





# molex®

**Mini-Mac**  
**Semi-Automatic Wire Termination Applicator**  
**Order Number 63800-0100**  
**Operation Manual**









- Description
- Operation
- Maintenance

## Safety Warnings and Information

	<p><b>Read and understand</b> all of the instructions and safety information in this manual before operating or servicing this tool.</p> <p style="text-align: center;"><u>Keep this manual available when using this tool.</u></p> <p>Replacement manuals are available for download at no charge at <a href="http://www.molex.com">www.molex.com</a>.</p>
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<b>SAFETY ALERT SYMBOL</b>	
<p>This symbol is used to call your attention to hazards or unsafe practices which could result in an injury or property damage. The signal word, defined below, indicates the severity of the hazard. The message after the signal word provides information for preventing or avoiding the hazard.</p>	
 <b>DANGER</b>	<p><b>DANGER:</b> Indicates an imminently hazardous situation which, if not avoided, could result in death or serious injury.</p>
 <b>WARNING</b>	<p><b>WARNING:</b> Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.</p>
 <b>CAUTION</b>	<p><b>CAUTION:</b> Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. <b>CAUTION</b> may also be used to alert against unsafe practices associated with events that could lead to personal injury.</p>

	<p> <b>WARNING</b></p> <p><b>Always</b> wear proper eye protection when Operating or servicing this equipment.</p> <p>Failure to wear eye protection could result in serious eye injury from flying debris.</p>		<p> <b>WARNING</b></p> <p><b>Heavy Object</b> To avoid muscle strain or back injury, use lifting aids and proper lifting techniques when removing or replacing.</p> <p>Failure to observe these precautions may result in injury or property damage.</p>
	<p> <b>WARNING</b></p> <p><b>Never</b> wear clothing or jewelry that is loose or That could potentially hang into the equipment and get caught.</p> <p>Failure to observe this warning could result in Severe Injury or death.</p>		<p> <b>WARNING</b></p> <p><b>Never</b> install or service this machine while connected to any electrical power source. Disconnect power by unplugging the press from its power source.</p> <p>Failure to observe this warning could result In severe injury or death.</p>
	<p> <b>WARNING</b></p> <p><b>Never</b> operate, service, install, or adjust this machine without proper instruction and without first reading and understanding the instructions in this manual and all applicable press and/or wire processing machine manuals.</p>		<p> <b>WARNING</b></p> <p><b>Always</b> hand cycle the applicator in the equipment to ensure the tooling is properly aligned.</p> <p>Failure to observe these precautions may result in Injury or property damage.</p>

	 <b>WARNING</b>  <b>Never</b> use this press or wire processing machine without guards or safety devices that are intended to prevent hands from remaining in the die space.  Failure to observe this warning could result in Severe injury or death.	 <b>WARNING</b>    <b>Do not use</b> compressed air to clean this equipment. The forces created by compressed air can force debris into the tool.  Failure to observe these precautions may result in injury or property damage.
	 <b>WARNING</b>  <b>Always</b> wear proper ear protection when Operating or servicing this applicator.	
 <b>CAUTION</b>  The Molex applicators are designed to operate in presses with standard shut heights of 135.80mm (5.346"). Installation in crimp presses with other than standard shut heights can cause severe tool breakage. It is advisable that before installation, a check of the shut height be performed. Molex will not be liable for any damages as a result of installation in a crimp press with nonstandard or improperly set shut height. Failure to observe these precautions may result in injury or property damage.		
 <b>CAUTION</b>  <b>Never</b> perform any service or maintenance other than as described in this manual. <b>Never</b> modify, alter or misuse the equipment Molex crimp specifications are valid only when used with Molex terminals, applicators and tooling. Failure to observe this precaution may result in injury and property damage.		

## Tooling Technical Assistance

Molex offers tooling technical assistance for customers who may need some guidance for tooling adjustments. This support can be obtained by calling either of the two numbers listed below and asking for the Molex Tooling Group.  
Call Toll Free 1-800-786-6539 (US) 1-630-969-4550 (Global).

This assistance is limited to the operation and set-up of a customer's Molex Press. Questions with regard to Molex connector products or how to identify the proper tooling and/ or tooling documentation should be directed to your local Molex personnel or Customer Service Representative.

When calling for service on the press a copy of the *Tooling Manual* and Specific *Applicator Tooling Specification Sheet* should be present and a person that is familiar with the applicator should be present. Be sure the following information is supplied:

1. Customer name
2. Customer address
3. Person to contact such as (name, title, e-mail, and telephone number)
4. Applicator order number (Lease number also if applicable)
5. Serial number (Lease number also if applicable)
6. Molex Connector product order number
7. Urgency of request
8. Nature of problem

### Application Tooling Support

**Phone:** (402) 458-TOOL (8665)  
**E-Mail:** [applicationtooling@molex.com](mailto:applicationtooling@molex.com)  
**Website:** [www.molex.com/applicationtooling](http://www.molex.com/applicationtooling)

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## Section 1

### General Description

- 1.1 Description
- 1.2 Features
- 1.3 Technical Specifications
- 1.4 Delivery Check
- 1.5 Crimp Tooling Accessories
- 1.6 Tools
- 1.7 Specification Sheets

Principal Mechanical Parts of the Mini-Mac Applicator (Newer Version 2)

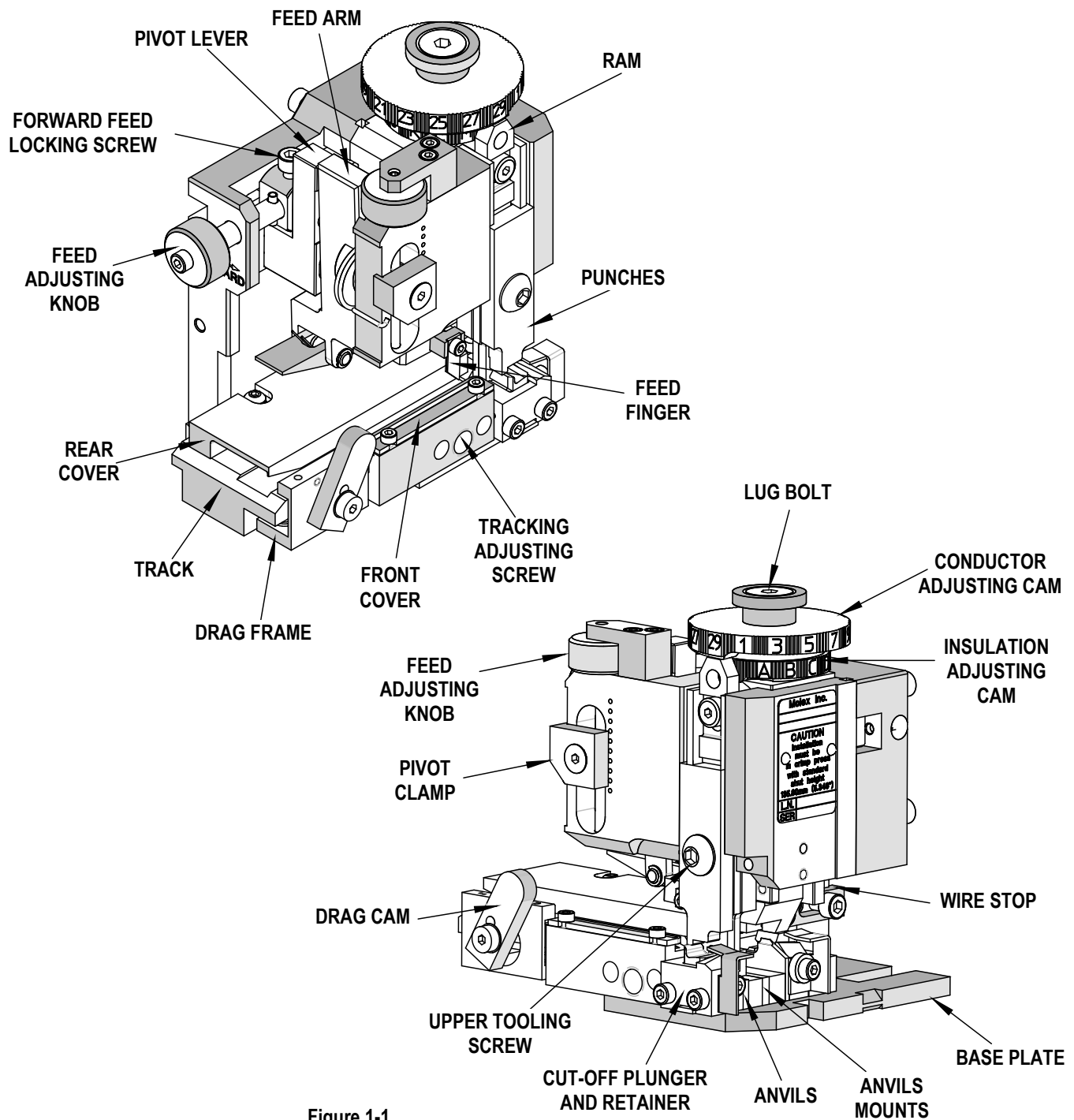


Figure 1-1

## Principal Mechanical Parts of the Mini-Mac Applicator (Version 2)

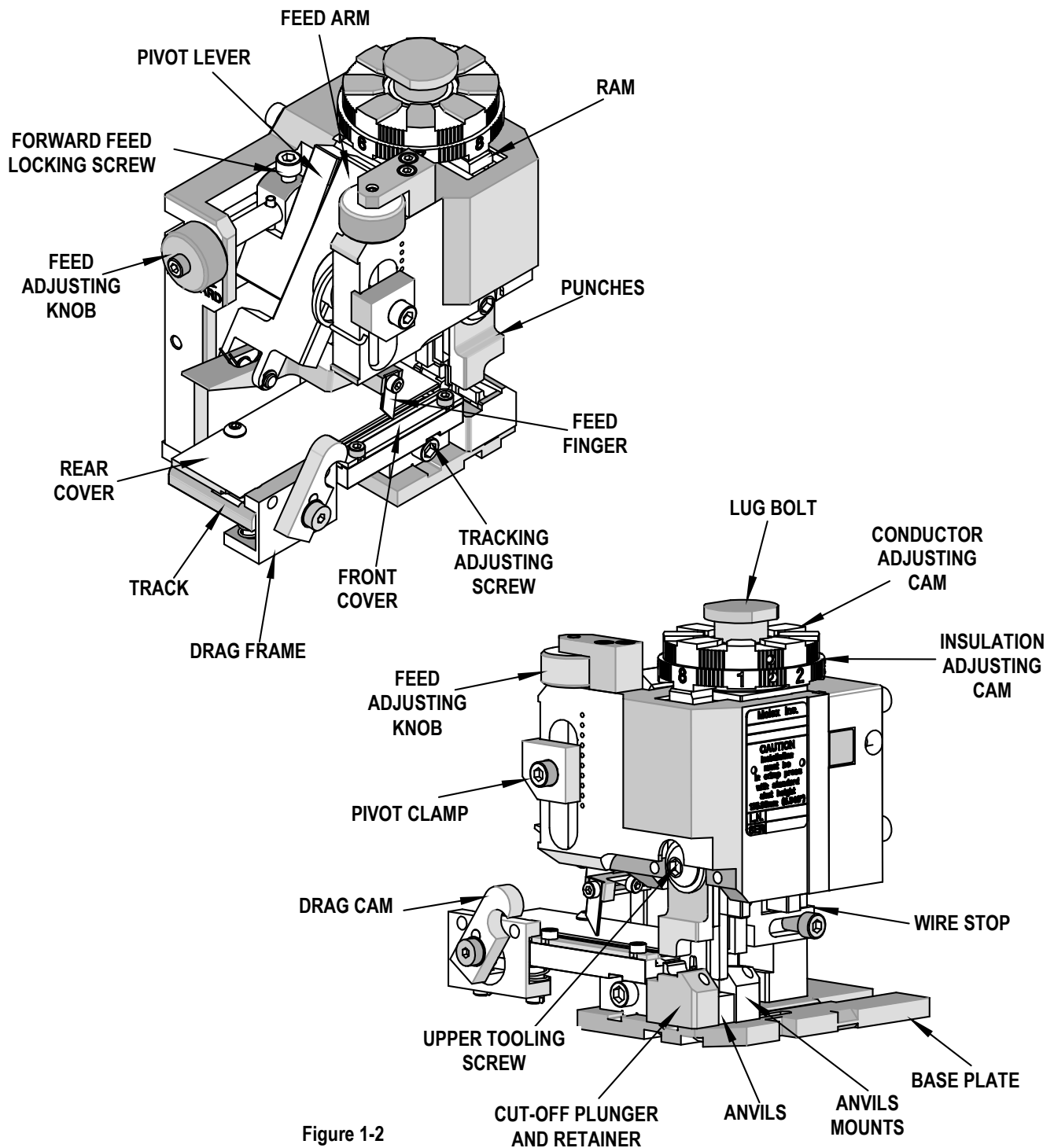


Figure 1-2

# Principal Mechanical Parts of the Mini-Mac Applicator (Version 1)

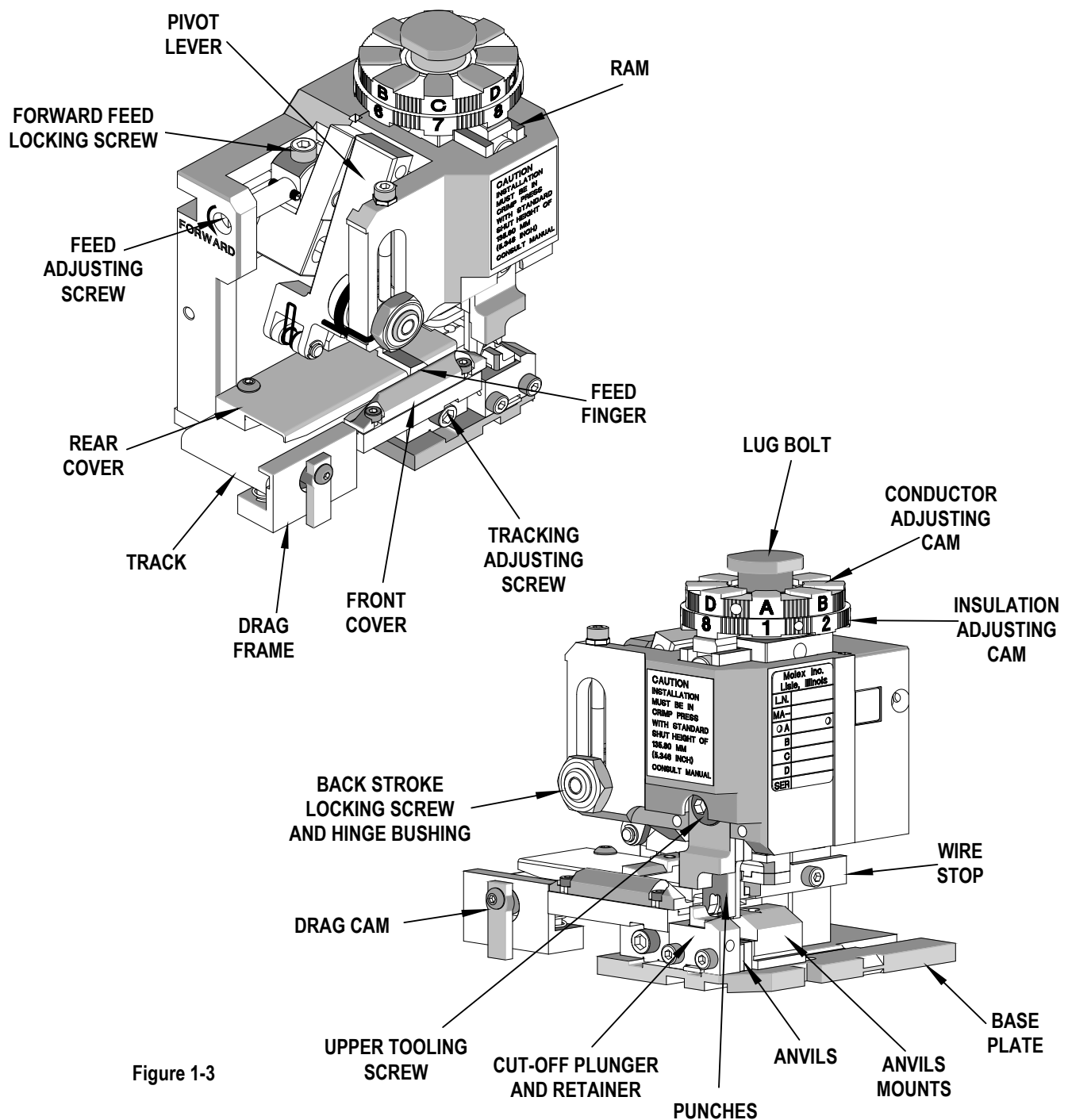


Figure 1-3

## General Description

### 1.1 Description

The Molex Mini-Mac Applicator is designed to provide an effective method of applying a wide range of side feed and back feed terminals to a pre-stripped discrete wire and cable. This applicator works in the Molex TM-2000, TM-3000 and TM-4000 Universal Press and in most industry standard presses.

The Molex Mini-Mac Applicator is designed to operate with numerous commercially available universal bench presses and fully automated wire processing machines.

The Mini-Mac Applicator offers minimal setup time. It is versatile, reliable, easy to install, and is designed for mid-volume to high-volume, semi or fully-automatic operations.

Molex offers the following crimp presses for operating the Mini-Mac Applicator:

- ✓ TM-2000 Press 120 V 60 Hz. **63800-8300**
- ✓ TM-2000 Press 240 V 50 Hz. **63800-8400**
- ✓ TM-3000 Press 120 V 60 Hz. **63801-7200**
- ✓ TM-3000 Press 240 V 50 Hz. **63801-7300**
- ✓ TM-4000 Press 240 V 60 Hz. **63801-7600**

The Mini-Mac Applicator is also compatible with most OEM presses (Artos, Mecal, Komax, Megomat, Toyojamco, etc). It also adapts to most wire processing machines

Molex believes in continual improvement in our products and tooling. We implement changes to our Mini-Mac and other applicators based on suggestions from our customers. This manual contains information that applies to all versions of the Mini-Mac we have produced. Some methods of adjustment and some parts are different from version to version. To effectively use this manual, determine the version of the Mini-Mac you have, from the illustrations contained, in the parts list section 4. Follow the adjustment and parts lists for that version.

