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FTI OPERATIONS, MAINTENANCE, AND REPAIR MANUAL

Medium Brute Right Angle Puller (MBRA)

Part #2720-134, Log #36681
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This manual should be used in conjunction with the FTI
"Medium Brute Puller Unit Operations, Maintenance, and Repair Manual"

ABOUT FATIGUE TECHNOLOGY

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.

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: INTRODUCTORY INFORMATION—MEDIUM BRUTE RIGHT ANGLE PULLER

This instruction manual contains information on the operation and maintenance of the Medium Brute Right Angle Puller (MBRA) designed by Fatigue Technology (FTI) for use with the patented Split Sleeve Cold Expansion™ (SsCx™) process. To obtain optimum performance and many years of trouble-free service, carefully follow maintenance procedures and operate the MBRA properly.

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

The Medium Brute Right Angle Puller is a compact, durable tool that enables coldworking in restricted access areas that are difficult or impossible to get to with conventional tools.

- Is capable of cold expanding holes in restricted access areas up to 0.94-inch (23.8mm) diameter in aluminum and mild steel, or 0.75-inch (19mm) diameter in titanium and high strength steel.
- Attaches to the Medium Brute (MB) series of puller units. See the Medium Brute Puller Unit Operations, Maintenance, and Repair Manual for additional safety information.
- The MBRA-10 alone weighs approximately 11.7 pounds (5.31 kg); with the Medium Brute Puller Unit, it weighs approximately 31.7 pounds (14.38 kg). The MBRA-5 alone weighs approximately 9.7 pounds (4.4 kg); with the Medium Brute Puller Unit, it weighs approximately 29.7 pounds (13.47 kg).
- Requires only 0.65-inch (16.51mm) lateral clearance (see Figure 3.0-1).
- Head can rotate 360 degrees on the puller unit.
- Has a maximum pull force of 24,000 pounds (maximum generated by the Medium Brute Puller Unit).
- The MBRA is capable of much more pull force than an LBRA and is physically larger. For low-force applications an LBRA may be better suited. This manual only covers the MBRA units and does NOT apply to the LBRA.

SECTION 2.0: SAFETY

Safe operation of the MBRA is of paramount concern. Along with standard shop safety practices (eye protection, safe handling of high-pressure equipment, etc.), the following items are peculiar to the MBRA/puller unit assembly:

1. Wear eye protection when operating the puller unit.

2. Disconnect the air supply when:
   - Maintenance is to be performed
   - Hydraulic hose is disconnected
   - PowerPak is not in use

3. Disconnect the MB Puller Unit from the PowerPak before attaching the MBRA.

4. 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. Never use your hands to grasp a leaking hose under pressure. The force of escaping hydraulic fluid could cause serious injury.

5. Keep hands away from the nosecap assembly while holding the nosecap against the workpiece.

6. Release the puller unit trigger when the mandrel clears the workpiece or becomes stuck.

7. The Medium Brute end cap must always be in place while in use. Injury may occur if the end cap is removed during operation.

8. Before operating the pump, tighten all hose connections using the proper tools. Do not over-tighten the connections. Connections need only be tightened securely and leak-free. Over-tightening may cause premature thread failure or high-pressure fittings to split at pressures lower than their rated capacities.

9. Operators must read this manual in its entirety before using the Medium Brute Right Angle Puller. Eye and ear protection must be worn while operating the Medium Brute. Three safety stickers on the Medium Brute Puller Unit series act as a reminder to these instructions. The symbols are shown in Figure 2.0-1.

10. Do not use in potentially explosive atmospheres.

Read manual before using

Always wear eye protection

Always wear ear protection

Figure 2.0-1
Safety Stickers

Hydraulic Hose Safety

1. Inspect the hydraulic hose for signs of wear (cuts, abrasions, or kinks) to the outer shell material. 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.

2. DO NOT attempt to disconnect the hydraulic hose while it is under pressure.

DO NOT expose hoses to potential hazards, such as extreme heat or cold, sharp surfaces, or heavy impact.

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 that could cause premature failure of the hose and possibly result in injury. Damaged hoses must be replaced immediately.

DO NOT use the hose to move attached equipment.

