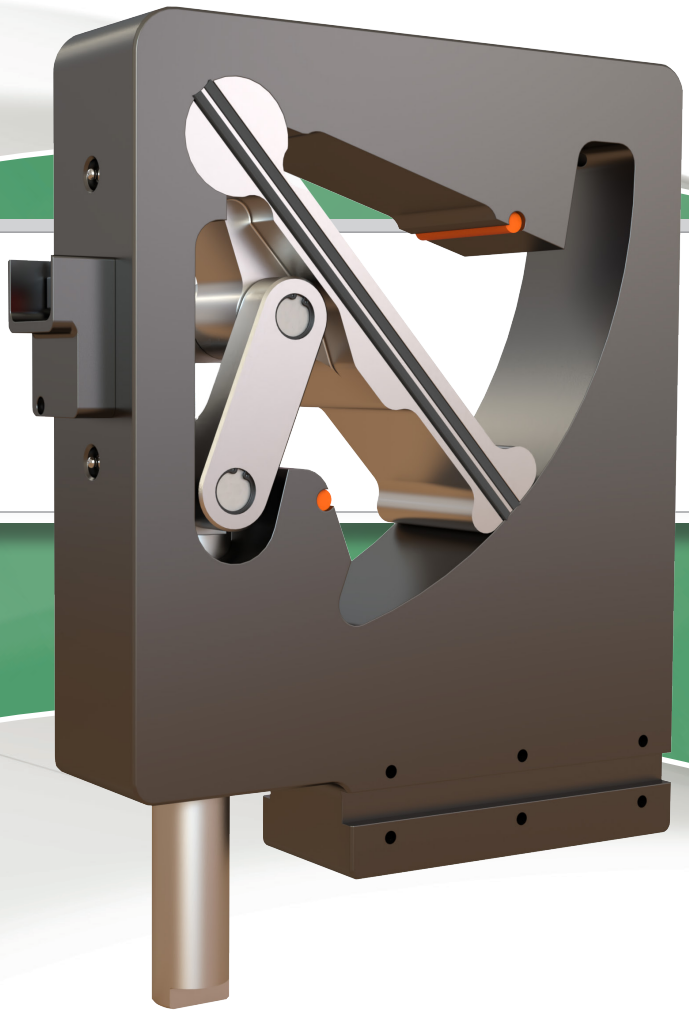
Air Toggle Presses

Set-Up & Maintenance Guide



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SET-UP & MAINTENANCE GUIDE

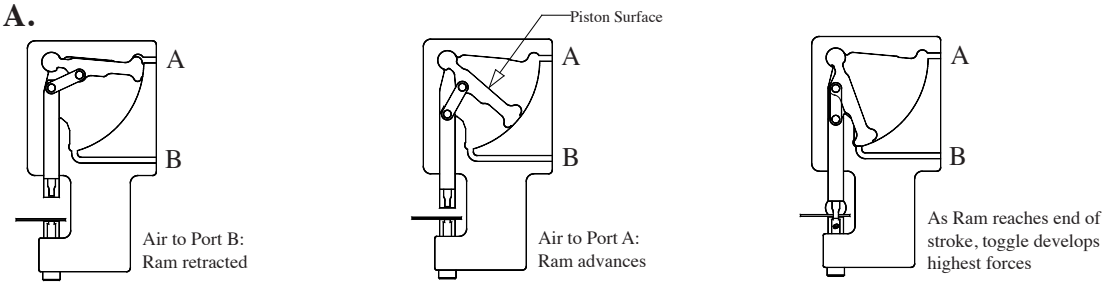
Safety:

User's Responsibility: Each person who is to operate and maintain the unit must be familiar with all safety precautions before attempting to use or service the press equipment. The owner of the machine is responsible to train and supervise all personnel as to safety precautions. The customer must provide proper guarding to protect personnel from moving machinery.

1.0 How It Works:

The BTM Toggle Press produces high forces using 80 psi air pressure. The toggle mechanism multiplies the force of the air pressure acting on the piston surface. **Force is generated on a curve**; as the press ram advances force output increases, with maximum force produced at the end of the stroke. (Figure A.)

Figure A.