### 1.2 Features

- Adjustment allow users to achieve specified heights with little effort with the 4 increment settings for conductor crimp height and the 8 increment settings for insulation height.
- Adjustment rings allow users to quickly adjust the conductor or insulation crimp height.

- Track adjustment for bellmouth and cut-off tab  
Compatible with the Molex TM-2000, TM-3000 and TM-4000 Universal Press and most industry standard presses. However, it does NOT fit into Molex TM40/42 press.
- Directly adapts to most automatic wire processing machines.
- Quick set-up time; plus the crimp height, track and feed adjustments can be preset in applicator.
- Applicator designed to industry standard mounting and shut height 135.80mm (5.346").
- Automatic terminal feed with applicator in press.
- Adjustable terminal feed with applicator in press.
- Terminals are separated from carrier strip automatically during crimping operation.
- Quiet operation with low maintenance and easy to keep clean

### 1.3 Technical Specification

#### Dimensions

Width:	132mm	(5.2")
Depth:	101mm	(4.0")
Height:	152mm	(6.0")

#### Weight

4.1kg (9lbs)

#### Press Stroke Compatibility

41.28mm	(1 5/8")
28.58mm	(1 1/8")

#### Guarding

The Mini-Mac Applicator is supplied with no guards and is intended to be used with the guards supplied by the press manufacturer.



**Caution: DO NOT** use the applicator without guards

### 1.4 Delivery Check

Carefully remove the Mini-Mac Applicator from its shipping container and determine that the following items are included in the package.

	Mini-Mac Applicator	1
11-18-4238	Short Feed Cam	1
TM-638000100	Instruction Manual	1
	Specification Sheets	1
	Sample Crimped Terminals	5

## Crimp Tooling Accessories

63890-0719  
63800-2800

Terminal Oiler Appendix C  
Digital Crimp Micrometer

The specification sheet should be filed. These are available on the Molex website ([www.molex.com](http://www.molex.com)).

## 1.5 Tools

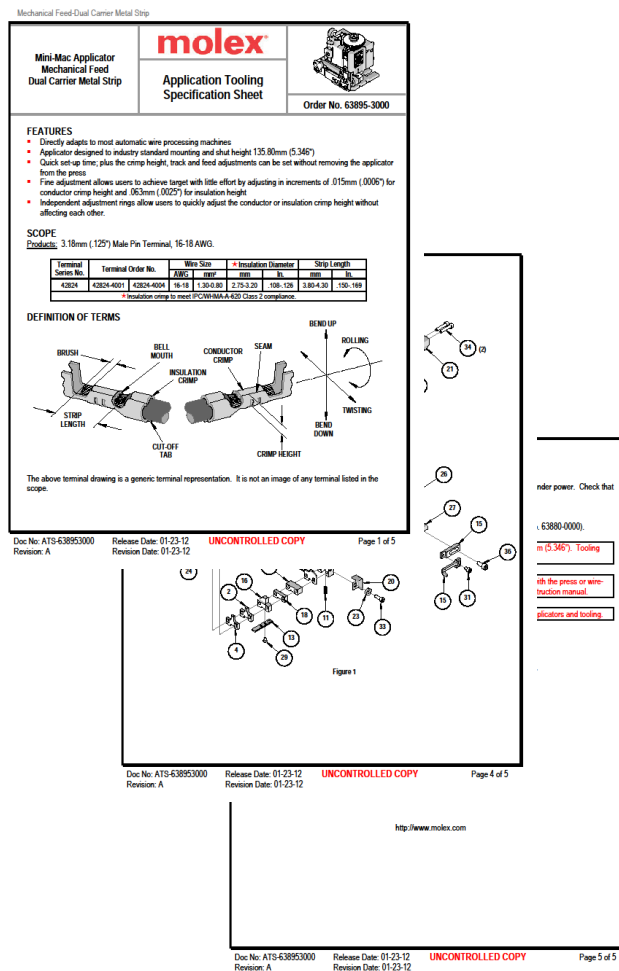
The following tools are recommended for setup and adjustments to the applicator in this press

1. Metric standard hex wrench set
2. Adjustable wrench
3. Wire stripper / cutter
4. Scissors

## 1.6 Specification Sheets

Molex ships specification sheets with every applicator. The specification sheet contains the following:

- ✓ Terminal numbers
- ✓ Wire AWG ranges
- ✓ Insulation diameter ranges
- ✓ Strip lengths
- ✓ Pull Force
- ✓ Crimp heights
- ✓ Bell mouth
- ✓ Bend, twist and roll limits
- ✓ Tooling parts list and assembly



## Section 2

### Set-Up and Operation

- 2.1. Shut Height
- 2.2. Setup
- 2.3. Adjustments
- 2.4. Crimp Tooling Installation and Tool Removal
- 2.5. Slug Clearance for Mini-Mac Applicators
- 2.6. Oiling





**Read the following instructions before attempting to operate the applicators.**

## 2.1 Shut Height

The Molex Mini-Mac Applicators are designed to operate in crimp presses with standard shut height of 135.80mm (5.346"). Installation in crimp presses with other than standard shut heights can cause severe tool breakage. It is recommended that before installation, a check of the shut height be performed. The correct shut height is required to prevent the punches from hitting the anvils and the cut-off tooling from bottoming out on the base plate. It also allows the movement of applicators from press to similar press without making adjustments to the applicator or press shut height.

The shut height of the press can be checked with a shut height gauge, which is calibrated under load to achieve the 135.80mm (5.346") measurement. It is recommended that the shut height be checked monthly. A shut height gauge is available from most press manufacturers.

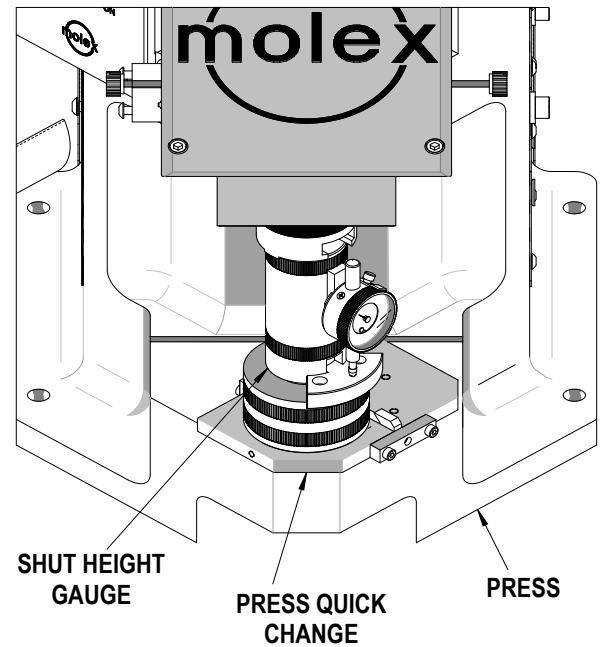


Figure 2-1

### Measuring Press Shut Height

1. Always disconnect the power supply from the press. Remove the machine guards if necessary.
2. Remove the applicator from the press (See Section 2-4 Applicator Installation and Removal for additional information). Make sure that the bottom of the press ram and press quick change mounting plate are free from foreign material.
3. Place the shut height gauge into the press on the press quick change mounting plate. See Figure 2-1.
4. Manually cycle the press to the downstroke position. (Follow press manufacturers instructions on manually cycling the press.)
5. Read the shut height measurement from the front of the gauge. Follow gauge manufacturers' instruction, usually the gauge reads "0" when set correctly.
6. If adjustments are necessary, refer to the press manufacturer for adjustment of the press shut height.
7. Repeat the above steps until the correct shut height is obtained.
8. Shut height gauges must be calibrated on a regular basis.

## 2.2 Set-Up



### IMPORTANT

Power must be shut off and electrical cord disconnected. Manual press cycling is an absolutely required procedure for safety and preventing equipment damage. Always cycle by hand when trouble shooting or changing adjustments, tooling, applicator, or accessories.

The principal mechanical parts of the Mini-Mac are illustrated in Section 3. Assembly Drawings.

### Applicator Installation and Removal

1. All presses must be equipped with a common universal type quick change mounting plate and adapter on the press. Contact the press manufacturer for specific information.
2. Always turn off and disconnect the power supply to the press. Remove the press guards.
3. Clean the quick change mounting plate of scrap or chips that may interfere with the Mini-Mac Applicator installation.
4. Using a 4mm hex wrench, turn the M5 x 30 SHCS clockwise until the locking clamp is in the full out position.
5. Locate the applicator base plate with the location clamps on the press quick change mounting plate.

6. Slide the Mini-Mac Applicator onto the quick change mounting plate until the two notches on the left side engage against the stops, and at the same time, enter the lug bolt into the adapter on the press. See Figure 2-2.
7. To lock applicator, turn the M5 x 30 Lg. SHCS counter clockwise until tight.
8. Some presses have locking latches on the quick change mounting plate which have to be flipped up to secure the applicator. Others have knurled finger screws or "T" type latches. Most of these are located on the right side of the quick change mounting plate to secure the position of the applicator. These must be in place and secured before operating the press.
9. Replace the press guards.
10. Remove the applicator by reversing the previous steps. When storing an applicator always leave a strip of terminals in the applicator to prevent damage to the tooling. See Section 3.5 Storage.

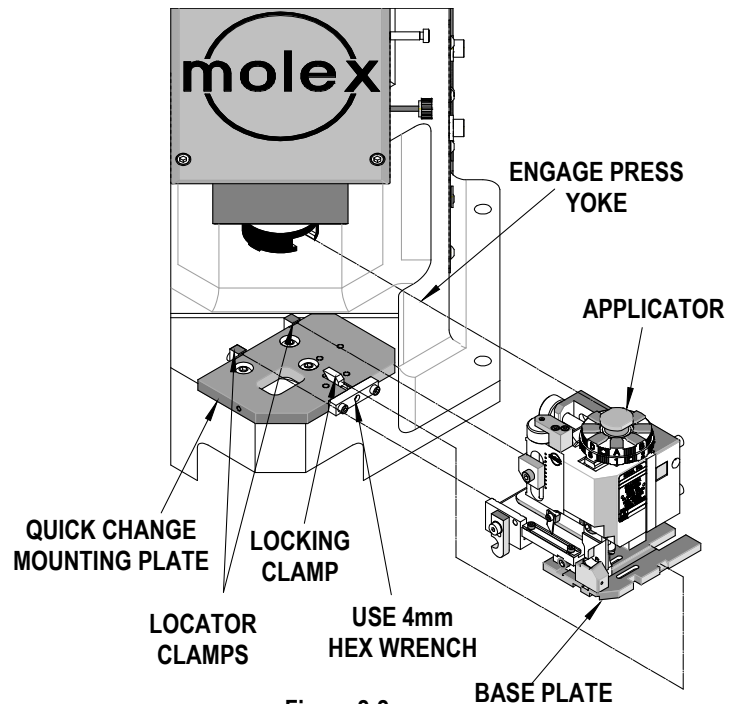


Figure 2-2

### Loading and Unloading Terminal Strip

1. The specified terminals are printed on the setup sheet for the applicator. Only use the Molex terminals on the setup sheet which is supplied with the applicator.
2. Always disconnect the power supply from the press. Remove the machine guards if necessary.
3. Before inserting a terminal strip, the drag cam must be in the upright position. This will allow the terminal to slide with ease through the applicator track. See Figure 2-3.
4. Push the terminal strip until the first terminal comes to rest centered above the anvil.
5. Turn the drag cam down to engage the terminal drag frame.
6. Cycle the press by hand so that the feed finger transfers the next terminal to a centered position over the anvil. Check that all other parts slide and engage without any interference. It is recommended to go through this procedure several times.
7. When unloading the terminal strip, make sure the power is turned off and disconnected from the press. Remove the machine guards if necessary.
8. Lift the drag cam until the drag frame is in the upright position. Hand cycle the press to the fully upright position to check the drag.
9. Raise feed finger and pull terminal strip back until disengaged from applicator track. See Figure 2-3. If preferred, cut the terminal carrier strip and pull it through the applicator with needle nose pliers.
10. Replace the machine guards before operating the press.

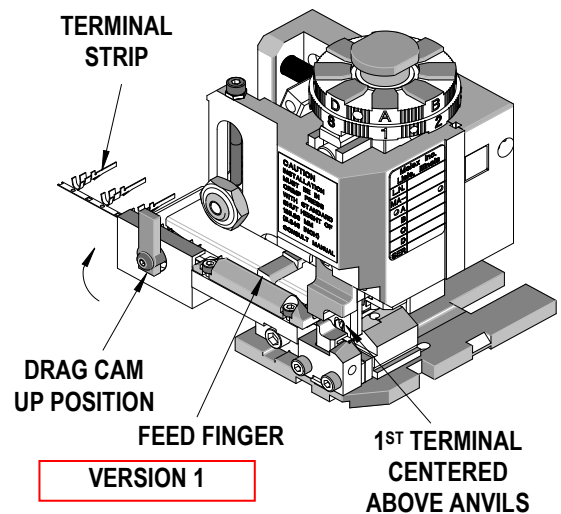
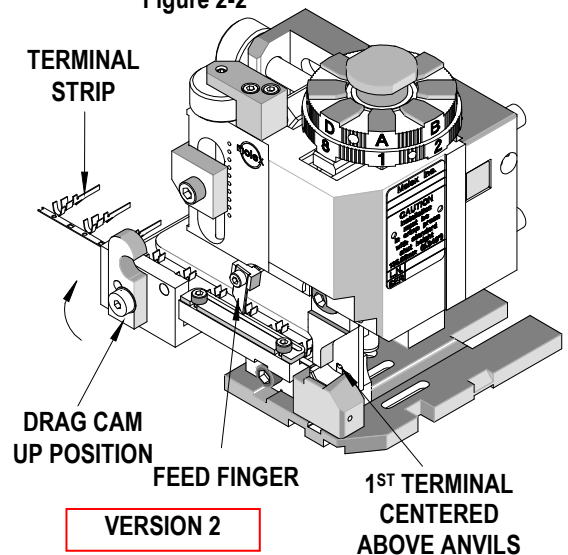


Figure 2-3

## Punch and Anvil Alignments

Note: Always clean mounting surfaces of crimp tooling and tooling holders prior to alignment.

1. Always disconnect the power supply from the press. Remove the machine guards if necessary.
2. With a terminal in position over the anvils, slightly release anvil mounting screw. See Figure 2-4.
3. Gently hand cycle the ram of the press to bottom of its stroke. Tighten anvil mounting screws in this position to ensure perfect alignment of punches and anvils.
4. Hand cycle the press ram to the highest position.
5. Replace the machine guards before operating the press.

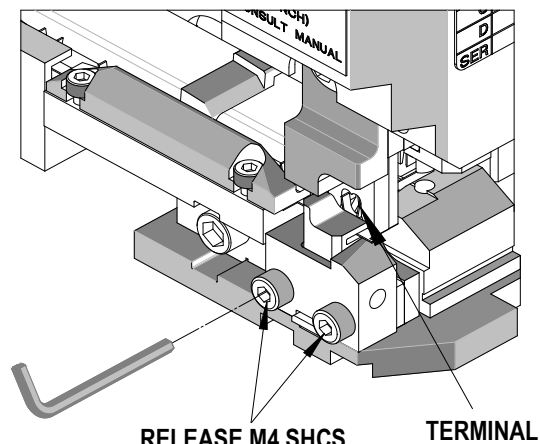


Figure 2-4

## 2.3. Adjustments

### Cover Plate Adjustments

1. Always disconnect the power supply from the press. Remove the machine guards if necessary.
2. Remove the applicator from the press. (Refer to Section 2.2-Applicator Installation and Removal).
3. Rotate the drag cam until the drag frame is in the upright position. The rear cover plate should be adjusted so that the terminal strip will slide smoothly through the track with no resistance.
4. Some applicators require the removal of the applicator frame from the base plate. This is done by removing the two M6 BHCS located on the bottom of the base plate. See Figure 2-5.
5. Loosen the two M4 BHCS to adjust the position of the rear cover. See Figure 2-6.
6. Slide terminal strip through the track to ensure accurate cover positioning.
7. After the correct position is achieved, tighten the two M4 BHCS.
8. Reattach the applicator frame to the base plate if needed. Locate the position of the frame using the dowel pins. Tighten the two M6 BHCS to secure the frame to the base plate.