DO NOT remove the strain reliever from hoses.

3. Hose strain relievers must be placed around hose fittings during use. Hoses with damaged strain relievers must be replaced immediately.

4. Hose material and coupler seals must be compatible with hydraulic fluid that meets the requirements of MIL-PRF-5606.

5. 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.

6. Before operating the PowerPak, make sure all hose connections are tightened securely. DO NOT over-tighten.

7. 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.

Table 3.0-1
MBRA-10 Specifications

Model Number	MBRA-10
Weight	11.7 Pounds
Stroke	3.25”
Mandrel Attachment	5/8”-18 Thread
Nosecap Attachment	1-1/4”-18 Thread
Maximum Pull Force	24,000 Pounds
Minimum Edge Distance	0.65”

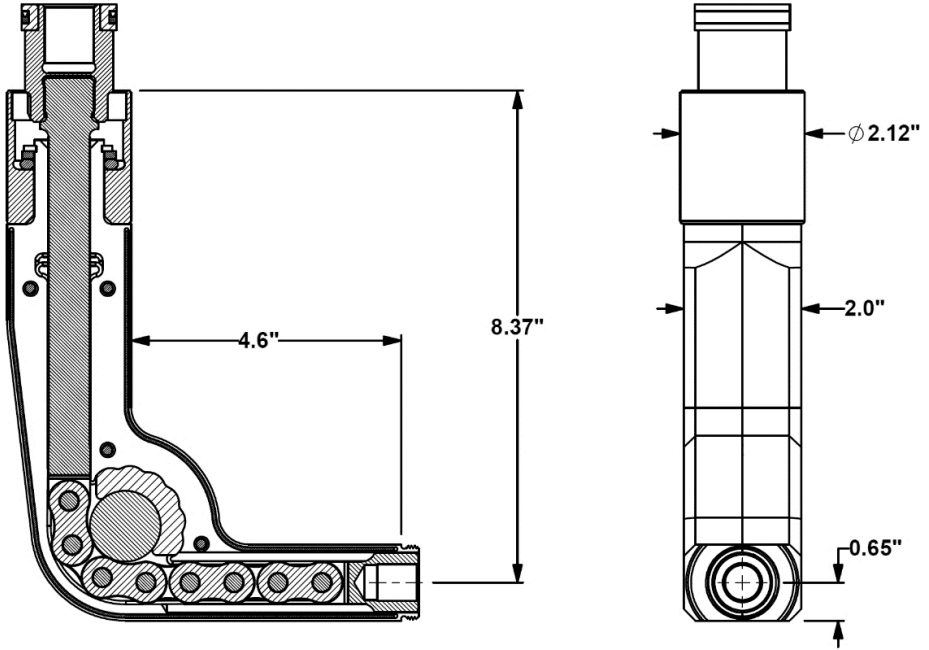

Figure 3.0-1
MBRA-10 Dimensions

Table 3.0-2
MBRA-5 Specifications

Model Number	MBRA-5
Weight	9.7 Pounds
Stroke	1.75”
Mandrel Attachment	5/8”-18 Thread
Nosecap Attachment	1-1/4”-18 Thread
Maximum Pull Force	24,000 Pounds
Minimum Edge Distance	0.65”