1.1 Press Sizing:

Accurate calculation of the *required force* and *work stroke* is necessary in order to perform the work without over-taxing the press. Calculating force for piercing and shearing is relatively straightforward. Calculations for operations such as coining, crimping, clinching and riveting can be more complex, requiring special formulas and/or tryout. BTM Sales Department offers assistance in press sizing. Call BTM at +1.810.364.4567 for information. Chart **1.5** shows *calculated* forces at incremental distances from the end of the stroke for each BTM press model. This chart is to be used with your force calculation and work stroke requirement to select the appropriate press model.

1.2 Determining Work Stroke Required:

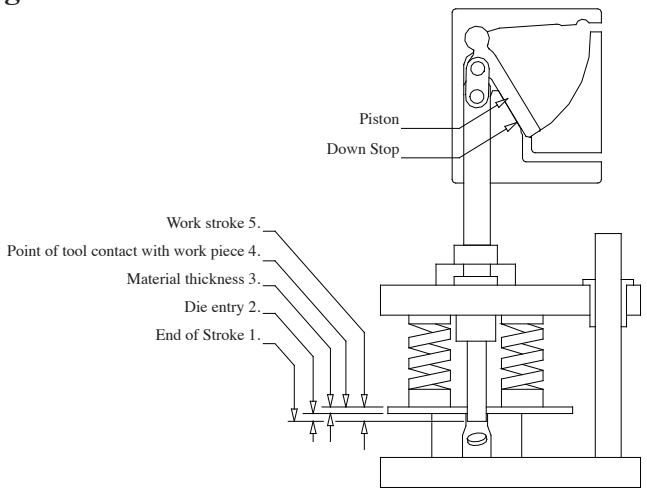
Work Stroke is figured backwards from the fully extended end of the press stroke (piston on down stop). (Figure B.)

1. End of Stroke
2. Entry of the punch into the die beyond the work piece.
3. Material Thickness
4. Point of tool contact with work piece.
5. Distance from point of tool contact with work piece to end of full stroke = work stroke.

Example:

2.	Material Thickness	= .036" (.91 mm)
3.	Punch Penetration	+ .030" (.76 mm)
4.	Work Stroke	= .066" (1.68 mm)

Figure B.



1.3 Force Calculation:

The example below demonstrates press sizing based on *piercing* force requirements and is useful for other operations as well. Several factors must be considered, including the shear strength and thickness of the material to be pierced, length of cut of the pierced hole, and the amount of punch entry or work stroke. Shear strength values for a variety of materials are provided in chart **1.7** for your convenience. BTM recommends adding a *50% safety factor* to the force requirement calculation to compensate for other variables such as friction, die springs, dull cutting tools, lifting of dies (see **3.7**) and operating pressure fluctuations.

A.	Shear Strength of Material	= _____
B.	Thickness of Material	= _____
C.	Length of Cut (circumference)	= _____
Multiply AxBxCx1.5 (Safety Factor)		=Force Output Required

Example: *Force output required to pierce a .25" (6.4mm) diameter hole in .036" (.9mm) thick steel mild low carbon.*

A.	Material Shear Strength (chart **1.7**)	=50,000 psi	(344.7N/mm^2)
B.	Material Thickness	=.036"	(.9mm)
C.	Length of cut (.25" diameter hole) (formula = diameter x Pi)	=.78"	(19.8mm)
Multiply (AxBxC) & add 50% safety factor (x1.5)		=2106 lbs.	(9215N)

Press Force Output Required at the point where tooling contacts the work piece.

1.4 Press Selection:

After determining the force required with safety factor, the work stroke must be considered in selecting the appropriate press model. Use chart **1.5** to verify that the press you are considering produces the required force at the distance from the end of the stroke where your tooling will contact the work piece. If it does not, a larger press is required. *In the example provided in* **1.2** *(work stroke .66" (1.68mm))* **& 1.3**, *a 2 Ton BTM Toggle Press (force output required 2106# (9215N)) would be an appropriate choice to perform the piercing operation.*

1.5 BTM Toggle Press Force Chart (1.5):

This chart lists forces exerted by the press ram at incremental distances from the end of the stroke. Note that the toggle mechanism develops a force curve (Figure C.), with force increasing as the ram advances. All forces are rated at 80 psi (5.5 bars) air pressure to the BTM press.