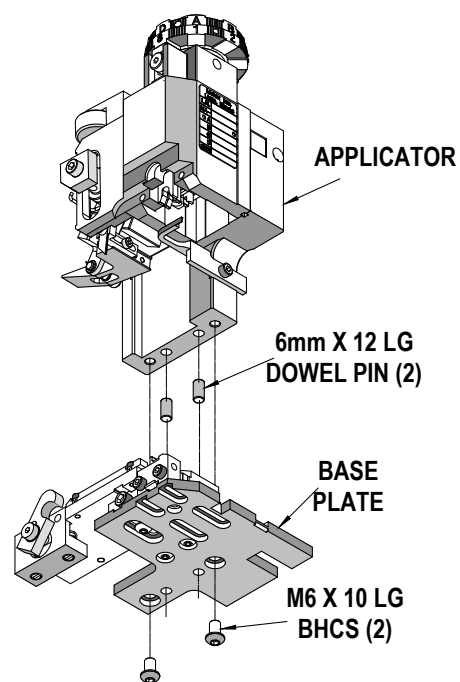


Figure 2-5

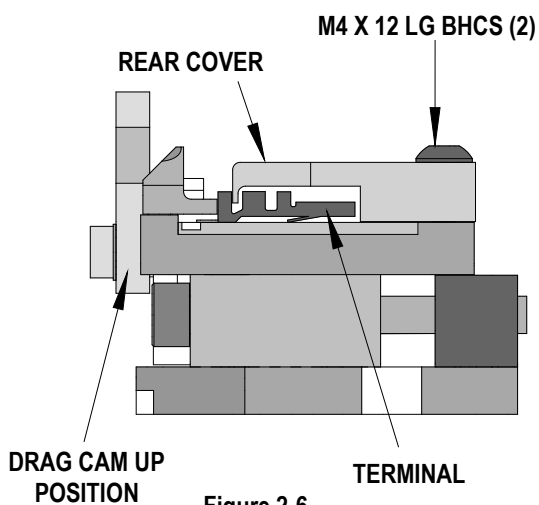


Figure 2-6

## Track Adjustments

1. Always disconnect the power supply from the press. Remove the machine guards if necessary.
2. To move the track in the proper location with the anvils and the cut-off plunger take the applicator out of the press, and turn the applicator on its side. Loosen the M5 X 6 BHCS underneath the base plate which is attached to the track base. See Figure 2-7.
3. Using an allen wrench turn the adjusting screw located on the front of the track to position the terminal in the correct location. Turning the screw clockwise will move the track and base into the applicator. Turning the screw counter-clockwise will move the track towards the operator. Depending on the required movement, the feed finger may need to be loosened. See Figure 2-8.
4. To lock the track in position tighten the M5 X 6 BHCS underneath the base plate.
5. Replace machine guards.
6. Hand cycle the press to ensure the applicator is functioning properly, then reconnect the power and turn the press on. Crimp a terminal under power and observe the quality of the termination. See Appendix A.
7. Adjustments may be necessary to the feed finger to position it correctly in location to the terminal. See Feed Finger Adjustments.
8. Repeat the above steps until the desired terminal position is obtained.

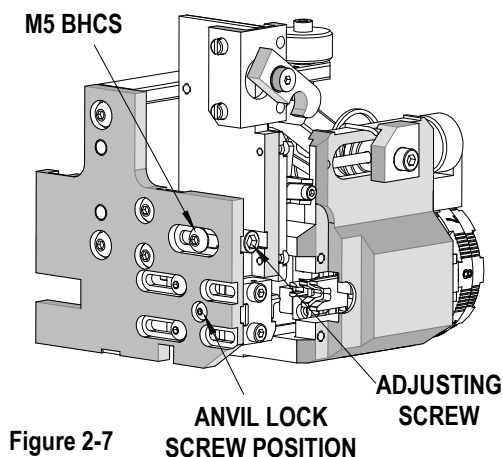


Figure 2-7

## Feed Finger Adjustments Version 2

1. Position the feed finger to properly feed the next terminal in position. Typically terminals are fed by the carrier strip.
2. Turn off and disconnect the power supply from the press. Remove the machine guards if necessary.
3. Remove the applicator from the press. See Section 2.2-Applicator Installation and Removal.
4. Position the feed pawl lever so that the M3 SHCS on the feed finger mount is accessible.
5. Loosen the M3 SHCS located on the feed finger mount and slide the feed finger to the desired position. See Figure 2-8A.
6. Tighten the M3 BHCS to lock the feed finger in position

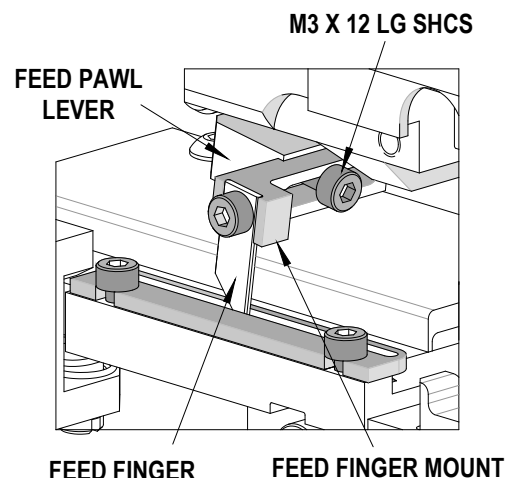


Figure 2-8A

## Feed Finger Adjustments Version 1

1. Position the feed finger to properly feed the next terminal in position. Typically terminals are fed by the carrier strip.
2. Turn off and disconnect the power supply from the press. Remove the machine guards if necessary.
3. Remove the applicator from the press. See Section 2.2-Applicator Installation and Removal.
4. Pull back the feed pivot lever to view the feed finger mounting screw.
5. Loosen the M4 BHCS located on the feed arm and slide the feed finger to the desired position. See Figure 2-8B.
6. Tighten the M4 BHCS to lock the feed finger in position.

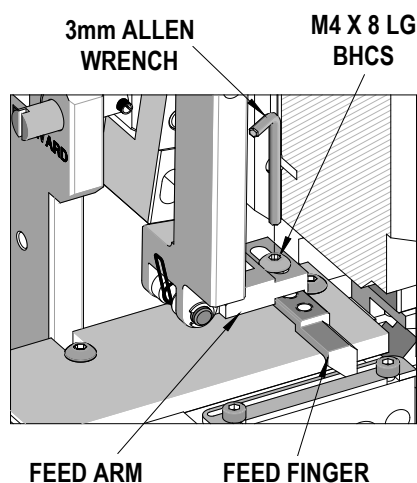


Figure 2-8B

### Feed Stroke Cam Adjustments

1. The feed stroke is controlled by the ram and is determined by the press stroke. For example a press with a 28.58mm (1 1/8") stroke uses a shorter feed cam. A press with a 41.28mm (1 5/8") has a longer stroke. Refer to the press manual to determine the proper stroke.
2. Determine what feed timing is desired. Typically, when the applicator is mounted in a wire processing machine, the feed stroke cam should be assembled in the down stroke position. While the press is idle in the up position, a terminal will not be present over the anvil. For most bench applications, the cam is installed in the up stroke position. This will leave a terminal over the anvil when the press is idle in the up position. See Figure 2-9.
3. Turn off and disconnect the power supply from the press. Remove the machine guards if necessary.
4. Remove the applicator from the press. See section 2.2-Applicator Installation and Removal.
5. Pull back on the feed pivot lever and remove the ram from the applicator.
6. Holding on to the feed cam, remove the M5 SHCS on the back of the ram.
7. Position the cam in the desired position for feeding and attach with the M5 SHCS. See Figure 2-9.

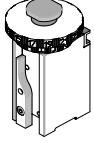
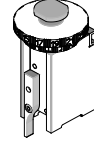
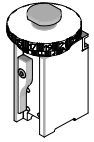
Feed Cam Order No.	Press Stroke		Feed Timing
	mm	In.	
 63800-0105	41.28	1-5/8	Up stroke (terminal present over anvil)
	28.58	1-1/8	
 63800-0105	41.28	1-5/8	Down stroke (terminal not present over anvil)
 11-18-4238	28.58	1-1/8	Down stroke (terminal not present over anvil)

Figure 2-9

### Forward Feed Adjustments

1. To check the forward feed position, the terminal that is being crimped should be positioned exactly over the anvil.
2. Turn off and disconnect the power supply from the press. Remove the machine guards if necessary.
3. Loosen the M5 SHCS feed lock and then turn the feed adjusting knob to reposition the terminal. To shorten the feed position, turn the adjusting knob clockwise (CW). To lengthen the feed position turn the adjusting knob counter-clockwise (CCW). See Figure 2-10.
4. After properly adjusting the forward feed position of the terminal, tighten the M5 SHCS feed lock.

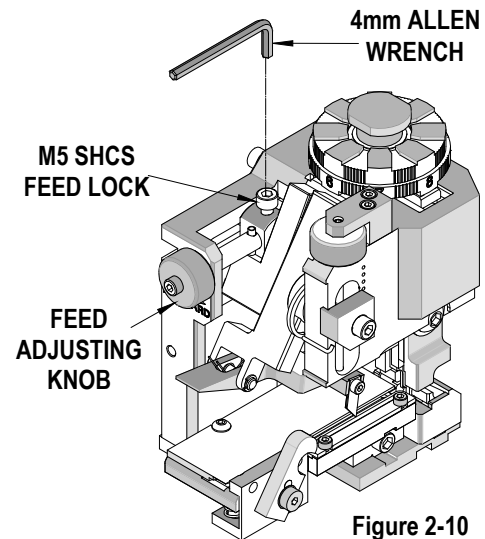


Figure 2-10

### Back Stroke Feed Adjustments Version 2

1. When loading the terminal strip, the back feed stroke should have a little over-travel to pick up the next position.
2. Always turn off and disconnect the power supply from the press. Remove the machine guards if necessary.
3. Loosen the M5 pivot clamp SHCS to permit up and down movement of the hinge bushing. See Figure 2-11A.
4. Hand cycle the press to the bottom of the stroke.
5. To achieve the correct back stroke location, turn the stroke feed adjusting knob. To shorten the back feed stroke turn the knob counter clockwise (CCW). To lengthen the back feed stroke turn the knob clockwise (CW). See Figure 2-11A.
6. Once the desired stroke is achieved, tighten the M5 pivot clamp SHCS.

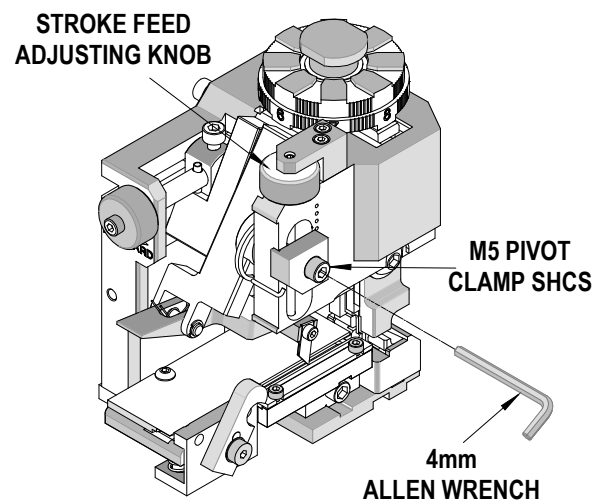


Figure 2-11A



7. Readjustment of the forward feed stroke could be necessary. See Forward Feed Adjustments.

### Back Stroke Feed Adjustments Version 1

1. When loading the terminal strip, the back feed stroke should have a little over-travel to pick up the next position.
2. Always turn off and disconnect the power supply from the press. Remove the machine guards if necessary.
3. Loosen the M12 hex jam nut to permit up and down movement of the hinge bushing. See Figure 2-11B.
4. Hand cycle the press to the bottom of the stroke.
5. Loosen the M4 SHCS.
6. To achieve the correct back stroke location, adjust the position of the hinge bushing. Lowering the hinge bushing in the support slot will shorten the stroke; raising the hinge bushing will lengthen the back feed stroke. See Figure 2-11B.
7. Once the desired stroke is achieved, tighten the M12 hex jam nut and bring the M4 SHCS up against the hinge bushing.
8. Readjustment of the forward feed stroke could be necessary. See Forward Feed Adjustments.

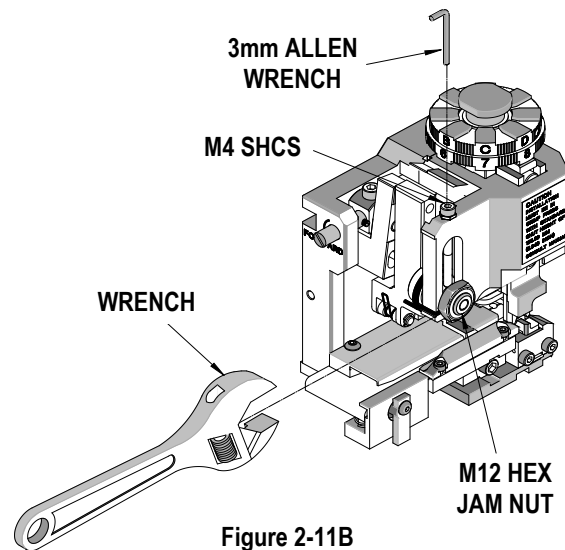


Figure 2-11B

### Conductor Crimp Punch Adjustments

1. With the guards intact, place a stripped length of suitable wire into the terminal and terminate the wire under power.
2. Inspect the quality of conductor crimp and measure the crimp height. See Appendix A.3-Conductor Crimp Height Measurement.
3. If adjustments are necessary, turn off and disconnect the power supply from the press. Remove the machine guards.
4. The desired crimp height can be achieved by rotating the conductor adjusting cam. See Figure 2-12. Each increment represents approximately 0.10mm (.004") for a total adjustment of 0.40mm (.016"). The "A" setting is the loosest crimp height and the "D" setting is the tightest. If you find that the crimp height is not acceptable you can rotate the adjusting cam until the desired crimp height is obtained. See Shut Height.
5. Replace the machine guards and repeat the previous steps until the desired crimp height is obtained. See Appendix A Conductor Crimp Height Measurement.
6. Perform a pull test on conductor crimp to verify the mechanical integrity of the crimp. See Appendix A.5-Pull Force Test.

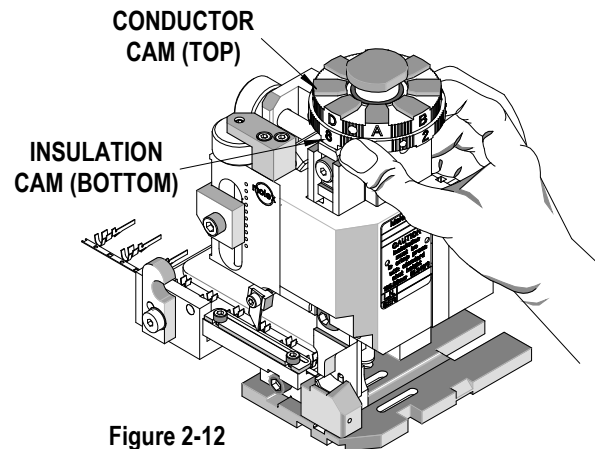


Figure 2-12

### Insulation Crimp Punch Adjustment

1. Place a stripped length of the appropriate wire into the terminal and crimp under power.
2. Observe quality of insulation crimp. See Appendix A.4-Insulation Crimp.
3. If adjustments are necessary, always turn off and disconnect the power supply from the press. Remove the machine guards.
4. Rotate the insulation adjusting cam to achieve the desired insulation height. Each increment represents approximately 0.22mm (.009") for a total adjustment of 1.78mm (.070"). The "1" setting is for the loosest crimp height and the "8" setting the tightest crimp height.
5. Repeat the previous steps until the desired insulation height is obtained.

**Note:** Due to the large variety of insulation wall thickness, materials, and diameter, Molex does not specify insulation crimp height. For each different wire type, the insulation crimp height can be measured, recorded and inspected as a quality indicator.

## Wire Stop Adjustment

For automatic wire processing machines the wire stop can be used to assist in the stripping of the terminal from the punches. However, in certain circumstances the wire stop will need to be removed when running on a automated machine.

1. Check the setup documents to obtain the correct strip length.
2. Place the correct wire into the terminal and crimp the wire under power.
3. Observe quality of crimp and the wire position. See Appendix A.1-Conductor Brush and Terminal Position.
4. If adjustments are necessary, turn off and disconnect the power supply from the press. Remove the machine guards. Some wire stops are located on the applicator frame, others are located over the anvil mount.
5. Loosen the screw for the wire stop and adjust the position of the wire stop. See Figure 2-13. Towards the operator increases the brush length and towards the applicator frame decreases it.
6. Hand cycle the press to ensure the applicator is functioning properly. Then Crimp a terminal under power and observe the quality of the termination. See Appendix A.

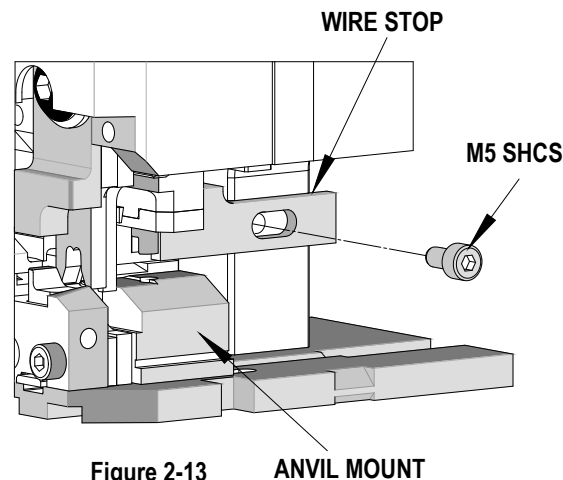


Figure 2-13 ANVIL MOUNT

The ram retains the conductor punch in a present position; also, the floating insulation punch and front cut-off striker are held by an M8 BHCS. The floating insulation punch varies insulation crimp height setting in relation to wire crimp setting. The front cut-off striker depresses the cut-off plunger and separates the crimped terminal from the carrier strip.

Double carrier strip terminals also require a rear cut-off plunger(not shown).

Many Molex terminals have a center carrier strip in which case a cut-off punch separates the crimped terminal from the carrier strip. As such, a cut off striker is not needed.

## 2.4 Crimp Tooling Installation and Removal



**Caution:** Always disconnect power before installing or removing tooling.

### Installation and Removal of the Upper Tooling (Punches)

NOTE : Always clean mounting surfaces of crimp tooling and tooling holders prior to installation.

1. Always turn off and disconnect the power supply from the press. Remove the machine guards if necessary.
2. Remove the applicator from the press. See Section 2.2-Applicator Installation and Removal.
3. Pull back the feed arm and remove the ram from the applicator.
4. Loosen and unscrew the M8 BHCS. See Figure 2-14.
5. Remove off the punches, strikers and tooling washer out of the ram. Put in the new upper tooling.
6. Reverse the previous steps to reinstall the upper tooling.

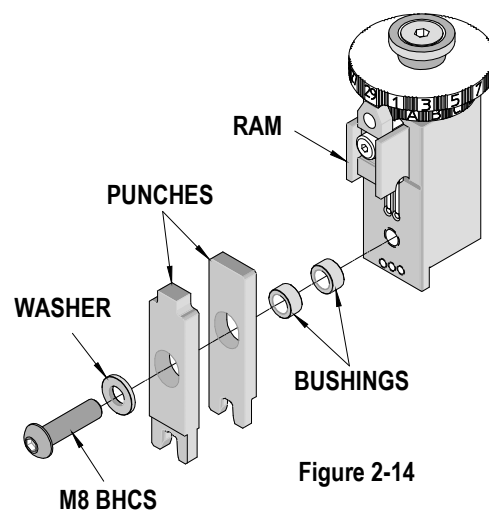


Figure 2-14

### Installation and Removal of the Lower Tooling (Anvils)



**Caution:** Always disconnect power before installing or removing tooling.



NOTE : Always clean mounting surfaces of crimp tooling and tooling holders prior to installation.