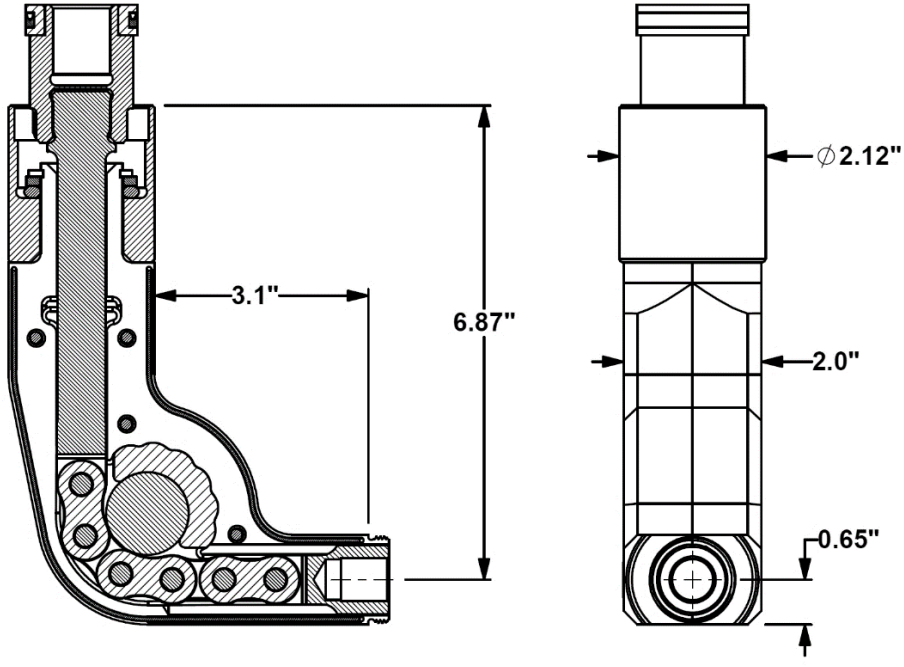

Figure 3.0-2
MBRA-5 Dimensions

Table 4.0-1
CB Mandrels for MBRA-10

STDN Size	Maximum Mandrel Length	Maximum Sleeve Length
18-0-N	CBM-18-0-N-MBRA-23.9-V1	2.39"
18-1-N	CBM-18-1-N-MBRA-23.9-V1	2.39"
18-2-N	CBM-18-2-N-MBRA-23.7-V1	2.37"
18-3-N	CBM-18-3-N-MBRA-23.7-V1	2.37"
20-0-N	CBM-20-0-N-MBRA-23.4-V1	2.34"
20-1-N	CBM-20-1-N-MBRA-23.4-V1	2.34"
20-2-N	CBM-20-2-N-MBRA-23.3-V1	2.33"
20-3-N	CBM-20-3-N-MBRA-23.3-V1	2.33"
22-0-N	CBM-22-0-N-MBRA-23.1-V1	2.31"
22-1-N	CBM-22-1-N-MBRA-23.1-V1	2.31"
22-2-N	CBM-22-2-N-MBRA-23-V1	2.30"
22-3-N	CBM-22-3-N-MBRA-23-V1	2.30"
24-0-N	CBM-24-0-N-MBRA-22.9-V1	2.29"
24-1-N	CBM-24-1-N-MBRA-22.9-V1	2.29"
24-2-N	CBM-24-2-N-MBRA-22.7-V1	2.27"
24-3-N	CBM-24-3-N-MBRA-22.7-V1	2.27"
26-0-N	CBM-26-0-N-MBRA-22.5-V1	2.25"
26-1-N	CBM-26-1-N-MBRA-22.5-V1	2.25"
26-2-N	CBM-26-2-N-MBRA-22.4-V1	2.24"
26-3-N	CBM-26-3-N-MBRA-22.4-V1	2.24"
28-0-N	CBM-28-0-N-MBRA-22.3-V1	2.23"
28-1-N	CBM-28-1-N-MBRA-22.3-V1	2.23"
28-2-N	CBM-28-2-N-MBRA-22.1-V1	2.21"
28-3-N	CBM-28-3-N-MBRA-22.1-V1	2.21"
30-0-N	CBM-30-0-N-MBRA-22-V1	2.20"
30-1-N	CBM-30-1-N-MBRA-22-V1	2.20"
30-2-N	CBM-30-2-N-MBRA-22.3-V1	2.23"
30-3-N	CBM-30-3-N-MBRA-22.3-V1	2.23"