Figure C.

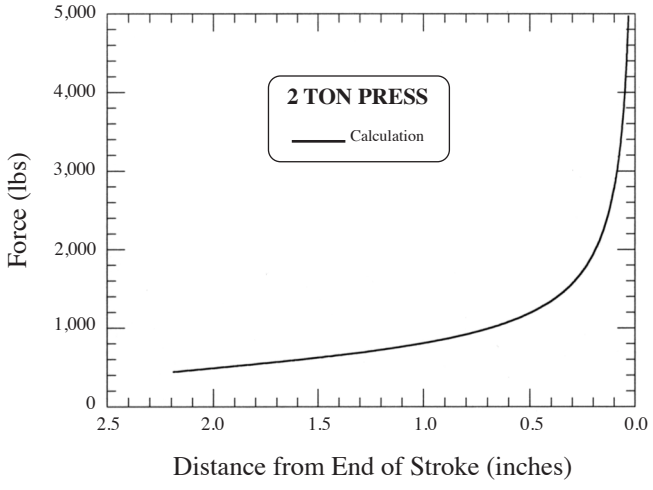


Chart 1.5 Force at Stroke Distance

Note: All values in the force chart are calculated and do not include safety factor.

Distance from End of Stroke	BTM Press Model					
	1 Ton	2 Ton	5 Ton	10 Ton	20 Ton	40 Ton
	Force output in pounds and Newtons at 80 psi (5.5 bar)					
.00" .00mm						
.01" 0.25 mm	4483 19,941	8965 39,878	22526 100,201	45053 200,406	122515 544,974	245031 1,089,952
.02" .05 mm	3161 14,061	6321 28,117	15906 70,753	31812 141,507	86297 383,866	172593 767,737
.03" 0.75 mm	2572 11,441	5145 22,886	12960 57,649	25920 115,298	70255 312,510	150509 625,015
.06" 1.5 mm	1804 8,025	3609 16,054	9113 40,537	18225 81,069	49357 219,551	98714 439,102
.12" 3.0 mm	1261 5,609	2523 11,223	6392 28,433	12785 56,870	34594 153,882	69188 307,763
.24" 6.1 mm	878 3,906	1755 7,807	4466 19,866	8933 39,736	24171 107,518	48341 215,031
.50" 12.7 mm	593 2,638	1186 5,276	3041 13,527	6082 27,054	16457 73,204	32914 146,409
.75" 19.0 mm	474 2,108	949 4,221	2452 10,907	4903 21,810	13268 59,019	26536 118,038
1.00" 25.4 mm	402 1,788	804 3,576	2100 9,341	4200 18,683	11364 50,550	22728 101,099
1.25" 31.75 mm	351 1,561	701 3,118	1859 8,269	3717 16,534	10059 44,745	20118 89,489
1.50" 38.1 mm	310 1,379	621 2,762	1679 7,469	3359 14,942	9089 40,430	18178 80,860
1.75" 44.45 mm	276 1,228	552 2,455	1539 6,846	3077 13,687	8326 37,036	16653 74,076
2.00" 50.8 mm	244 1,085	487 2,166	1423 6,330	2847 12,664	7703 34,265	15406 68,529
2.25" 57.15 mm	–	–	1326 5,898	2652 11,797	7176 31,920	14352 63,841
2.50" 63.5 mm	–	–	1242 5,525	2483 11,045	6719 29,888	13438 59,775
3.00" 76.2 mm	–	–	1099 4,889	2197 9,773	5945 26,445	11890 52,889
3.50" 88.9 mm	–	–	976 4,341	1952 8,683	5282 23,495	10565 46,995
4.00" 101.6 mm	–	–	863 3,839	1725 7,673	4669 20,769	9337 41,533
4.50" 114.3 mm	–	–	749 3,332	1497 6,659	4051 18,020	8103 36,925