1. Always turn off and disconnect the power supply from the press. Remove the machine guards if necessary.
2. Remove the applicator from the press. See Section 2.2-Applicator Installation and Removal.
3. Pull back the feed arm and raise the ram.
4. Remove the anvil lock screw from the bottom of the base plate. See Figure 2-7. Then remove the anvils from the groove on the base plate. Put in the new anvils, leaving the mounting screw loose. For tightening See Punch and Anvil Alignment.
5. The cut-off plunger is spring loaded. When the SHCS in the bottom side of the retainer block is removed, push the plunger out of the plunger retainer block. Replace the spring if damage or loss of pressure is evident. To replace, reverse this procedure after screw is installed, be certain that the plunger moves freely.

## 2.5 Slug Hole Clearance for Mini-Mac Applicators



**Important: Please read carefully**

Double check for proper slug clearance when installing series **MA60703**, **MA60756** and **MA60712** Mini-Mac applicators on industry standard presses.. The slugs from the carrier strip cut-off should be able to fall freely through the press base without any obstructions.

1. This can be easily checked by removing the lower tooling, anvils and cut-off block from the applicator.
2. Place the Mini-Mac applicator in the press. Look at the position of the slug (rectangular) hole in the Mini-Mac Applicator base to ensure no part of that hole is obstructed.
3. If there is an obstruction, the press base can easily be machined by removing material, allowing the slugs to drop freely. Please remember that the base of the crimp press should be machined and not the mini-Mac applicator base.

## 2.6 Oiling

When running gold plated contacts and some high tensile alloys, oiling the terminal crimp section can eliminate sticking and prolong tool life. See Appendix C.

## Section 3

### Maintenance

3.1 Cleaning

3.2 Lubrication

3.3 Spare parts

3.4 Perishable Parts

3.5 Storage

### 3.1 Cleaning

**CAUTION:** Always disconnect power supply before all maintenance

For efficient operation, the Mini-Mac Applicator should be cleaned daily. Use a soft bristle brush to remove debris from critical areas such as the crimp tooling. For best results, remove the crimp tooling from the press. Brush and then use a clean cloth to wipe off the upper and lower tooling mounting areas. Before reinstalling tooling, wipe all sides of the punches and anvils with a clean cloth.

### 3.2 Lubrication

**WARNING:** Disconnect electrical power before all maintenance.

1. Grease the ram including the up and down stroke feed arm.
2. Oil the feed finger assembly and all moving parts.
3. Lubricate with multipurpose synthetic lubricant with Teflon or an equivalent. Molex ships its applicators pre-greased with Permatex multi-purpose synthetic grease with Teflon No. 82329. A SAE 30WT non-detergent oil or light spindle oil or 3-n-1 oil should be used on pivot points.

**WARNING:** Never use penetrants such as WD40 for any lubrication on the machine.

4. Lubricate all points shown in Figures 3-1 with the specified oil and grease (or equivalent).

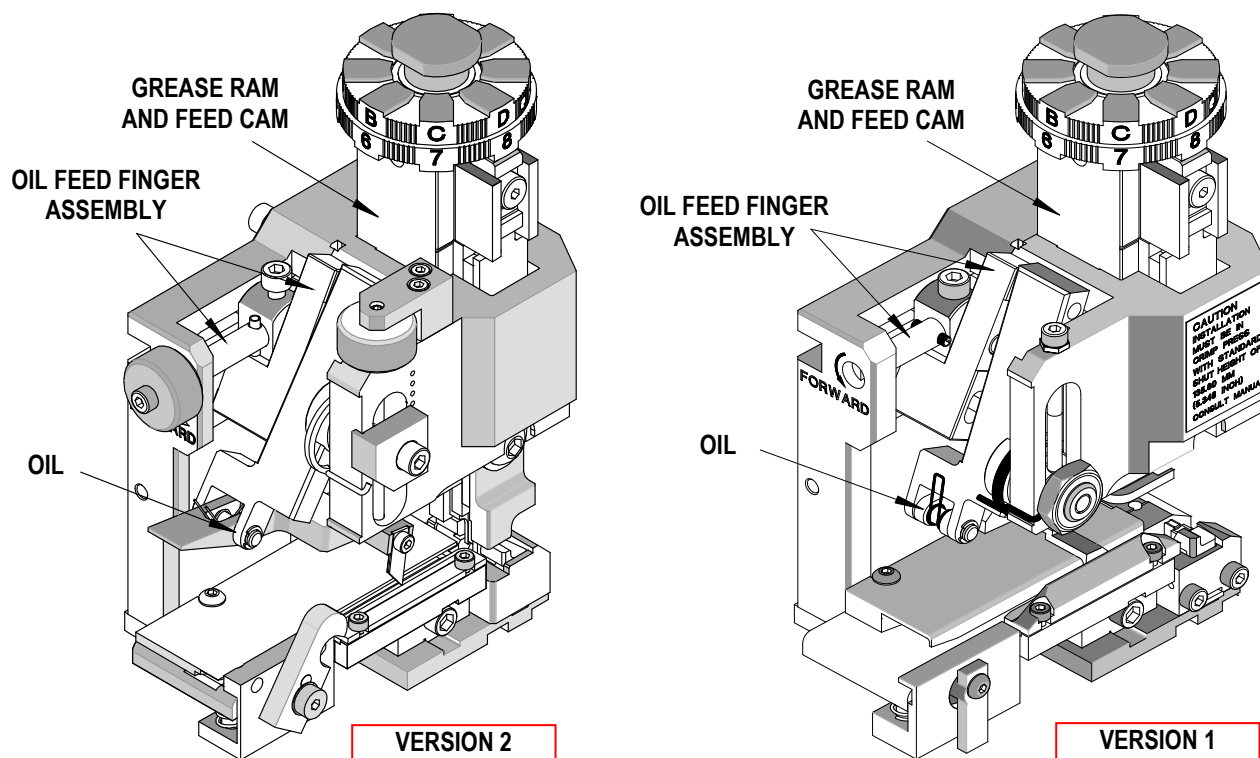


Figure 3-1

An example of a maintenance chart is shown below. Copy and use this chart to track the maintenance of your Mini-Mac Applicator or use this as a template to create your own schedule or use your company's standard chart, if applicable.

### Preventive Maintenance Chart

**Daily:** Clean. See Section 3.1.

**As Required:** Lubricate. See Section 3.2.

**CHECK SHEET**      **MONTH** \_\_\_\_\_ **YEAR** \_\_\_\_\_

Week	Daily Cycle s	Daily Clean	Days of the Week							Solution
			MON	TUE	WED	THU	FRI	SAT	SUN	
1										
2										
3										
4										
Cleaning Reapply greasing Reapply oil	25,000	Yes								Soft Brush Industrial Degreaser
Inspect all tooling, feed fingers etc. for wear	25,000	Yes								Replace if signs of wear.

Schedule should be adjusted up or down depending on usage. Molex recommends that a log of preventive maintenance be kept with the press.

### 3.3 Spare Parts

Customers are responsible for maintaining the Mini-Mac Applicator. Spare parts are available. Moving and functioning parts can be damaged or wear out over time and will require replacement. Molex recommends that the customer keep some or all of them in stock to reduce production down time. These parts are identified in the Parts List. See Section 5.

### 3.4 Perishable Parts

Customers are responsible for maintaining the Mini-Mac Applicator. Perishable parts are those parts that come in contact with the product and will wear out over time. Molex recommends that all customers keep at least one set of the perishable tool kit in stock at all times. This will reduce the amount of production down time. **For the proper perishable tool kit information, refer to the Crimp Tooling Specification Sheet supplied with the Applicator.**

## Tooling Replacement Schedule

The following is offered as a general guide-line for tooling replacement. The manufacturer should monitor the process and collect data on actual frequency as tool wear varies on different terminal materials and tool life can be increased with good maintenance practices or decrease with lack of maintenance.

Items	Cycles Brass Alloys	Cycles Steel	Actual
Punches	300,000/500,000	200,000/400,000	
Anvils	500,000/750,000	400,000/750,000	
Cut-off Plungers/Retainers	300,000/500,000	200,000/400,000	
Feed Fingers	300,000/900,000	300,000/900,000	
Cut-off Punches	500,000/750,000	200,000/400,000	
Cut-off Blades	300,000/500,000	200,000/300,000	

Judgement on tool replacement should be based on the attributes of the crimp they produce.

See the following chart for common signs of wear

Punches	On Terminal	Notes
Scoring	Uneven Curls	Replace
Tip Loss	Open seam	Replace
Anvils		
Rounded Edges	Large Extrusion	Replace
Chipping	Burrs-On Tabs	Replace
Worn Cut Edges	Burrs	Replace
Cut-Off Plungers		
Chipped or Rounded	Burr on Tab	Replace
Cut Edge	Burr on Tab	Replace
Cut-off Dies	Burrs on Cut Area	Replace

## 3.5 Storage

To prevent the bottoming of the ram which can cause damage to the crimp punches and anvils, leave a strip of terminals in the applicator or place a piece of wood or rubber between the punches and the anvils.

## Section 4

4.1 Parts Lists and Assembly Drawings

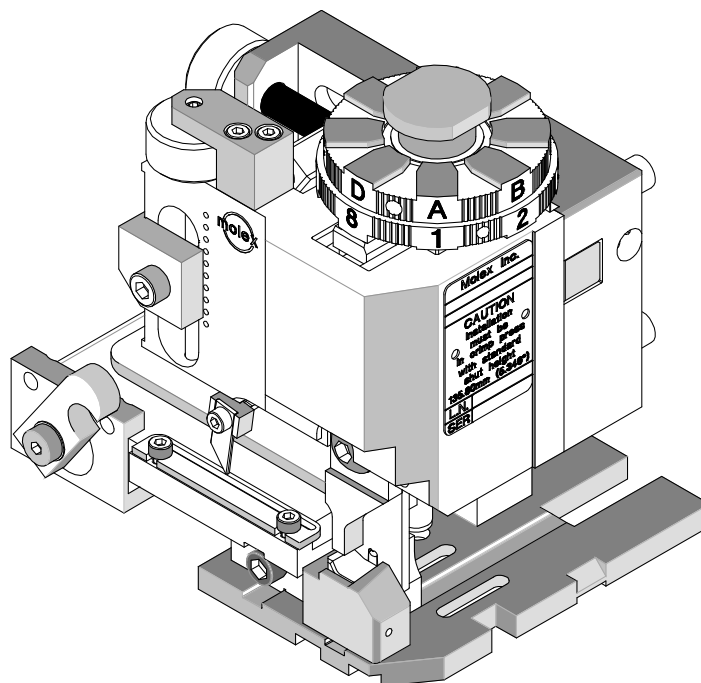
4.2 Troubleshooting

**VERSION 2** Parts List and Assembly Drawings (See Figure 4-1A and 4-2A)

Mini-Mac Applicator <b>VERSION 2</b>				
Item	Order No.	Engineering No.	Description	Qty
1	11-17-3215	60654	Serial Tag	1
2	11-18-4238	60700-1	Feed Cam (Short) Optional	1
3	11-18-4795	60700-66	Wave Washer Spring	1
4	63600-1561	63600-1561	Shim Washer	1
5	63800-0103	63800-0103	Base Plate	1
6	63800-0104	63800-0104	Ram	1
7	63800-0105	63800-0105	Feed Cam (Long)	1
8	63800-0106	63800-0106	Insulation Striker	1
9	63800-0108	63800-0108	Terminal Track	1
10	63800-0109	63800-0109	Rear Support Frame	1
11	63800-0110	63800-0110	Adjusting Screw	1
12	63800-0111	63800-0111	Track Base	1
13	63800-0112	63800-0112	Drag Frame	1
14	63800-0116	63800-0116	Guide Pin - Drag Frame	2
15	63800-0120	63800-0120	Feed Arm	1
16	63800-0121	63800-0121	Lever Feed Pivot	1
17	63800-0123	63800-0123	Slider-Feed Cam	1
18	63800-0124	63800-0124	Pin-Feed Adjusting	1
19	63800-0127	63800-0127	Torsion Spring-Feed Pawl	1
20	63800-0129	63800-0129	Washer -3.40 Thick	1
21	63800-0130	63800-0130	Lug Bolt	1
22	63800-0131	63800-0131	Conductor Adjusting Cam	1
23	63800-0132	63800-0132	Insulation Adjusting Cam	1
24	63800-0140	63800-0140	Cylinder Pin	1
25	63800-0142	63800-0142	Roller-Cam Follower	1
26	63800-0143	63800-0143	Pin-Cam Follower	1
27	63800-0144	63800-0144	Key Stock 3 by 3 by 19mm Long	2
28	63800-4302	63800-4302	Face Plate	1
29	63801-3211	63801-3211	Back Frame	1
30	63801-3225	63801-3225	Torsion Spring-Hinge	1
31	63801-4462	63801-4462	Feed Finger Mount	1
32	63801-4561	63801-4561	Feed Pawl	1
33	63801-5862	63801-5862	Drag Cam Lever	1
34	63890-0817	63890-0817	Terminal Feed Pawl Lever	1
35	63890-0881	63890-0881	Adjusting Screw	1
36	63890-0883	63890-0883	Adjust Knob Retainer	1
37	63890-0884	63890-0884	Adjustable Pivot	1
38	63890-0885	63890-0885	Slider	1
39	63890-0886	63890-0886	Feed Positioning Screw	1
40	63890-0887	63890-0887	Pivot Clamp	1
41	63890-0899	63890-0899	Adjusting Knob	2
42	N/A	N/A	Compression Spring (Lee Spring # LC-020A-4MW)	2**
43	N/A	N/A	Compression Spring (Lee Spring # LC-032E-0MW)	2**
44	N/A	N/A	Snap Ring 3.2 ID by 7 OD by .62 Thk	2**
45	N/A	N/A	Washer .512" ID by 1.125" OD by 0.15" Thick	1**
46	N/A	N/A	Washer .512" ID by 1.125" OD by 0.18" Thick	1**
47	N/A	N/A	M3 by 5 Long BHCS	1**
48	N/A	N/A	M3 by 12 Long SHCS	1**
49	N/A	N/A	M3 by 20 Long SHCS	2**



Mini-Mac Applicator <b>VERSION 2</b>				
Item	Order No.	Engineering No.	Description	Qty
50	N/A	N/A	M4 by 8 Long Set Screw (Flat Point)	3**
51	N/A	N/A	M4 by 12 Long BHCS	1**
52	N/A	N/A	M4 by 16 Long SHCS	1**
53	N/A	N/A	M4 Thread Stripper Bolt 6 OD by 10 Long	1**
54	N/A	N/A	M5 by 6 Long BHCS	3**
55	N/A	N/A	M5 by 8 Long SHCS	1**
56	N/A	N/A	M5 by 10 Long SHCS	3**
57	N/A	N/A	M5 by 25 Long SHCS	1**
58	N/A	N/A	M5 by 35 Long SHCS	4**
59	N/A	N/A	M6 by 10 Long BHCS	2**
60	N/A	N/A	M6 by 8 Long Set Screw	1**
61	N/A	N/A	M6 by 10 Long SHLDR Screw	1**
62	N/A	N/A	M8 by 25 Long SHCS (Machine Screw)	1**
63	N/A	N/A	2mm by 10 Long Roll Pin	1**
64	N/A	N/A	3mm by 12 Long Roll Pin	2**
65	N/A	N/A	5mm by 20 Long Dowel Pin	1**
66	N/A	N/A	5mm by 25 Long Dowel Pin	1**
67	N/A	N/A	6mm by 12 Long Dowel Pin	2**
68	N/A	N/A	Ball Retainer 1/8 in.	2**
69	N/A	N/A	Extension Spring (Lee Spring # LE-041C-9)	1**
70	N/A	N/A	#2 (.098 Dia.) by .125 in. Long Drive Screw	2**
** Available from an industrial supply company such as MSC (1-800-645-7270).				