Table 4.0-2
CB Mandrels for MBRA-5

STDN Size	Maximum Mandrel Length	Maximum Sleeve Length
18-0-N	CBM-18-0-N-MBRA-8.9-V1	0.89"
18-1-N	CBM-18-1-N-MBRA-8.9-V1	0.89"
18-2-N	CBM-18-2-N-MBRA-8.7-V1	0.87"
18-3-N	CBM-18-3-N-MBRA-8.7-V1	0.87"
20-0-N	CBM-20-0-N-MBRA-8.4-V1	0.84"
20-1-N	CBM-20-1-N-MBRA-8.4-V1	0.84"
20-2-N	CBM-20-2-N-MBRA-8.3-V1	0.83"
20-3-N	CBM-20-3-N-MBRA-8.3-V1	0.83"
22-0-N	CBM-22-0-N-MBRA-8.1-V1	0.81"
22-1-N	CBM-22-1-N-MBRA-8.1-V1	0.81"
22-2-N	CBM-22-2-N-MBRA-8-V1	0.80"
22-3-N	CBM-22-3-N-MBRA-8-V1	0.80"
24-0-N	CBM-24-0-N-MBRA-7.9-V1	0.79"
24-1-N	CBM-24-1-N-MBRA-7.9-V1	0.79"
24-2-N	CBM-24-2-N-MBRA-7.7-V1	0.77"
24-3-N	CBM-24-3-N-MBRA-7.7-V1	0.77"
26-0-N	CBM-26-0-N-MBRA-7.5-V1	0.75"
26-1-N	CBM-26-1-N-MBRA-7.5-V1	0.75"
26-2-N	CBM-26-2-N-MBRA-7.4-V1	0.74"
26-3-N	CBM-26-3-N-MBRA-7.4-V1	0.74"
28-0-N	CBM-28-0-N-MBRA-7.3-V1	0.73"
28-1-N	CBM-28-1-N-MBRA-7.3-V1	0.73"
28-2-N	CBM-28-2-N-MBRA-7.1-V1	0.71"
28-3-N	CBM-28-3-N-MBRA-7.1-V1	0.71"
30-0-N	CBM-30-0-N-MBRA-7-V1	0.70"
30-1-N	CBM-30-1-N-MBRA-7-V1	0.70"
30-2-N	CBM-30-2-N-MBRA-7.3-V1	0.73"
30-3-N	CBM-30-3-N-MBRA-7.3-V1	0.73"

Table 4.0-3
CA Mandrels for MBRA-10

STDN Size	Maximum Mandrel Length	Maximum Sleeve Length
60	CAM-60-MBRA-24-V2	2.40”
61	CAM-61-MBRA-23.9-V2	2.39”
62	CAM-62-MBRA-23.7-V2	2.37”
63	CAM-63-MBRA-23.6-V2	2.36”
70	CAM-70-MBRA-23.5-V2	2.35”
71	CAM-71-MBRA-23.4-V2	2.34”
72	CAM-72-MBRA-23.3-V2	2.33”
73	CAM-73-MBRA-23.2-V2	2.32”
80	CAM-80-MBRA-23.1-V2	2.31”
81	CAM-81-MBRA-23.1-V2	2.31”
82	CAM-82-MBRA-22.8-V2	2.28”
83	CAM-83-MBRA-22.6-V2	2.26”
90	CAM-90-MBRA-22.5-V2	2.25”
91	CAM-91-MBRA-22.4-V2	2.24”
92	CAM-92-MBRA-22.3-V2	2.23”
93	CAM-93-MBRA-22.2-V2	2.22”
100	CAM-100-MBRA-22.1-V2	2.21”
101	CAM-101-MBRA-22-V2	2.20”
102	CAM-102-MBRA-21.9-V2	2.19”
103	CAM-103-MBRA-21.8-V2	2.18”
110	CAM-110-MBRA-21.7-V2	2.17”
111	CAM-111-MBRA-21.6-V2	2.16”