Chart 1.6 Force Required to Pierce Holes

*Without Safety Factor

Metal Thickness	Hole Diameters							
	.125" 3.0mm	.250" 6.0mm	.375" 9.0mm	.500" 12.0mm	.625" 15.0mm	.750" 21.0mm	.875" 21.0mm	1.000" 25.0mm
	Force In Tons & KiloNewtons Required For Piercing Round Holes In Mild Steel*							
.020" 0.5 mm	.22 2.0	.45 4.0	.7 6.20	.8 7.1	.95 8.5	1.25 11.1	1.5 13.3	1.65 14.7
.030" 0.7 mm	.3 2.7	.6 5.3	.9 8.0	1.2 10.7	1.5 13.3	1.8 16.0	2.1 18.7	2.4 21.4
.040" 1.0 mm	.45 4.0	.82 7.3	1.25 11.1	1.65 14.7	2.1 18.7	2.45 21.8	2.9 25.8	3.2 28.5
.050" 1.2 mm	.52 4.6	1.00 8.9	1.5 13.3	2.0 17.8	2.45 21.8	2.9 25.8	3.4 30.2	3.9 34.7
.060" 1.5 mm	.6 5.3	1.2 10.7	1.8 16.0	2.36 21.0	2.95 26.2	3.54 31.5	4.13 36.7	4.72 42.0
.070" 1.7 mm	.7 6.2	1.45 12.9	2.0 17.8	2.8 24.9	3.5 31.1	4.2 37.4	4.9 43.6	5.5 48.9
.100" 2.5 mm	1.0 8.9	2.0 17.8	3.0 26.7	4.0 35.6	5.0 44.5	6.0 53.4	7.0 62.3	8.0 71.2
.150" 3.7 mm	–	3.0 26.7	4.5 40.0	6.0 53.4	7.5 66.7	9.1 81.0	10.5 93.4	12.2 108.5
.250" 6.0mm	–	4.9 43.6	7.4 65.8	9.8 87.2	12.3 109.4	14.7 130.8	17.2 153.0	19.7 175.3
.500" 12.0 m	–	–	–	19.7 175.3	24.6 218.8	29.5 262.4	34.4 306.0	39.4 350.5

1.6 Piercing Force Requirements:

This chart shows the force required to pierce round holes (of various diameters) in mild steel (of various thickness.) A 50% safety factor should be added to these numbers when sizing your press.

1.7 Piercing Materials Other Than Mild Steel:

Piercing force required for material other than mild steel can be calculated using the rated shear strength (chart **1.7**) and the formula given at **1.3.** The chart **1.7** provides shear strength & multiplication factors for other common materials. Multiply the factor for your material by the force shown in chart **1.6.**

Example:
Piercing a .500" (12mm) hole in .050" (1.2mm) mild steel requires 2 Tons. To pierce the same hole in the same thickness of Aluminum 1060-0 multiply 2 Tons x .14 (chart **1.7**) = .28 Ton.

Chart 1.7 Material Strengths

Material	Multiplication Factor	Shear Strength			
Aluminum 1060-0	.14	7,000	psi	48.26	N/mm²
Nylon	.24	12,000	psi	82.74	N/mm²
Copper	.52	26,000	psi	179.26	N/mm²
Aluminum 2011-T3	.64	32,000	psi	220.63	N/mm²
Brass	.72	36,000	psi	248.21	N/mm²
Aluminum 2014-T6	.84	42,000	psi	289.58	N/mm²
Steel Mild Low Carbon	1.00	50,000	psi	344.74	N/mm²
Steel Stainless 409	1.30	65,000	psi	448.16	N/mm²
Steel Stainless 304 L	1.62	81,000	psi	558.47	N/mm²
Steel Stainless 321	1.66	83,000	psi	572.26	N/mm²

2.0 Press Specifications:

BTM Toggle Press bodies are made from 6061-T6 Aluminum (45,000 psi tensile strength) and are hard coat anodized to a Rockwell C70 surface hardness. Pistons, links, pins, and rams are steel. Piston seals are molded V block style.

2.1 Tolerances:

The following are tolerances that can be expected for the dimensions given in this catalog (unless specified otherwise):

2 place decimal (.00).....+/-.010" (+/-0.25m)
3 place decimal (.000)..... +/-.005" (+/-0.13mm)
4 place decimal (.0000)..... +/-.0005" (+/-0.01mm)
Ram rotation..... +/-15'

2.2 Air Consumption
BTM Press Volume Chart:

Volume is shown in cubic inches and cubic centimeters per full cycle.