**VERSION 2** Mini-Mac Applicator Assembly

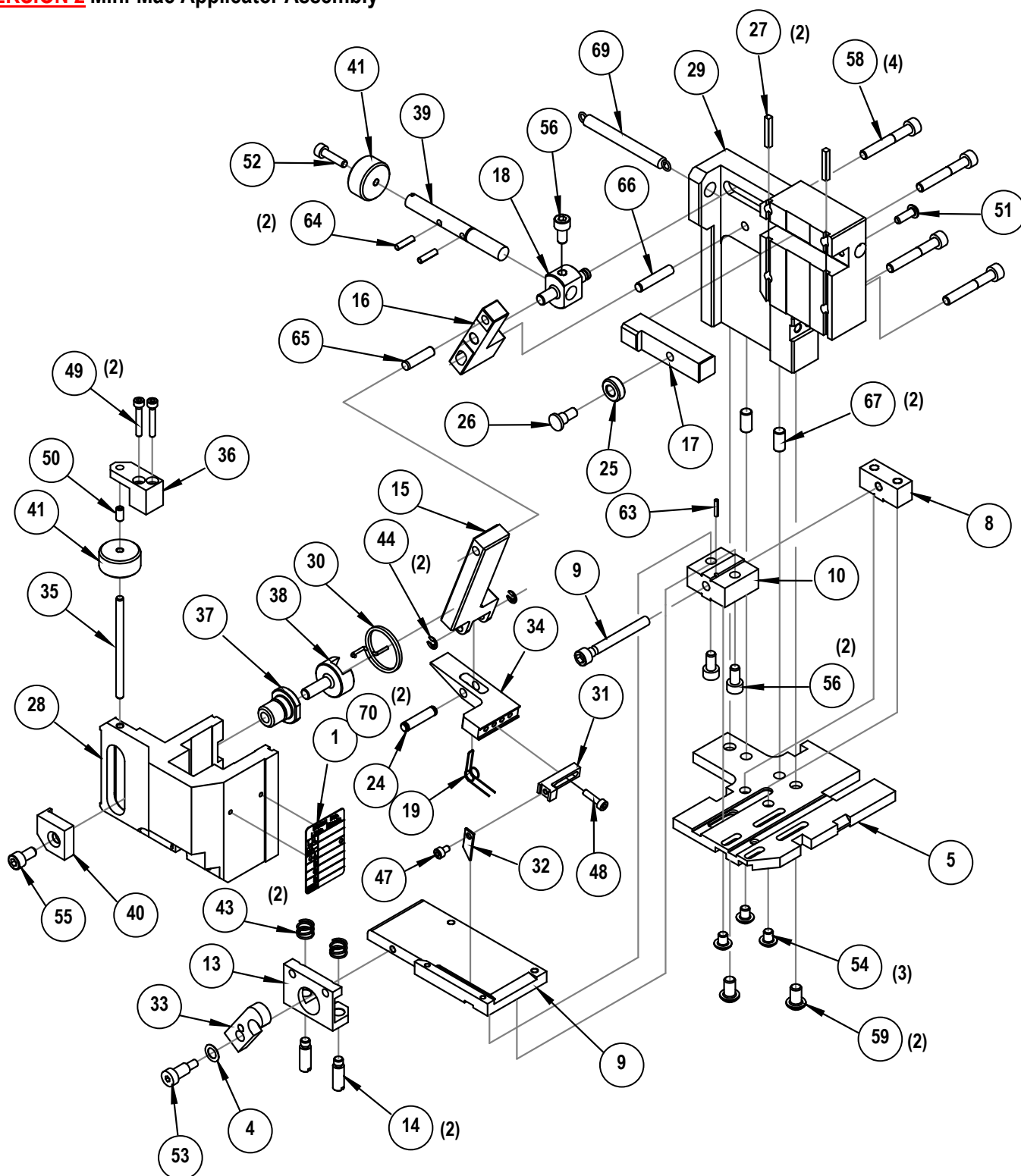


Figure 4-1A

**VERSION 2** Mini-Mac Applicator Assembly (Cont.)

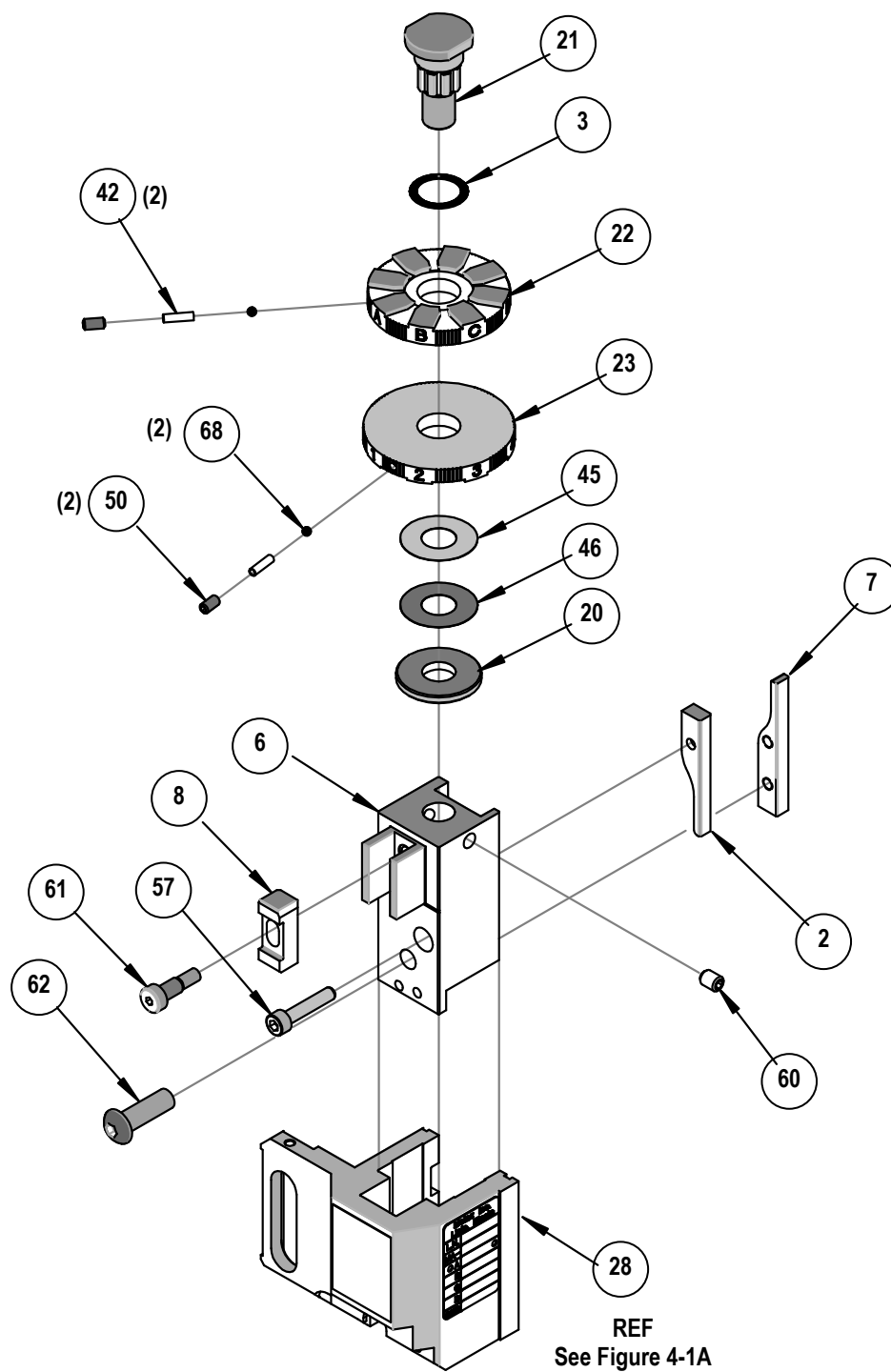
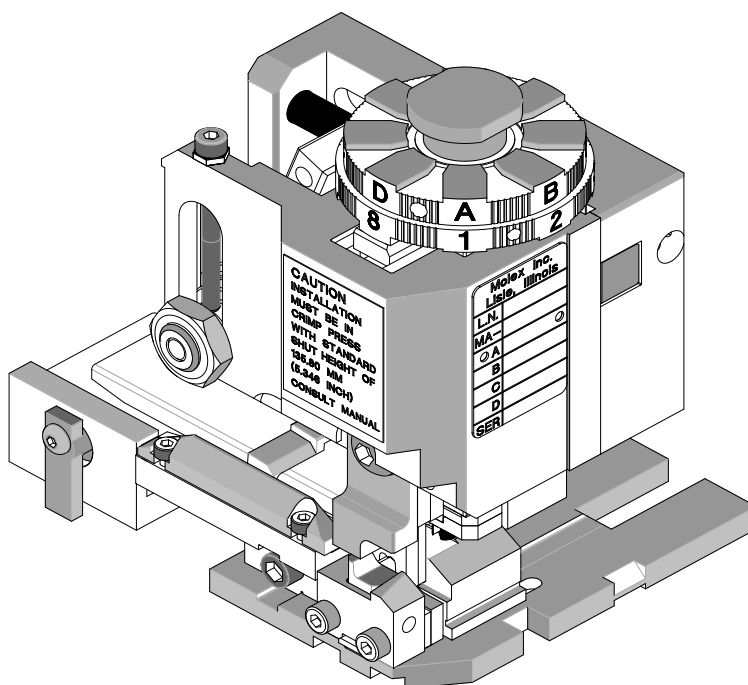


Figure 4-2A

**VERSION 1** Parts List and Assembly Drawings (See Figure 4-1B and 4-2B)

Mini-Mac Applicator <b>VERSION 1</b>				
Item	Order No.	Engineering No.	Description	Qty
1	11-17-3215	60654	Serial Tag	1
2	11-18-0165	60700-65	Mini-Mac Label (Caution)	1
3	11-18-4795	60700-66	Wave Washer Spring	1
4	11-18-4238	60700-1	Feed Cam (Short) Optional	1
5	63800-0102	63800-0102	Face Plate	1
6	63800-0103	63800-0103	Base Plate	1
7	63800-0104	63800-0104	Ram	1
8	63800-0105	63800-0105	Feed Cam (Long)	1
9	63800-0106	63800-0106	Insulation Striker	1
10	63800-0108	63800-0108	Terminal Track	1
11	63800-0109	63800-0109	Rear Support Frame	1
12	63800-0110	63800-0110	Adjusting Screw	1
13	63800-0111	63800-0111	Track Base	1
14	63800-0112	63800-0112	Drag Frame	
15	63800-0113	63800-0113	Drag Cam	1
16	63800-0115	63800-0115	Spacer Tube	1
17	63800-0116	63800-0116	Guide Pin - Drag Frame	2
18	63800-0117	63800-0117	Feed Pawl Lever	1
19	63800-0118	63800-0118	Hinge Bushing	1
20	63800-0119	63800-0119	Feed Finger	1
21	63800-0120	63800-0120	Feed Arm	1
22	63800-0121	63800-0121	Lever Feed Pivot	1
23	63800-0122	63800-0122	Feed Adjusting Screw	1
24	63800-0123	63800-0123	Slider-Feed Cam	1
25	63800-0124	63800-0124	Pin-Feed Adjusting	1
26	63800-0125	63800-0125	Torsion Spring-Hinge	1
27	63800-0127	63800-0127	Torsion Spring-Feed Pawl	1
28	63800-0129	63800-0129	Washer -3.40 Thick	1
29	63800-0130	63800-0130	Lug Bolt	1
30	63800-0131	63800-0131	Conductor Adjusting Cam	1
31	63800-0132	63800-0132	Insulation Adjusting Cam	1
32	63800-0140	63800-0140	Cylinder Pin	1
33	63800-0141	63800-0141	Slider	1
34	63800-0142	63800-0142	Roller-Cam Follower	1
35	63800-0143	63800-0143	Pin-Cam Follower	1
36	63800-0144	63800-0144	Key Stock 3 by 3 by 19mm Long	2
37	63800-0301	63800-0301	Back Frame	1
38	N/A	N/A	Compression Spring (Lee Spring # LC-020A-4MW)	2**
39	N/A	N/A	Compression Spring (Lee Spring # LC-032E-0MW)	2**
40	N/A	N/A	Snap Ring 3.2 ID by 7 OD by .62 Thk	2**
41	N/A	N/A	Washer .512" ID by 1.125" OD by 0.15" Thick	1**
42	N/A	N/A	Washer .512" ID by 1.125" OD by 0.18" Thick	1**
43	N/A	N/A	M4 Hex Nut	1**
44	N/A	N/A	M4 by 8 Long BHCS	1**
45	N/A	N/A	M4 by 8 Long Set Screw (Flat Point)	2**
46	N/A	N/A	M4 by 12 Long BHCS	2**
47	N/A	N/A	M4 by 45 Long SHCS	1**
48	N/A	N/A	M5 by 6 Long BHCS	3**
49	N/A	N/A	M5 by 10 Long SHCS	3**
50	N/A	N/A	M5 by 25 Long SHCS	1**

Mini-Mac Applicator <b>VERSION 1</b>				
Item	Order No.	Engineering No.	Description	Qty
51	N/A	N/A	M5 by 35 Long SHCS	4**
52	N/A	N/A	M6 by 10 Long BHCS	2**
53	N/A	N/A	M6 by 8 Long Set Screw	1**
54	N/A	N/A	M6 by 10 Long SHLDR Screw	1**
55	N/A	N/A	M8 by 25 Long SHCS (Machine Screw)	1**
56	N/A	N/A	M12 Self Locking Hex Nut	1**
57	N/A	N/A	2mm by 10 Long Roll Pin	1**
58	N/A	N/A	3mm by 12 Long Roll Pin	2**
59	N/A	N/A	5mm by 20 Long Dowel Pin	1**
60	N/A	N/A	5mm by 25 Long Dowel Pin	1**
61	N/A	N/A	6mm by 12 Long Dowel Pin	2**
62	N/A	N/A	Ball Retainer 1/8 in.	2**
63	N/A	N/A	Extension Spring (Lee Spring # LE-041C-9)	1**
64	N/A	N/A	#2 (.098 Dia.) by .125 in. Long Drive Screw	2**
** Available from an industrial supply company such as MSC (1-800-645-7270).				