Table 4.0-4
CA Mandrels for MBRA-5

STDN Size	Maximum Mandrel Length	Maximum Sleeve Length
60	CAM-60-MBRA-9-V2	0.90”
61	CAM-61-MBRA-8.9-V2	0.89”
62	CAM-62-MBRA-8.7-V2	0.87”
63	CAM-63-MBRA-8.6-V2	0.86”
70	CAM-70-MBRA-8.5-V2	0.85”
71	CAM-71-MBRA-8.4-V2	0.84”
72	CAM-72-MBRA-8.3-V2	0.83”
73	CAM-73-MBRA-8.2-V2	0.82”
80	CAM-80-MBRA-8.1-V2	0.81”
81	CAM-81-MBRA-8.1-V2	0.81”
82	CAM-82-MBRA-7.8-V2	0.78”
83	CAM-83-MBRA-7.6-V2	0.76”
90	CAM-90-MBRA-7.5-V2	0.75”
91	CAM-91-MBRA-7.4-V2	0.74”
92	CAM-92-MBRA-7.3-V2	0.73”
93	CAM-93-MBRA-7.2-V2	0.72”
100	CAM-100-MBRA-7.1-V2	0.71”
101	CAM-101-MBRA-7-V2	0.70”
102	CAM-102-MBRA-6.9-V2	0.69”
103	CAM-103-MBRA-6.8-V2	0.68”
110	CAM-110-MBRA-6.7-V2	0.67”
111	CAM-111-MBRA-6.6-V2	0.66”

Figure 4.0-1
MBRA Mandrel

Table 4.0-5
CB Nosecaps

STDN Size	Model Number
16-0-N	CBC-MBRA-160F
16-1-N	CBC-MBRA-161F
16-2-N	CBC-MBRA-162F
16-3-N	CBC-MBRA-163F
18-0-N	CBC-MBRA-180F
18-1-N	CBC-MBRA-181F
18-2-N	CBC-MBRA-182F
18-3-N	CBC-MBRA-183F
20-0-N	CBC-MBRA-200F
20-1-N	CBC-MBRA-201F
20-2-N	CBC-MBRA-202F
20-3-N	CBC-MBRA-203F
22-0-N	CBC-MBRA-220F
22-1-N	CBC-MBRA-221F
22-2-N	CBC-MBRA-222F
22-3-N	CBC-MBRA-223F
24-0-N	CBC-MBRA-240F
24-1-N	CBC-MBRA-241F
24-2-N	CBC-MBRA-242F
24-3-N	CBC-MBRA-243F
26-0-N	CBC-MBRA-260F
26-1-N	CBC-MBRA-261F
26-2-N	CBC-MBRA-262F
26-3-N	CBC-MBRA-263F
28-0-N	CBC-MBRA-280F
28-1-N	CBC-MBRA-281F
28-2-N	CBC-MBRA-282F
28-3-N	CBC-MBRA-283F
30-0-N	CBC-MBRA-300F
30-1-N	CBC-MBRA-301F
30-2-N	CBC-MBRA-302F
30-3-N	CBC-MBRA-303F

Table 4.0-6
CA Nosecaps

STDN Size	Model Number
60	CAC-MBRA-60F
61	CAC-MBRA-61F
62	CAC-MBRA-62F
63	CAC-MBRA-63F
70	CAC-MBRA-70F
71	CAC-MBRA-71F
72	CAC-MBRA-72F
73	CAC-MBRA-73F
80	CAC-MBRA-80F
81	CAC-MBRA-81F
82	CAC-MBRA-82F
83	CAC-MBRA-83F
90	CAC-MBRA-90F
91	CAC-MBRA-91F
92	CAC-MBRA-92F
93	CAC-MBRA-93F
100	CAC-MBRA-100F
101	CAC-MBRA-101F
102	CAC-MBRA-102F
103	CAC-MBRA-103F
110	CAC-MBRA-110F
111	CAC-MBRA-111F

Figure 4.0-2
MBRA Nosecap

SECTION 5.0: ASSEMBLY OF THE MBRA ONTO A MEDIUM BRUTE PULLER

To install an MBRA onto a Medium Brute puller:

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

1. Remove all tooling from the barrel end of the Medium Brute, including the threaded adapter (Figure 5.0-1).

Figure 5.0-1
Medium Brute Puller Unit, Tooling Removed

2. Using a spanner wrench, loosen the lock ring on the back of the Medium Brute and remove the endcap (Figure 5.0-2). A large flat screwdriver fits into the slot on the back of the piston to keep it from rotating.

Figure 5.0-2
Medium Brute Puller Unit, Endcap Removed

3. Extend the inner rod from the back of the MBRA, push the seal into the barrel, and thread the adapter onto the piston rod (Figure 5.0-3). Tighten securely while using a large flat screwdriver on the back of the Medium Brute to keep the piston from rotating.