Amount of Stroke in Use	BTM Press Model					
	1 Ton	2 Ton	5 Ton	10 Ton	20 Ton	40 Ton
.03" 0.75 mm	4.8 78.7	9.6 157.4	18.8 308.1	37.6 616.2	310.0 5080.0	620.0 10160.0
.06" 1.5 mm	6.6 108.2	13.2 216.4	37.4 612.9	74.8 1225.8	378.8 6207.4	757.6 12414.8
.12" 3.0 mm	9.2 150.8	18.4 301.6	56.2 921.0	112.4 1842.0	447.8 7338.1	895.6 14676.2
.24" 6.1 mm	12.2 199.9	24.4 399.8	65.4 1071.7	130.8 2143.4	585.4 9593.0	1170.8 19186.0
.50" 12.7 mm	18.4 301.5	36.8 603.0	84.2 1379.8	168.4 2759.6	723.2 11851.1	1446.4 23702.2
.75" 19.0 mm	22.0 360.5	44.0 721.0	103.0 1687.9	206.0 3375.8	826.6 13545.5	1653.2 27091.0
1.00" 25.4 mm	25.8 422.8	51.6 845.6	121.6 1992.7	243.2 3985.4	929.8 15236.7	1859.6 30473.4
1.25" 31.75 mm	29.0 475.2	58.0 950.4	131.0 2146.7	262.0 4293.0	1033.2 16931.1	2066.4 33862.2
1.50" 38.1 mm	31.8 521.1	63.6 1042.2	149.6 2451.5	299.2 4903.0	1067.6 17494.8	2135.2 3498.6
1.75" 44.45 mm	34.4 563.7	68.8 1127.4	168.4 2759.6	336.8 5519.2	1102.0 18058.5	2204.0 36117.0
2.00" 50.8 mm	37.6 616.2	75.2 1232.4	177.6 2910.3	355.2 5820.6	1171.0 19189.2	2342.0 38378.4
2.25" 57.15 mm	39.8 652.2	79.6 1304.4	187.0 3064.4	374.0 6128.8	1205.4 19753.0	2410.8 39506.0
2.50" 63.5 mm	–	–	196.4 3218.4	392.8 6436.8	1239.8 20316.7	2479.6 40633.4
3.00" 76.2 mm	–	–	205.8 3372.5	411.6 6745.0	1274.2 20880.4	2548.4 41760.8
3.50" 88.9 mm	–	–	215.2 3526.5	430.4 7053.0	1355.2 22207.7	2710.4 44415.4
4.00" 101.6 mm	–	–	224.4 3677.3	488.8 7354.6	1412.0 23138.5	2824.0 46277.0
4.50" 114.3 mm	–	–	261.8 4290.1	523.6 8580.2	1549.8 25396.7	3099.6 50793.4

2.2.1 Calculating Air Consumption:

To determine air consumption in cubic feet or liters per minute use the following formula. Metric versions shown in green.

Formula:

$$CFM = \frac{\text{Press volume x cycles / min}}{1728}$$

$$SCFM = \frac{(14.7 + \text{pressure})}{14.7} \text{ x CFM}$$

Air Volume = press volume x cycles / min

$$\text{Consumption} = \frac{1+ \text{pressure}}{1} \text{ x press volume}$$

Example: 1 ton press with 1.5" (38 mm) stroke
volume = 31.8 in^3 (521.1 cm^3) (Chart **2.2**)
60 cycles / minute
at 80 psi (5.5 bar)

Solution:

$$SCFM = \frac{14.7 + 80}{14.7} \text{ x } \frac{31.8 \text{ x } 60 \text{ cycles / min.}}{1728}$$

SCFM = 7.1

$$\text{Litres / Min} = \frac{1 + 5.5}{1} \text{ x } 0.521 \text{ } dm^3 \text{ x } 60 \text{ cycles / min}$$

Litres / Min = 203

Note: BTM Presses may be ordered with stroke limiters to reduce air consumption. See catalog for your model.

2.3 Air & Valving Requirements:

BTM Toggle Presses are operated by compressed air. The recommended maximum pressure is 80 psi (5.5 bars). Air must be clean, dry and lubricated with a light spindle oil. Valving and piping should be greater than or equal to the press ports, or determined by the air requirements of the total number of presses when multiple presses are piped together. A Filter, Regulator, Lubricator (FRL) must be used to condition the air.