**VERSION 1** Mini-Mac Applicator Assembly

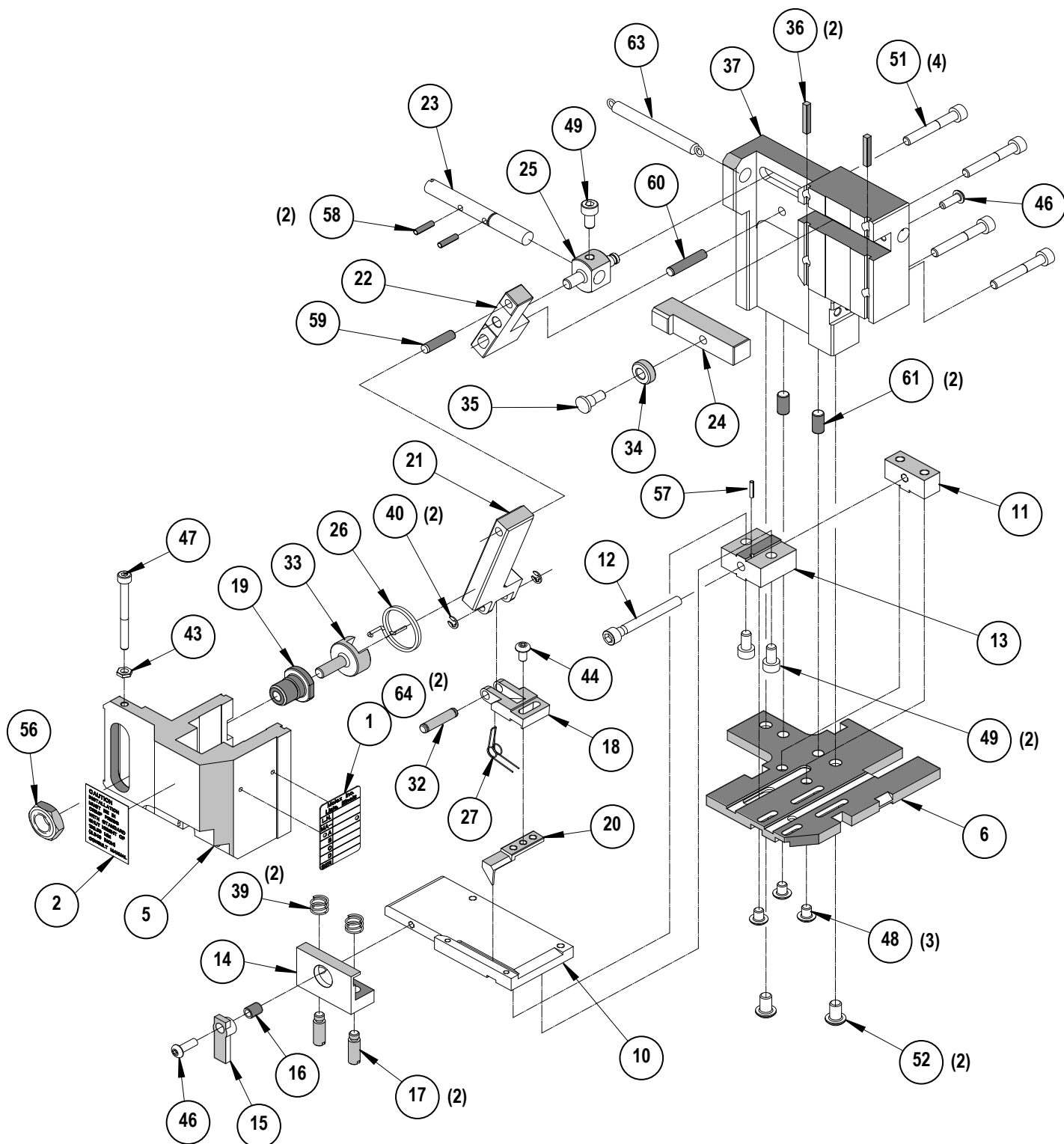


Figure 4-1B

**VERSION 1** Mini-Mac Applicator Assembly (Cont.)

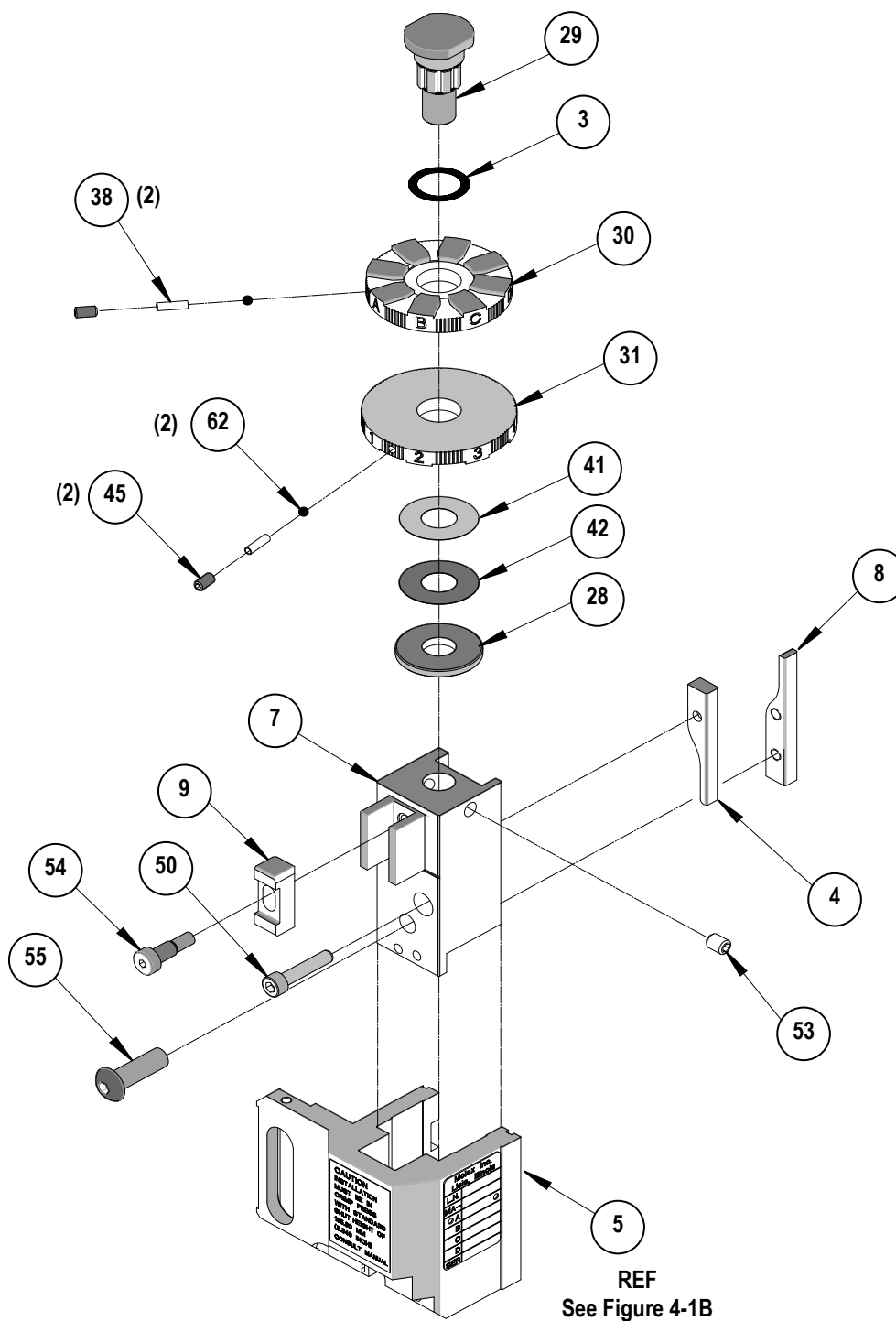


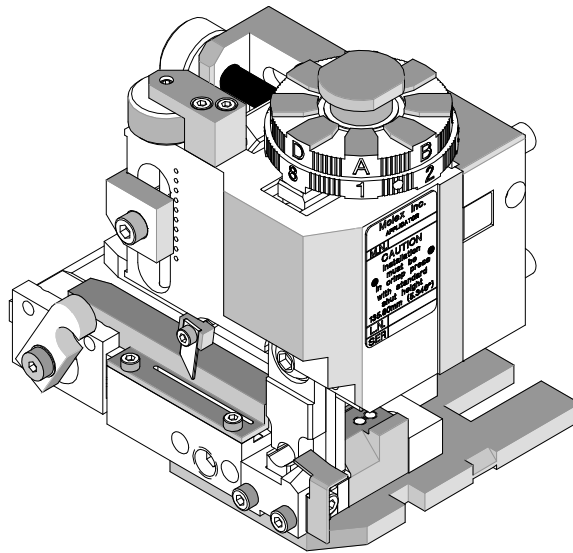
Figure 4-2B



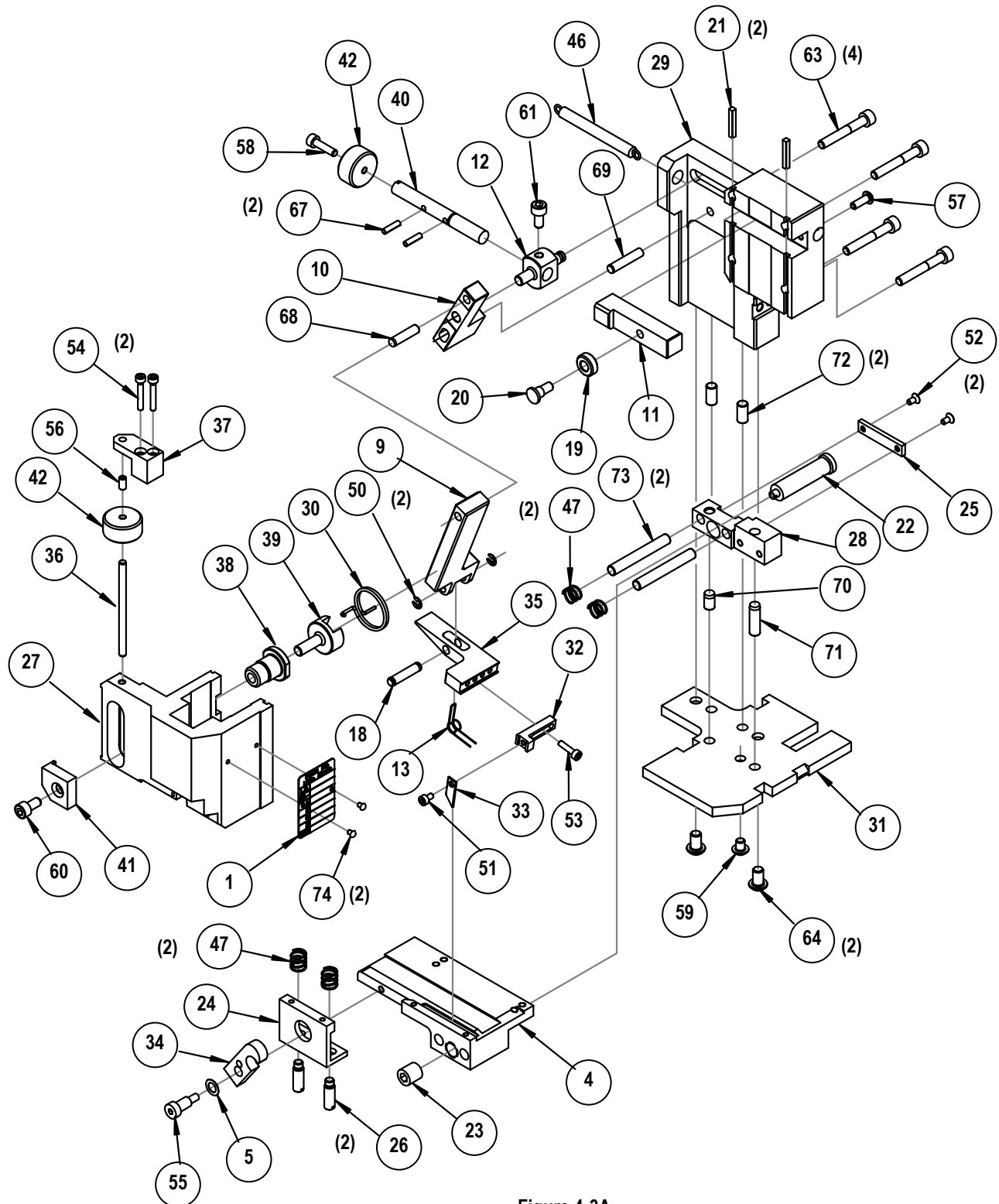
**VERSION 2** Parts List and Assembly Drawings Mini-Mac Heavy Duty Applicator  
(See Figure 4-3A and 4-4A)

Mini-Mac Applicator Heavy Duty <b>VERSION 2</b>				
Item	Order No.	Engineering No.	Description	Qty
1	11-17-3215	60654	Serial Tag	1
2	11-18-4238	60700-1	Feed Cam (Short) Optional	1
3	11-18-4795	60700-66	Wave Washer Spring	1
4	63443-6202	63443-6202	Terminal Track	1
5	63600-1561	63600-1561	Shim Washer	1
6	63800-0104	63800-0104	Ram	1
7	63800-0105	63800-0105	Feed Cam (Long)	1
8	63800-0106	63800-0106	Insulation Striker	1
9	63800-0120	63800-0120	Feed Arm	1
10	63800-0121	63800-0121	Lever Feed Pivot	1
11	63800-0123	63800-0123	Slider-Feed Cam	1
12	63800-0124	63800-0124	Pin-Feed Adjusting	1
13	63800-0127	63800-0127	Torsion Spring-Feed Pawl	1
14	63800-0129	63800-0129	Washer – 3.40 Thick	1
15	63800-0130	63800-0130	Lug Bolt	1
16	63800-0131	63800-0131	Conductor Adjusting Cam	1
17	63800-0132	63800-0132	Insulation Adjusting Cam	1
18	63800-0140	63800-0140	Cylinder Pin	1
19	63800-0142	63800-0142	Roller-Cam Follower	1
20	63800-0143	63800-0143	Pin-Cam Follower	1
21	63800-0144	63800-0144	Key Stock 3 by 3 by 19mm Long	2
22	63800-0310	63800-0310	Adjusting Screw	1
23	63800-0311	63800-0311	Locking Screw	1
24	63800-0312	63800-0312	Drag Frame	1
25	63800-0314	63800-0314	Retaining Bar	1
26	63800-0316	63800-0316	Guide Pin - Drag Frame	2
27	63800-4303	63800-4303	Face Plate	1
28	63800-4309	63800-4309	Rear Support Block	1
29	63801-3211	63801-3211	Back Frame	1
30	63801-3225	63801-3225	Torsion Spring-Hinge	1
31	63801-3281	63801-3281	Base Plate	1
32	63801-4462	63801-4462	Feed Finger Mount	1
33	63801-4561	63801-4561	Feed Pawl	1
34	63801-5862	63801-5862	Drag Cam Lever	1
35	63890-0817	63890-0817	Terminal Feed Pawl Lever	1
36	63890-0881	63890-0881	Adjusting Screw	1
37	63890-0883	63890-0883	Adjust Knob Retainer	1
38	63890-0884	63890-0884	Adjustable Pivot	1
39	63890-0885	63890-0885	Slider	1
40	63890-0886	63890-0886	Feed Positioning Screw	1
41	63890-0887	63890-0887	Pivot Clamp	1
42	63890-0899	63890-0899	Adjusting Knob	2
43	69028-0125	69028-0125	Shoulder Screw	1
44	69028-0155	69028-0155	Ball Retainer 1/8 in.	2
45	69028-0156	69028-0156	Spring - Ball Retainer	2
46	69028-0640	69028-0640	Extension Spring	1
47	69028-0660	69028-0660	Drag Spring	4
48	69028-0808	69028-0808	Washer 0.15 Thick	1
49	69028-0809	69028-0809	Washer .0.18Thick	1

Mini-Mac Applicator Heavy Duty <b>VERSION 2</b>				
Item	Order No.	Engineering No.	Description	Qty
50	69028-0836	69028-0836	Snap Ring 3.2 ID by 7 OD by .62 Thk	2
51	N/A	N/A	M3 by 5 Long SHCS	1**
52	N/A	N/A	M3 by 6 Long FHCS	2**
53	N/A	N/A	M3 by 12 Long SHCS	1**
54	N/A	N/A	M3 by 20 Long SHCS	2**
55	N/A	N/A	M4 Thread Stripper Bolt 6 OD by 10 Long	1**
56	N/A	N/A	M4 by 8 Long Set Screw	3**
57	N/A	N/A	M4 by 12 Long BHCS	1**
58	N/A	N/A	M4 by 16 Long SHCS	1**
59	N/A	N/A	M5 by 6 Long BHCS	1**
60	N/A	N/A	M5 by 8 Long SHCS	1**
61	N/A	N/A	M5 by 10 Long SHCS	1**
62	N/A	N/A	M5 by 25 Long SHCS	1**
63	N/A	N/A	M5 by 35 Long SHCS	4**
64	N/A	N/A	M6 by 10 Long BHCS	2**
65	N/A	N/A	M6 by 8 Long Set Screw	1**
66	N/A	N/A	M8 by 25 Long BHCS	1**
67	N/A	N/A	3mm by 12 Long Roll Pin	2**
68	N/A	N/A	5mm by 20 Long Dowel Pin	1**
69	N/A	N/A	5mm by 25 Long Dowel Pin	1**
70	N/A	N/A	6mm by 10 Long Dowel Pin	1**
71	N/A	N/A	6mm by 12 Long Dowel Pin	1**
72	N/A	N/A	6mm by 20 Long Dowel Pin	2**
73	N/A	N/A	6mm by 45 Long Dowel Pin	2**
74	N/A	N/A	#2 (.098 Dia.) by .125 in. Long Drive Screw	2**
** Available from an industrial supply company such as MSC (1-800-645-7270).				



## **VERSION 2 Mini-Mac Heavy Duty Applicator Assembly**



**Figure 4-3A**

**VERSION 2** Mini-Mac Heavy Duty Applicator Assembly (Cont.)

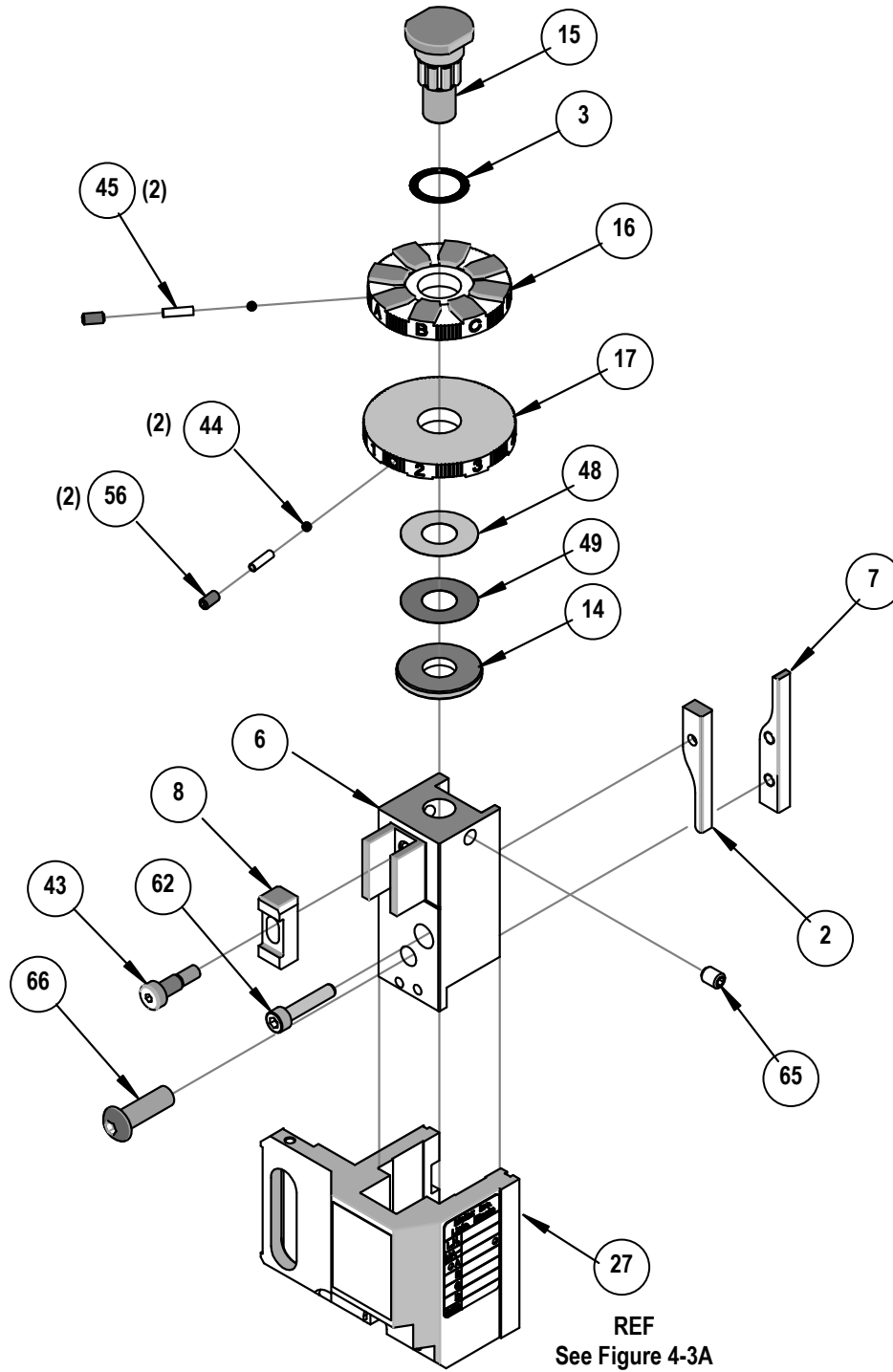
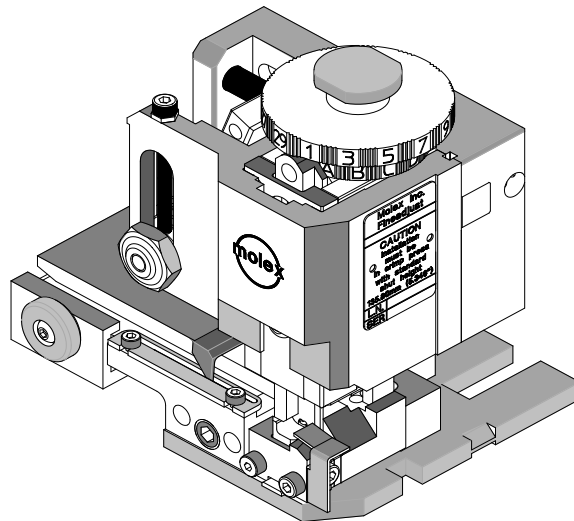