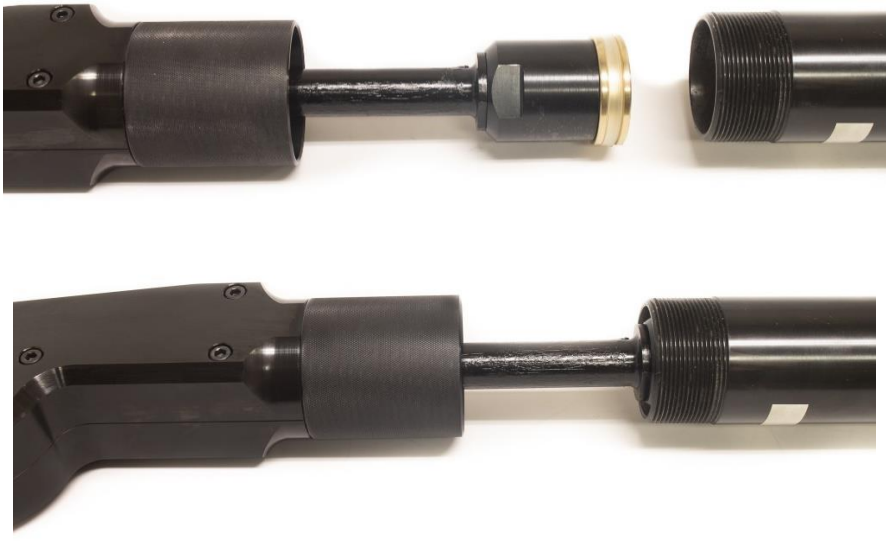

Figure 5.0-3
MBRA, Rod Threaded

4. Re-install the Medium Brute endcap and tighten the lock ring securely with a pinwrench. THE ENDCAP MUST BE IN PLACE DURING OPERATION. Thread the outer collar of the MBRA onto the barrel of the Medium Brute (Figure 5.0-4). The installation is now complete.

Figure 5.0-4
MBRA, Installation Completed

SECTION 6.0: ASSEMBLY AND MAINTENANCE

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

Refer to Figure 7.0-1 for identification of the components.

6. 1 Disassembly

1. To disassemble the MBRA, first remove it from the Medium Brute. If a nosecap is mounted, take it off as well.

2. Remove the adapter (13).

3. Remove the retaining ring (8) using retaining ring pliers (Figure 6.1-1). The knurled collar (6) can now be removed along with the o-ring (10) and washer (9).

Figure 6.1-1
Retaining Ring Removal

4. Remove the four screws in the left half of the housing. The left housing can now be removed and the internal parts accessed for maintenance.

6.2 Cleaning and Lubrication

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

1. Periodically clean the outer surfaces of the unit.

2. The internal moving parts should be periodically lubricated with Mobil-HP or equivalent grease to ensure smooth operation and extend the life of the unit (Figure 6.2-1).

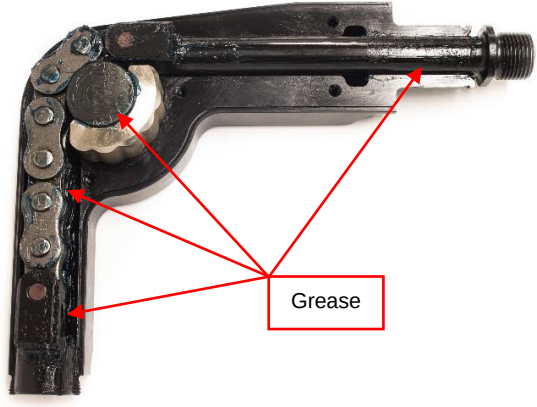

Figure 6.2-1
Greased Internals

3. Whenever the puller unit is to be stored for any length of time, maintain a thin coat of 10-weight oil on the outside surfaces to prevent rusting.

6.3 Replacing Parts/Repair

If parts need replacing or the unit needs repair, please contact FTI's Sales Department. FTI will work with the operator to try to troubleshoot over the phone, but a return of the MBRA unit may be required.