2.4 Surge Tank Sizing:

A surge tank is recommended when operating a 20 or 40 ton press, when piping multiple presses together or when a press is used in an air starved environment. Air supply lines must be adequately sized. (**See 2.3**.) Use the following formula to determine surge tank size:

Formula: $\frac{\text{Press volume in cubic inches (See Chart 2.2)} \times (14.7 + \text{Operating Pressure})}{14.7} \div 231 = \text{Surge Tank volume in Gallons}$

$\frac{\text{Press Volume in cubic centimeters (See Chart 2.2)} \times (1 + \text{Operating Pressure})}{1} \div 1000 = \text{Surge Tank volume in Litres}$

Example:

20 Ton Press x 4.5" (114.3mm) Stroke
Volume = 1549.8 in^3 (25396.7c.c) (Chart **2.2**)
Operating Pressure = 80 psi (5.5 bar)

Solution:

$\frac{1549.8 \times (14.7 + 80)}{14.7} \div 231 = 43$ Gallon Surge Tank

$\frac{25396.7 \times (1+5.5)}{1} \div 1000 = 163$ Litre Surge Tank

3.0 Application of BTM Toggle Presses:

Sound engineering principles should be adhered to when tooling and mounting BTM presses. Some guidelines follow.

3.1 Press Set-Up:

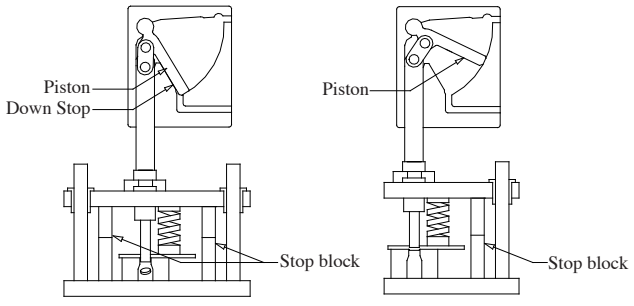
To attain maximum life from an Air Toggle Press, the work must be performed as near the end of the stroke as possible. *In all applications, the press must complete its stroke*. In piercing or shearing applications, the work will be performed above the end of the stroke and the tooling will continue through the work piece to complete the stroke. In other operations such as coining, clinching and riveting, the tooling must be adjusted so that the press reaches the end of the stroke as the work is completed. (Figure D.) *No hesitation of the ram is permissible during the work stroke*.

The recommended method of set-up is to adjust the tooling back so that the press can be fully cycled without contacting the work piece. A series of gradual adjustments are then made using 80 psi (5.5 bar) supply pressure, until the press completes the work. If the press hesitates or stalls above the bottom of the stroke using this method, it is undersized for the operation.

3.2 Stop Blocks:

When using stop blocks in a die, the press piston must be allowed to reach the internal stop. Stop blocks must be set-up so that the press completes the work and contacts the stop blocks when the piston meets the internal stop. The stop blocks are only required to balance the force being applied to the work piece. If installed incorrectly, the stop blocks and press mechanism will absorb the force meant to be applied to the work piece. (Figure D.)

Figure D.



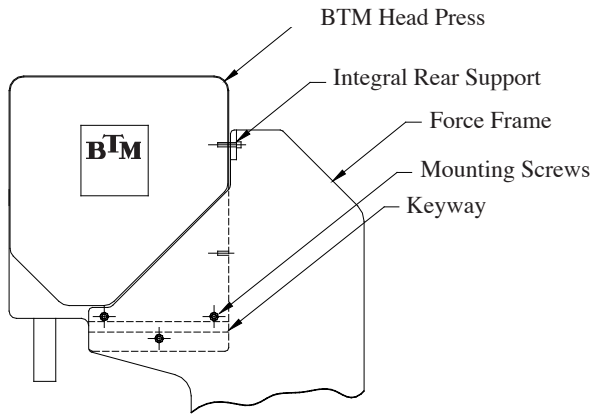
3.3 Press Mounting:

The BTM Air Toggle Press produces high forces which must be contained by the press mounting to ensure maximum life. When constructing force frames for press mounting, rigidity is essential to minimize deflection of the press ram.