Figure 4-4A

**VERSION 1** Parts List and Assembly Drawings Mini-Mac Heavy Duty Applicator  
(See Figure 4-3B and 4-4B)

Mini-Mac Applicator Heavy Duty <b>VERSION 1</b>				
Item	Order No.	Engineering No.	Description	Qty
1	11-17-3215	60654	Serial Tag	1
2	11-18-0132	60700-33	Drag Spring	2
3	11-18-0165	60700-65	Mini-Mac Label (Caution)	1
4	11-18-4238	60700-1	Feed Cam (Short) Optional	1
5	11-18-4795	60700-66	Wave Washer Spring	1
6	11-18-4819	60800A115	Drag Frame	1
7	11-18-5016	60812A105	Conductor Adjusting Cam	1
8	63800-0104	63800-0104	Ram	1
9	63800-0105	63800-0105	Feed Cam (Long)	1
10	63800-0106	63800-0106	Insulation Striker	1
11	63800-0115	63800-0115	Spacer Tube	1
12	63800-0116	63800-0116	Guide Pin - Drag Frame	2
13	63800-0117	63800-0117	Feed Pawl Lever	1
14	63800-0120	63800-0120	Feed Arm	1
15	63800-0121	63800-0121	Lever Feed Pivot	1
16	63800-0122	63800-0122	Feed Adjusting Screw	1
17	63800-0123	63800-0123	Slider-Feed Cam	1
18	63800-0124	63800-0124	Pin-Feed Adjusting	1
19	63800-0127	63800-0127	Torsion Spring-Feed Pawl	1
20	63800-0129	63800-0129	Washer – 3.40 Thick	1
21	63800-0130	63800-0130	Lug Bolt	1
22	63800-0132	63800-0132	Insulation Adjusting Cam	1
23	63800-0140	63800-0140	Cylinder Pin	1
24	63800-0141	63800-0141	Slider	1
25	63800-0142	63800-0142	Roller-Cam Follower	1
26	63800-0143	63800-0143	Pin-Cam Follower	1
27	63800-0144	63800-0144	Key Stock 3 by 3 by 19mm Long	2
28	63800-0145	63800-0145	Washer 0.13 Thick	1
29	63800-0301	63800-0301	Back Frame	1
30	63800-0303	63800-0303	Base Plate	1
31	63800-0310	63800-0310	Adjusting Screw	1
32	63800-0311	63800-0311	Locking Screw	1
33	63800-0313	63800-0313	Drag Cam	1
34	63800-0314	63800-0314	Retaining Bar	1
35	63800-4302	63800-4302	Face Plate	1
36	63800-4308	63800-4308	Terminal Track	1
37	63800-4309	63800-4309	Rear Support Block	1
38	63800-4318	63800-4318	Hinge Bushing	1
39	63800-4325	63800-4325	Torsion Spring-Hinge	1
40	63821-0024	63821-0024	"L" Feed Finger	1
41	69028-0125	69028-0125	Shoulder Screw	1
42	69028-0133	69028-0133	M12 Self Locking Hex Nut	1
43	69028-0155	69028-0155	Ball Retainer 1/8 in.	2
44	69028-0156	69028-0156	Spring - Ball Retainer	2
45	69028-0640	69028-0640	Extension Spring	1
46	69028-0660	69028-0660	Drag Spring	2
47	69028-0808	69028-0808	Washer 0.15 Thick	1
48	69028-0809	69028-0809	Washer .0.18Thick	1
49	69028-0836	69028-0836	Snap Ring 3.2 ID by 7 OD by .62 Thk	2
50	N/A	N/A	M4 Hex Nut	1**

Mini-Mac Applicator Heavy Duty <b>VERSION 1</b>				
Item	Order No.	Engineering No.	Description	Qty
51	N/A	N/A	M3 by 6 Long FHCS	2**
52	N/A	N/A	M4 by 8 Long Set Screw	2**
53	N/A	N/A	M4 by 8 Long BHCS	1**
54	N/A	N/A	M4 by 12 Long BHCS	1**
55	N/A	N/A	M4 by 45 Long SHCS	1**
56	N/A	N/A	M5 by 6 Long BHCS	1**
57	N/A	N/A	M5 by 10 Long SHCS	1**
58	N/A	N/A	M5 by 25 Long SHCS	1**
59	N/A	N/A	M5 by 35 Long SHCS	4**
60	N/A	N/A	M6 by 10 Long BHCS	2**
61	N/A	N/A	M6 by 8 Long Set Screw	1**
62	N/A	N/A	M8 by 25 Long BHCS	1**
63	N/A	N/A	3mm by 12 Long Roll Pin	2**
64	N/A	N/A	5mm by 20 Long Dowel Pin	1**
65	N/A	N/A	5mm by 25 Long Dowel Pin	1**
66	N/A	N/A	6mm by 10 Long Dowel Pin	1**
67	N/A	N/A	6mm by 12 Long Dowel Pin	2**
68	N/A	N/A	6mm by 20 Long Dowel Pin	1**
69	N/A	N/A	6mm by 45 Long Dowel Pin	2**
70	N/A	N/A	#2 (.098 Dia.) by .125 in. Long Drive Screw	2**
** Available from an industrial supply company such as MSC (1-800-645-7270).				



**VERSION 1** Mini-Mac Heavy Duty Applicator Assembly

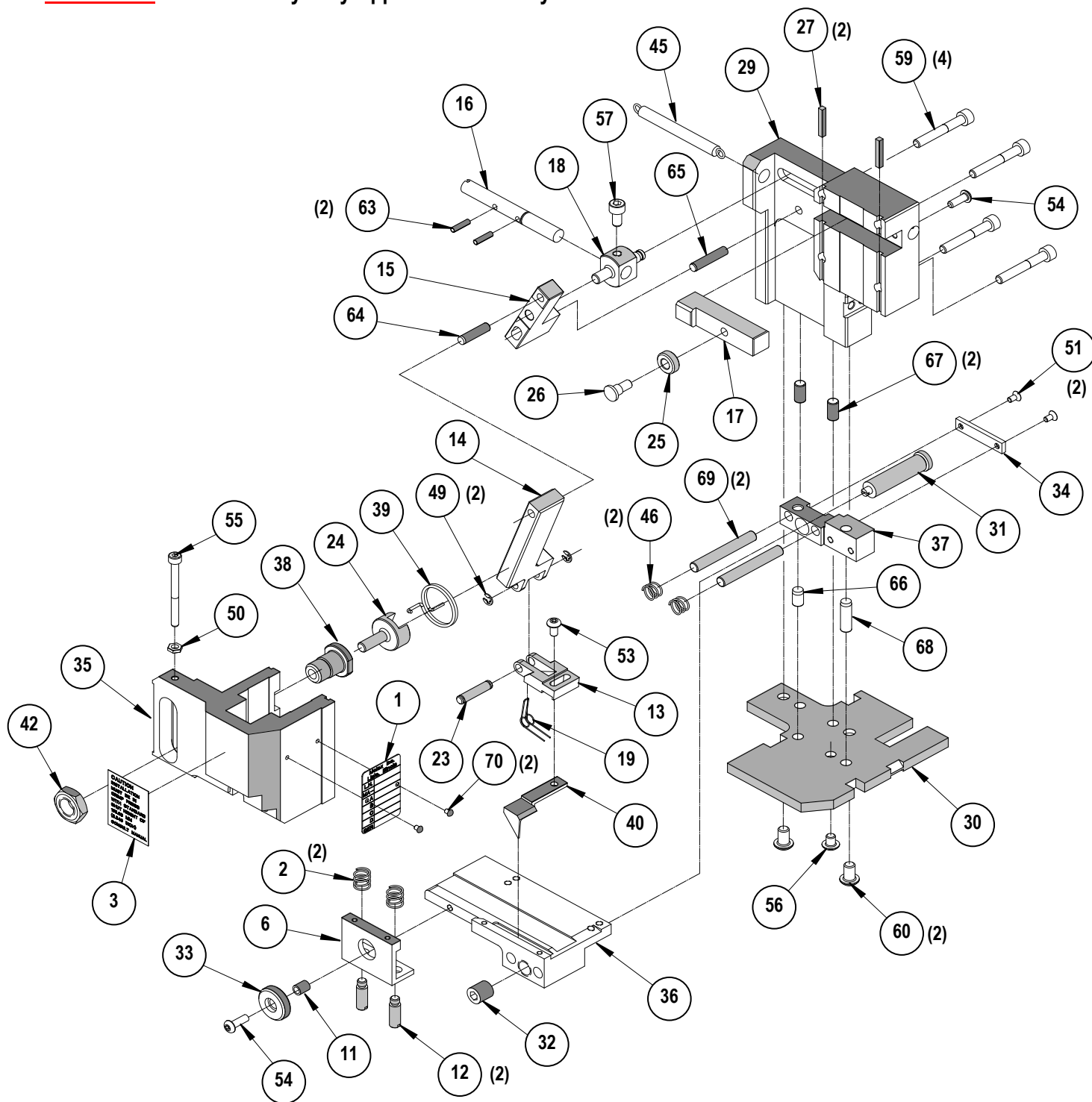
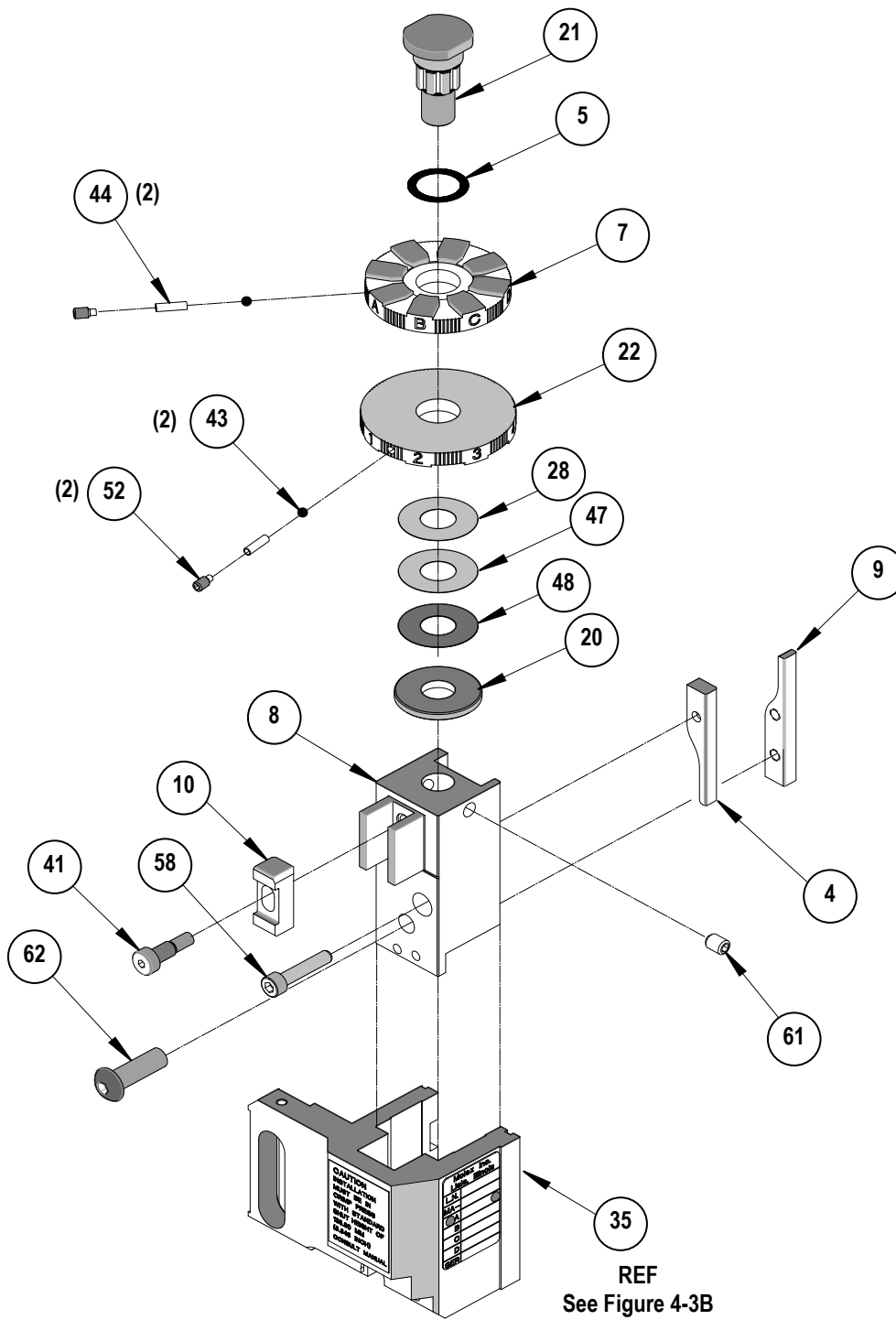


Figure 4-3B

## **VERSION 1** Mini-Mac Heavy Duty Applicator Assembly (Cont.)



**Figure 4-4B**

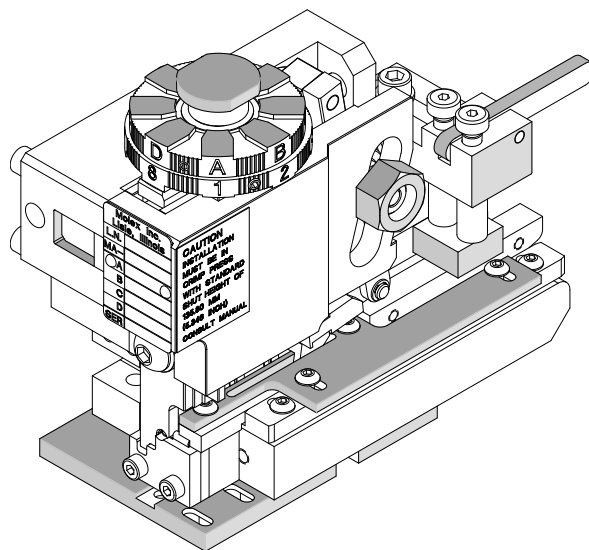


**VERSION 2 63801-2600-Parts List and Assembly Drawings for Mini-Mac Back Feed Applicator**

(See Figure 4-7 and 4-8)

63801-2600 Mini-Mac Back Feed Applicator <b>VERSION 2</b>				
Item	Order No.	Engineering No.	Description	Qty
1	*REF		Base Plate	1
2	*REF		Conductor Anvil	1
3	*REF		Conductor Punch	1
4	*REF		Cut-off Blade	1
5	*REF		Cut-off Blade (Front)	1
6	*REF		Cut-off Blade (Rear)	1
7	*REF		Feed Finger	1
8	*REF		Guide – L.H.	1
9	*REF		Guide – R.H.	1
10	*REF		Insulation Anvil	1
11	*REF		Insulation Punch	1
12	*REF		Spacer for Cut-off Blade	1
13	*REF		Stripper Blade	1
14	*REF		Terminal Track	1
15	*REF		Tooling Washer	1
16	*REF		Wire Stop	1
17	*REF		Compression Spring .360 OD by .035 WD by 1" Long	2**
18	*Ref		Anvil Mounting Screws	2**
19	*Ref		Track Mounting Screws	5**
20	*Ref		Cut-Off Mounting Screws	2**
21	*Ref		Wire Stop Mounting Screws	2**
22	*Ref		Track Mounting Screws	4**
23	*Ref		Dowel Pin	2**
24	11-17-3215	60654	Serial Tag (Mini-Mac)	1
25	11-18-0165	60700-65	Mini-Mac Label (Caution)	1
26	11-18-4795	60700-66	Wave Washer Spring	1
27	11-18-5016	60812A105	Conductor Adjusting Cam	1
28	69028-0634	69028-0634	Terminal Drag Plate	1
29	63800-0105	63800-0105	Feed Cam	1
30	63800-0106	63800-0106	Block Insulation Punch	1
31	63800-0117	63800-0117	Feed Pawl Lever	1
32	63800-0118	63800-0118	Hinge Bushing	1
33	63800-0121	63800-0121	Lever	1
34	63800-0122	63800-0122	Feed Adjusting Screw	1
35	63800-0124	63800-0124	Pin-Feed Adjusting	1
36	63800-0127	63800-0127	Torsion Spring	1
37	63800-0129	63800-0129	Washer	1
38	63800-0130	63800-0130	Lug Bolt	1
39	63800-0132	63800-0132	Insulation Adjusting Cam	1
40	63800-0140	63800-0140	Pin-Feed Arm	1
41	63800-0141	63800-0141	Slider	1
42	63800-0142	63800-0142	Roller	1
43	63800-0143	63800-0143	Pin	1
44	63801-2601	63801-2601	Frame	1
45	63801-2602	63801-2602	Front Frame	1
46	63801-2604	63801-2604	Ram	1
47	63801-2620	63801-2620	Feed Lever	1
48	63801-2623	63801-2623	Slider Feed Cam	1
49	63801-2625	63801-2625	Torsion Spring	1
50	63801-2692	63801-2692	Drag Mounting Bracket	1

63801-2600 Mini-Mac Back Feed Applicator <b>VERSION 2</b>				
Item	Order No.	Engineering No.	Description	Qty
51	63801-2693	63801-2693	Drag Mounting Bracket	1
52	63801-2694	63801-2694	Drag Lifting Lever	1
53	N/A	N/A	Compression Spring (Lee Spring # LC-020A-4MW)	2**
54	N/A	N/A	Extension Spring (Lee Spring # LE-041C-9)	1**
55	N/A	N/A	Snap Ring 3.2 ID by 7 OD mm by .62 mm Thk	2**
56	N/A	N/A	#2 (.098 Dia.) by .125 in. Long Drive Screw	2**
57	N/A	N/A	Ball Retainer 1/8 in.	1**
58	N/A	N/A	M4 by 8 Long Set Screw (Dog Point)	1**
59	N/A	N/A	M4 by 12 Long BHCS	1**
60	N/A	N/A	M5 by 10 Long SHCS	3**
61	N/A	N/A	Mounting Screws-M5 by 25 Long SHCS	2**
62	N/A	N/A	M5 by 45 Long SHCS	4**
63	N/A	N/A	M6 by 8 Long Set Screw	1**
64	N/A	N/A	M6 by 10 Long SHLDR Screw	1**
65	N/A	N/A	M6 by 20 Long SHCS	1**
66	N/A	N/A	M6 by 40 Long SHLDR Screw	2**
67	N/A	N/A	M6 Flat Washer	1**
68	N/A	N/A	M8 by 25 Long BHCS	1**
69	N/A	N/A	M12 Self Locking Hex Nut	1**
70	N/A	N/A	3mm by 12 Long Roll Pin	2**
71	N/A	N/A	4mm by 20 Long Dowel Pin	1**
72	N/A	N/A	5mm by 20 Long Dowel Pin	1**
73	N/A	N/A	5mm by 25 Long Dowel Pin	1**
The components indicated with * see Applicator Specification Sheet for part numbers.				
** Available from an industrial supply company such as MSC (1-800-645-7270).				



