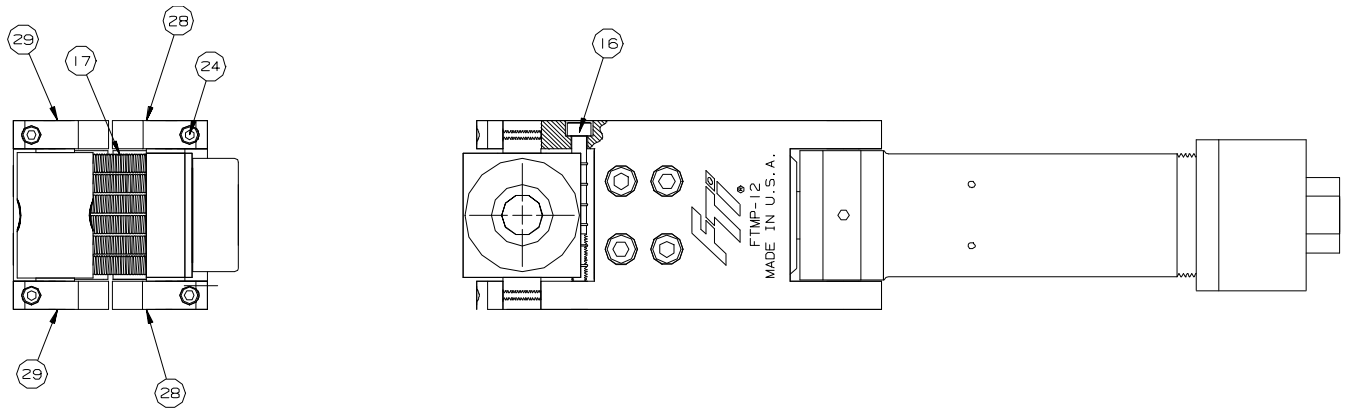


Figure 6.1-1
Midget Puller Unit Parts Illustration
Front View

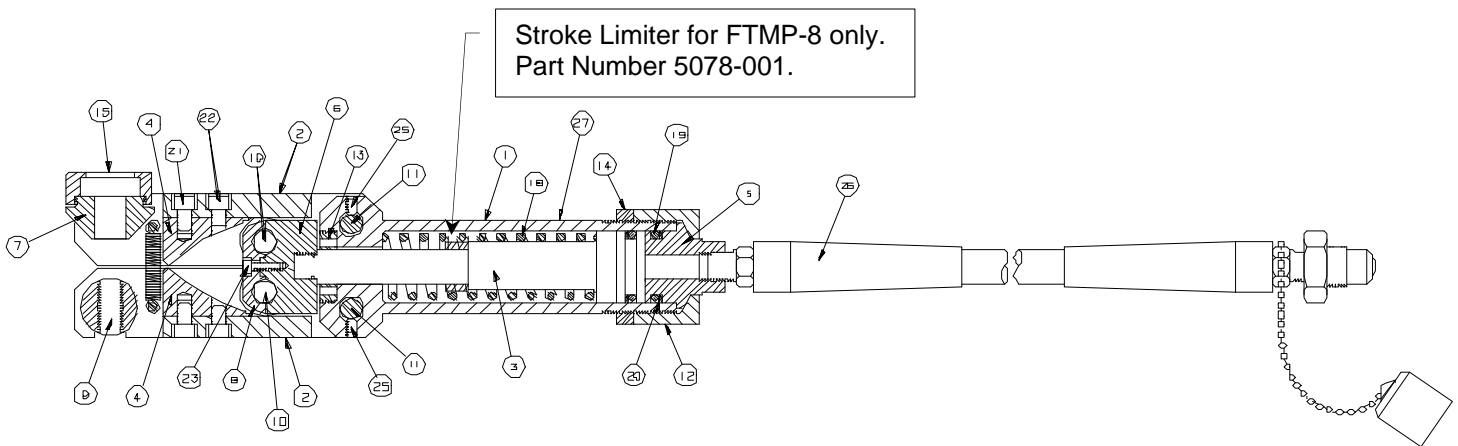


Figure 6.1-2
Midget Puller Unit Parts Illustration
Side View

6.2 MIDGET PULLER UNIT PARTS LIST

Table 6.2-1
Midget Puller Unit Parts List

Piece No.	Qty.	FTI Part No.	Description	Reference Information
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-8 and FTMP-12	

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