Head model (H) presses must be mounted so that both keyways are in direct shear and directly tied to an integral rear support and frame. (Figure E.)

Figure E.

BTM Head "H" Presses



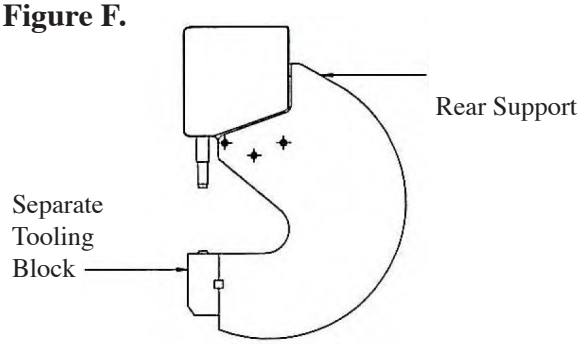
3.4 Throat Depth:

Designs incorporating deep throats must have sufficient force frames to inhibit deflection at the tooling. It is recommended that the tooling be mounted in a separate block affixed to the frame to provide final alignment. (Figure F.)

3.5 Anti-Rotation & Guides:

BTM Toggle Presses feature a ± 15' non-rotating ram. The method of mounting tooling to the ram can affect the life and performance of the press and tooling. Alignment of the tooling and containment of the deflection are imperative. In critical applications, usually where die clearance is less than .0005" (0.012mm) per side, it is recommended that an alignment guide be used. Sliding ways or posts and bushings are good techniques for this purpose.

Figure F.



3.6 Shut Height Adjustment:

Various methods of shut height adjustment are provided with standard BTM components. Rams with built-in adjusting screws (PA & PTA), adjustable die button support (PB models) and die set adapter groups (DSAG) are listed in catalog.

3.7 Lifting With The Toggle Press:

Force produced when retracting the toggle press is reverse of the force curve. However, certain long stroke presses will not perform in accordance with the force curve near the retracted position. Consult BTM when considering the lifting of large tools with the retract stroke.

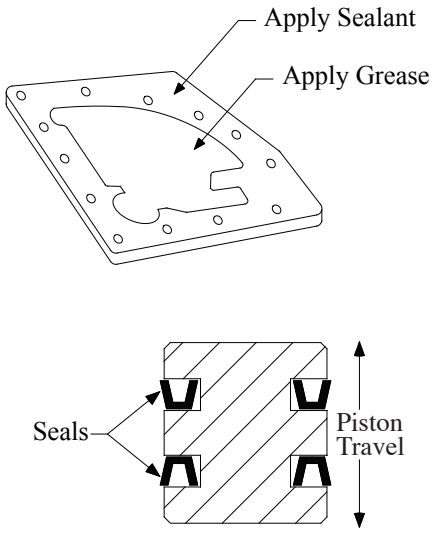
4.0 Maintenance:

Properly sized and applied, BTM Toggle Presses will provide a long service life. They require only regular lubrication and a clean, dry air supply. After extended service, seal replacement may be necessary. This is a relatively simple procedure and is outlined in **4.2.**

4.1 Lubrication:

The BTM Air Toggle Press is a mechanical device using air as its power source and therefore requires clean, dry air. A filter and pressure regulator must be incorporated into the air supply line. Light in-line lubrication is also recommended, but not required, as press seals are lubed for life at assembly. When incorporating in-line lubrication, use a light spindle oil in the lubricator (a reclassifier is also recommended). Lubrication is required every 20,000 cycles at grease fittings only. See lube tags on front of press assembly for specific lubrication instructions. Grease fittings are provided to lubricate the bearing and link pin areas on most presses. Use Chevron Black Pearl Grease EP or Phillips 66 Polytak Grease EP at grease fittings. **Note:** Failure to follow recommended lubrication procedures will void warranty. A video is available upon request detailing general press maintenance and seal replacement procedures.

Figure G.



4.2 Seal Replacement:

Refer to the catalog page showing your press model to order seal kit.

4.2.1 Loosen all the cover plate nuts by two threads only. Apply air to either port (80 psi (5.5 bar) maximum). This will separate one of the cover plates from the press body.