7.4 Reassembly

1. Replace all internal components into the right half housing.
2. Attach the left housing half using the four screws.
3. Install the knurled collar (6), followed by the o-ring (10) and washer (9). Ensure that the o-ring and washer are fully seated all the way down.
4. Install the retaining ring (8) using retaining ring pliers. The o-ring must be compressed to fit the retaining ring on, so it may be necessary to tap the retaining ring with a blunt pin until the ring is fully snapped into the groove.

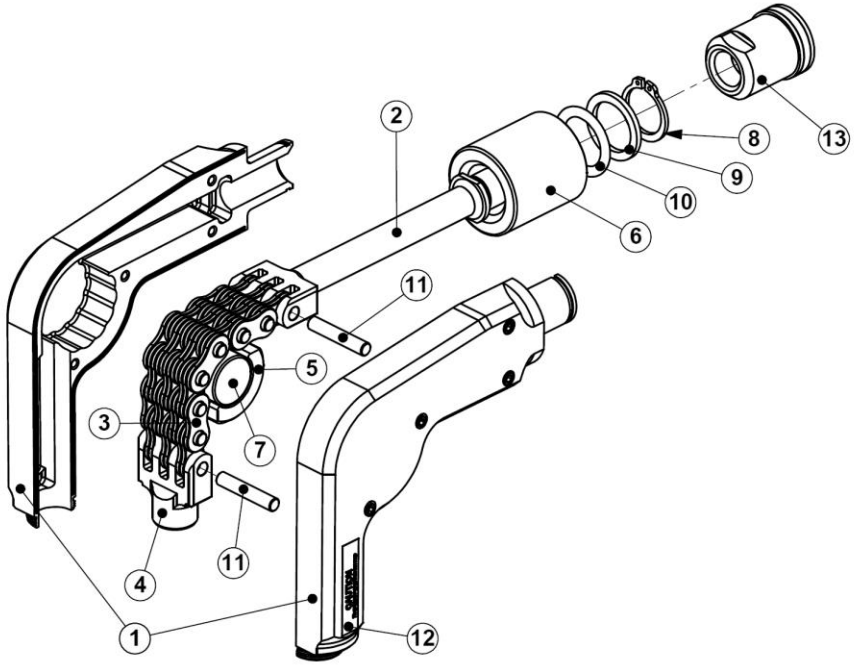

Figure 7.0-1
MBRA Illustrated Parts Breakdown

Table 7.0-1
MBRA-10 Parts List

Item Number	Quantity	Part Number	Description
1	1	60103-001	Housing Sub-Assembly
2	1	60094-001	Puller Clevis
3	1	5305-003	Chain
4	1	60093-001	Mandrel Clevis
5	1	60106-001	Roller Bushing
6	1	60091-001	Knurled Collar
7	1	60090-001	Roller
8	1	1199-529	External Retaining Ring
9	1	60095-001	Washer
10	1	1199-530	O-Ring
11	2	6915-002	Clevis Pin
12	1	1009-185	Caution Sticker
13	1	60097-001	Threaded Adapter
14	1	1199-561	Case
15	1	1361-001	Foam Set
16	1	1199-562	3/4” Wrench
17	1	1199-563	1-1/4” Wrench
18	1	1009-280	FTI Sticker
19	1	1009-319	MBRA-10 Sticker

Table 7.0-2
MBRA-5 Parts List

Item Number	Quantity	Part Number	Description
1	1	60103-002	Housing Sub-Assembly
2	1	60094-002	Puller Clevis
3	1	5305-004	Chain
4	1	60093-001	Mandrel Clevis
5	1	60106-001	Roller Bushing
6	1	60091-001	Knurled Collar
7	1	60090-001	Roller
8	1	1199-529	External Retaining Ring
9	1	60095-001	Washer
10	1	1199-530	O-Ring
11	2	6915-002	Clevis Pin
12	1	1009-185	Caution Sticker
13	1	60097-001	Threaded Adapter
14	1	1199-561	Case
15	1	1361-002	Foam Set
16	1	1199-562	3/4” Wrench
17	1	1199-563	1-1/4” Wrench
18	1	1009-280	FTI Sticker
19	1	1009-318	MBRA-5 Sticker

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