4.2.2 Remove all the cover plates screws & nuts, and the cover plate. The opposite cover plate will usually remain sealed to the body, and may be tapped loose using a wood block and a mallet. Remove the second cover plate.

4.2.3 Position the press body with the ram horizontal to prevent the ram from falling out when the link pin is removed. Remove the retainer ring from the ram link pin. The link pins on P-1 models are pressed into one side of the link and do not have retaining rings. Tap the link pin out and slide the ram out of the body.

4.2.4 Remove the piston and link from the body, and remove the old seals from the piston.

4.2.5 Remove the ram O-Ring from the body. The O-Ring on PB models is located on the ram.

4.2.6 Clean all parts. Inspect all parts for signs of wear or damage.

4.2.7 Check the cover plates to see if a "pencil" outline of the press cavity is visible. (Figure G.) If it is not, align the cover plates with the body and outline the contour with a pencil. Repeat procedure on second cover plate.

4.2.8 Install new piston seals with "V" grooves facing the powered surfaces of the piston. (Figure G.)(opposite each other)

4.2.9 Install new ram O-Ring.

4.2.10 Grease and re-assemble the piston, link and ram into the press body.

4.2.11 Apply a thin layer of grease to the area of the cover plates inside the "pencil" line. Apply a thin layer of SIKAFLEX* Sealant to the area outside the "pencil" line. (Figure G.) Do not apply sealant inside the line.

4.2.12 Assemble the cover plates to the press and torque screws according to the chart in (Figure H). Make sure all threads are free of sealant. A slight bypass of air is normal due to the rectangular seals.

Figure H. Cover Screw Size & Torque

	1 & 2 Ton		5 & 10 Ton	20 & 40 Ton
Screw Size	1/4	5/16	3/8	1/2
Torque in Ft / Lbs	9	23	50	110
Torque in N • m	12.2	31.2	67.8	149.0

*** Note Regarding Sealant**

BTM Air Toggle Presses manufactured after August 2001 use polyurethane sealant to seal the side cover plates. A tube of SIKAFLEX 221 is included with each BTM Seal Kit. Presses manufactured before August 2001 were sealed with RTV-108 silicone sealant. Silicone is no longer provided with BTM Seal Kits. Presses that were originally sealed with silicone can be re-sealed with SIKAFLEX 221.

4.3 Replacing Components:

Worn or damaged component parts may be replaced following the same procedure described in 4.2. Components are listed in the catalog for each model. Presses may be returned to BTM for factory repair.

WARRANTY

BTM warranties its Air Toggle Presses against defects in material and workmanship for (1) million cycles or a period of (1) year after the ship date from BTM, whichever comes first. This warranty is limited to replacing or repairing at BTM option, F.O.B. BTM factory, any part found by BTM to be defective in materials and/or workmanship. Any application of a BTM product outside the intended use of the product or non-compliant with the application guidelines in this catalog shall not be warranted by BTM. Furthermore, BTM will not be liable for any expenses incurred for repairs or replacement made outside BTM facilities without written consent (or damages arising out of such replacements or repairs). Under no circumstances will BTM be held responsible for any consequential damages. The warranty is limited to the repair or replacement of the defective part(s) and does not include installation. This warranty is the only warranty extended by the seller in connection with any sale made hereunder and is in lieu of all other warranties, express, implied or statutory including warranties of merchant-ability and fitness for purpose.

BTM COMPANY

BTM Offers a Range of Production Equipment for Applying our Clinch Tooling.

Hand-Held Units

BTM hand-held units are an economical approach to fastening sheet metal assemblies. Pneumatic, Hydraulic, and Self-Contained Units in a variety of styles are available. The units can be set up to join a range of thicknesses.

Die Sets

Clinch tooling can be inexpensively designed into single or compound motion die set packages.

Universal Presses

Universal presses easily adapt to join a variety of parts.

Special Fixtures

Manually loaded and unloaded dedicated tooling can be built for a single part or a family of parts.

Specialized Units

BTM provides pneumatic, hydraulic, air/oil, and electrically driven units with single or dual motions for both stationary and robotic applications.

Special Systems

Achieve faster cycle times with automatic part transfer and by combining processes.

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