**VERSION 2** 63801-2600-Mini-Mac Back Feed Applicator Assembly

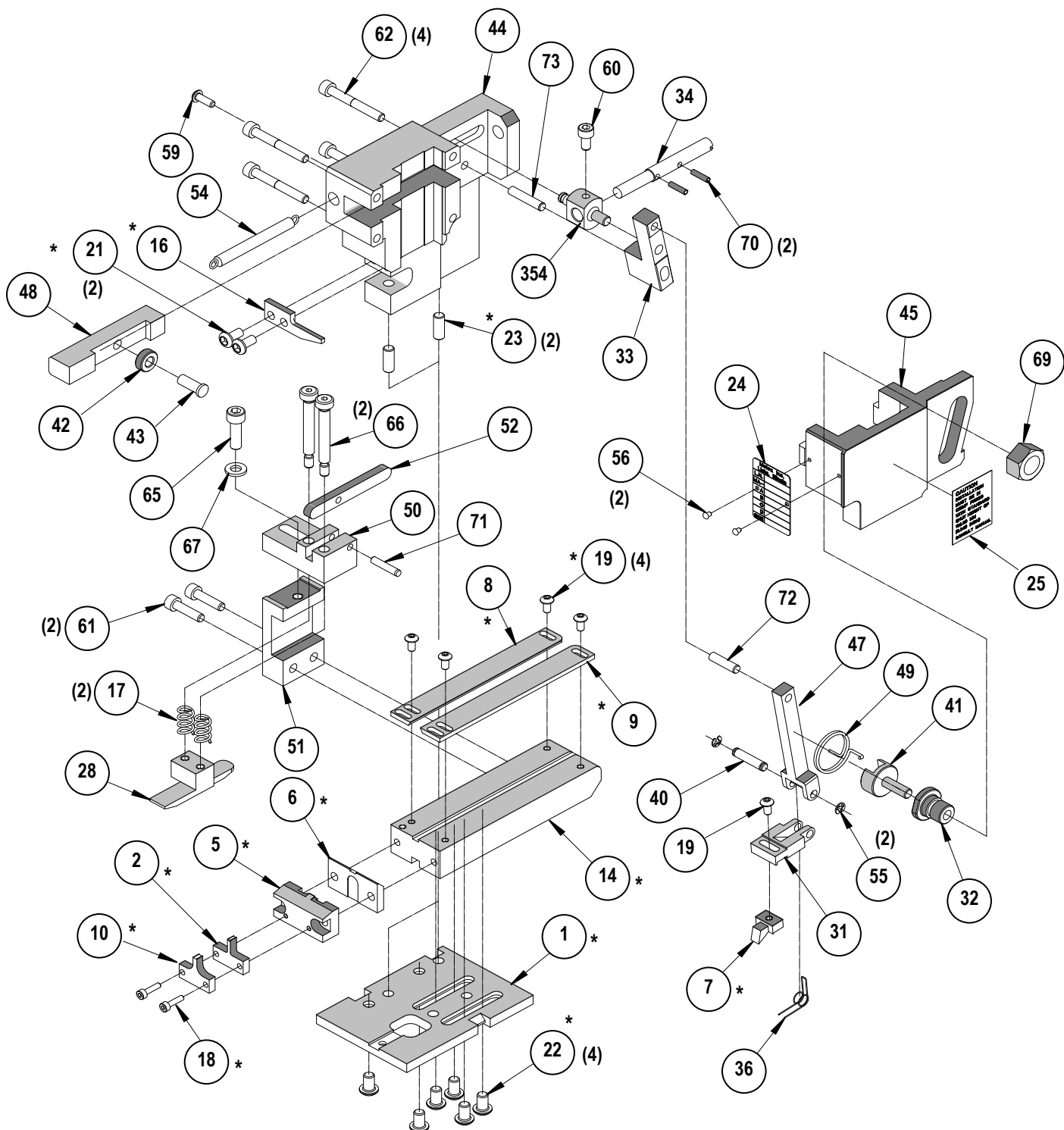


Figure 4-7

**VERSION 2** 63801-2600-Min-Mac Back Applicator Assembly (Cont.)

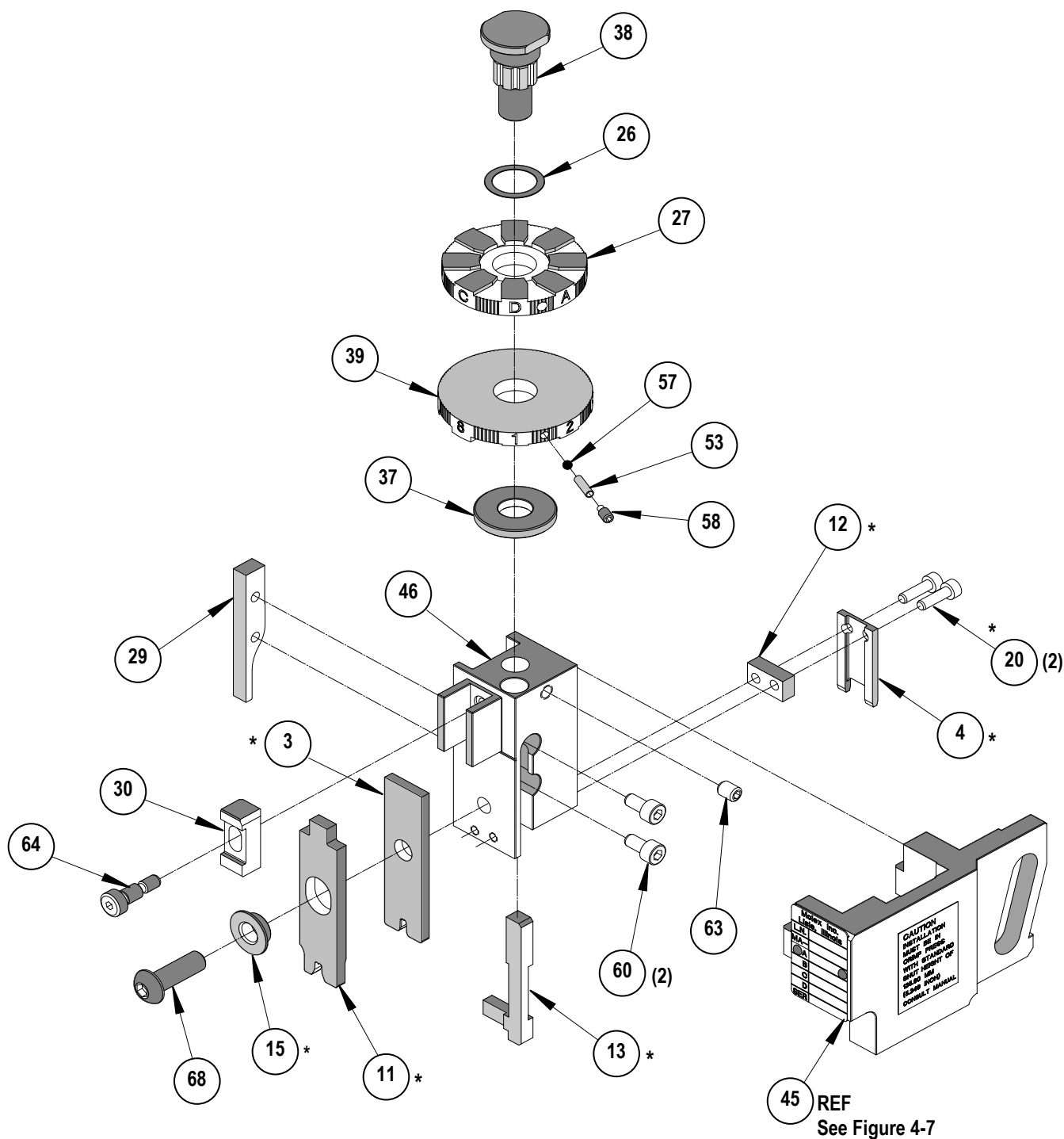
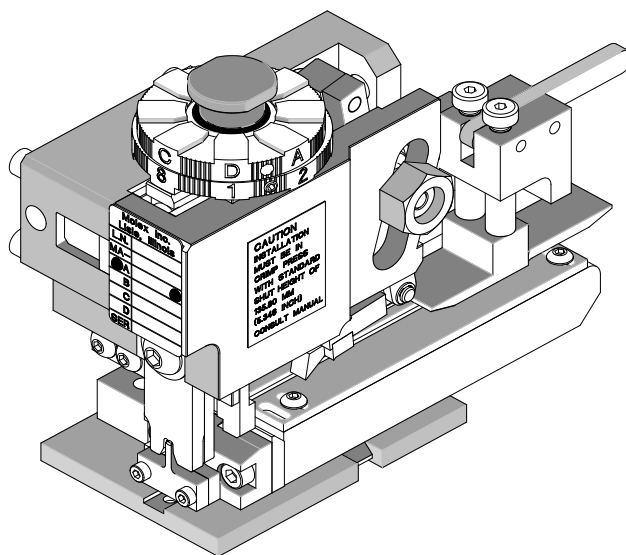


Figure 4-8

**VERSION 1** Parts List and Assembly Drawings for Mini-Mac Back Feed Applicator (See Figure 4-5 and 4-6)

Mini-Mac Back Feed Applicator <b>VERSION 1</b>				
Item	Order No.	Engineering No.	Description	Qty
1	11-17-3215	60654	Serial Tag (Mini-Mac)	1
2	11-18-0165	60700-65	Mini-Mac Label (Caution)	1
3	11-18-4238	60700-1	Feed Cam (Short)	1
4	11-18-4795	60700-66	Wave Washer Spring	1
5	11-18-5016	60812A105	Conductor Adjusting Cam	1
6	*REF		Insulation Punch	1
7	11-18-5123	60817A104	Wire Stop	1
8	*REF		Cut-off Blade	1
9	*REF		Spacer for Cut-off Blade	1
10	*REF		Guide – R.H. (Modified)	1
11	*REF		Cut-off Blade (Rear)	1
12	*REF		Cut-off Blade (Front)	1
13	*REF		Tooling Washer	1
14	*REF		Stripper Blade (Modified)	1
15	*REF		Terminal Track (Modified)	1
16	*REF		Conductor Anvil	1
17	*REF		Feed Finger (Modified)	1
18	*REF		Conductor Punch	1
19	*REF		Insulation Anvil	1
20	*REF		Guide – L.H. (Modified)	1
21	63800-0132	63800-0132	Insulation Adjusting Cam	1
22	69028-0106	69028-0106	Feed Pawl Lever	1
23	69028-0109	69028-0109	Hinge Bushing	1
24	69028-0110	69028-0110	Slider	1
25	69028-0118	69028-0118	Roller	1
26	69028-0119	69028-0119	Pin	1
27	69028-0123	69028-0123	Lug Bolt	1
28	69028-0126	69028-0126	Block Insulation Punch	1
29	69028-0154	69028-0154	Torsion Spring	1
30	69028-0290	69028-0290	Washer	1
31	69028-0323	69028-0323	Pin	1
32	69028-0628	69028-0628	Base Plate	1
33	69028-0630	69028-0630	Brake Spring	2
34	69028-0631	69028-0631	Feed Lever	1
35	69028-0632	69028-0632	Drag Mounting Bracket	1
36	69028-0633	69028-0633	Drag Lifting Lever	1
37	69028-0634	69028-0634	Terminal Drag Plate	1
38	69028-0636	69028-0636	Lever	1
39	69028-0637	69028-0637	Feed Adjusting Screw	1
40	69028-0638	69028-0638	Pin-Feed Adjusting	1
41	69028-0639	69028-0639	Slider Feed Cam	1
42	69028-0641	69028-0641	Ram	1
43	69028-0667	69028-0667	Torsion Spring	1
44	69028-0837	69028-0837	Pin-Feed Arm	1
45	69028-0919	69028-0919	Front Frame (Hardened)	1
46	69028-0999	69028-0999	Frame	1
47	N/A	N/A	Compression Spring (Assoc. # CO360-045-2250-S)	1**
48	N/A	N/A	Compression Spring (Lee Spring # LC-020A-4MW)	1**
49	N/A	N/A	Extension Spring (Lee Spring # LE-041C-9)	1**
50	N/A	N/A	Snap Ring 3.2 ID by 7 OD mm by .62 mm Thk	2**

Mini-Mac Back Feed Applicator <b>VERSION 1</b>				
Item	Order No.	Engineering No.	Description	Qty
51	N/A	N/A	#2 (.098 Dia.) by .125 in. Long Drive Screw	2**
52	N/A	N/A	M3 by 16 Long SHCS	2**
53	N/A	N/A	Ball Retainer 1/8 in.	1**
54	N/A	N/A	M4 by 8 Long Set Screw (Dog Point)	1**
55	N/A	N/A	M4 by 8 Long BHCS	5**
56	N/A	N/A	M4 by 12 Long BHCS	1**
57	N/A	N/A	M4 by 14 Long SHCS	2**
58	N/A	N/A	M5 by 10 Long SHCS	3**
59	N/A	N/A	M5 by 12 Long BHCS	2**
60	N/A	N/A	M5 by 20 Long SHCS	4**
61	N/A	N/A	M5 by 45 Long SHCS	4**
62	N/A	N/A	M6 by 10 Long BHCS	6**
63	N/A	N/A	M6 by 8 Long Set Screw	1**
64	N/A	N/A	M6 by 10 Long SHLDR Screw	1**
65	N/A	N/A	M6 by 40 Long SHLDR Screw	2**
66	N/A	N/A	M8 by 25 Long BHCS	1**
67	N/A	N/A	M12 Self Locking Hex Nut	1**
68	N/A	N/A	3mm by 12 Long Roll Pin	2**
69	N/A	N/A	4mm by 20 Long Dowel Pin	1**
70	N/A	N/A	5mm by 20 Long Dowel Pin	1**
71	N/A	N/A	5mm by 25 Long Dowel Pin	1**
72	N/A	N/A	6mm by 16 Long Dowel Pin	2**
The components indicated with * see Applicator Specification Sheet for part numbers.				
** Available from an industrial supply company such as MSC (1-800-645-7270).				



**VERSION 1** Mini-Mac Back Feed Applicator Assembly

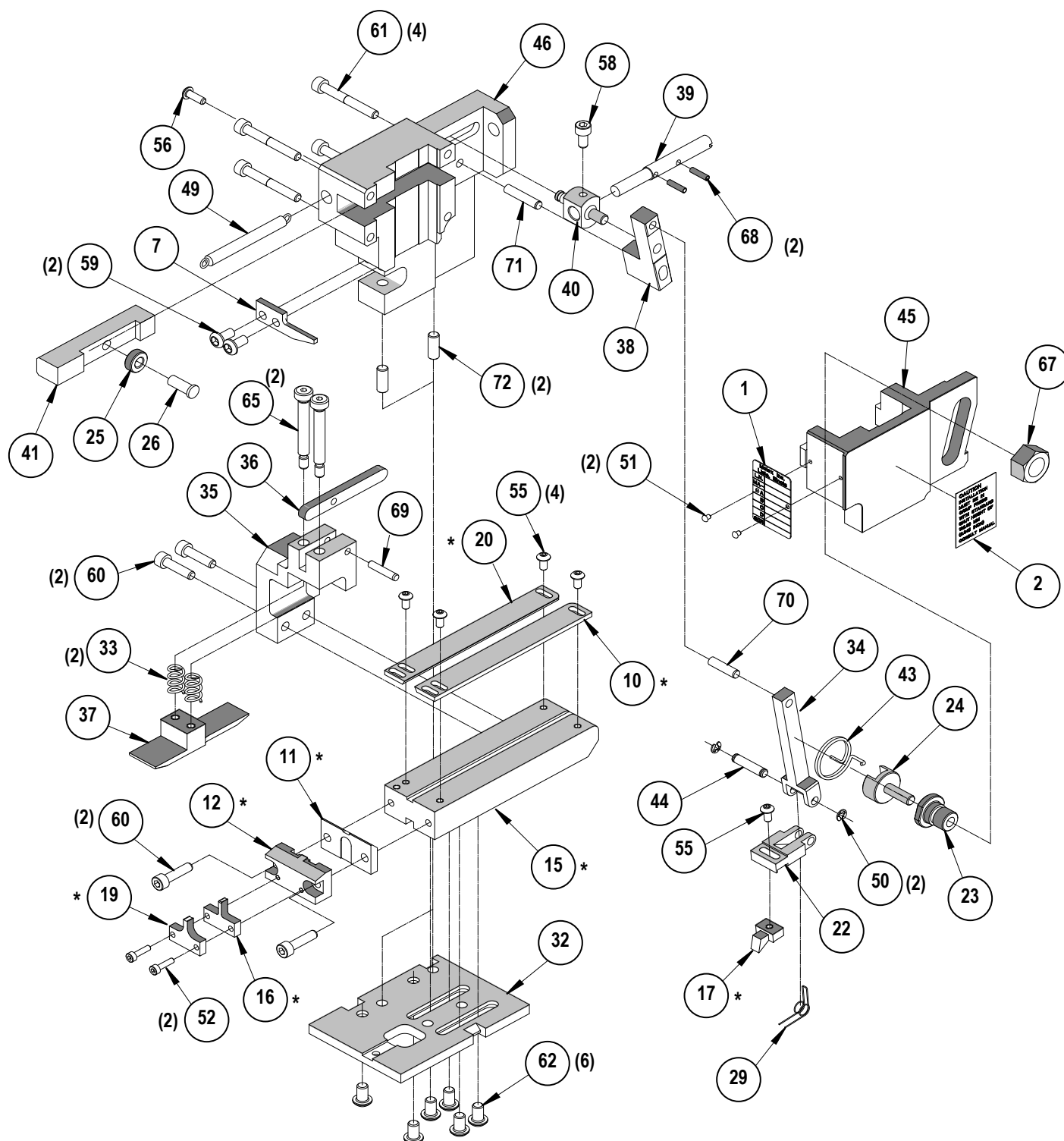


Figure 4-5

**VERSION 1** Min-Mac Back Feed Applicator Assembly (Cont.)

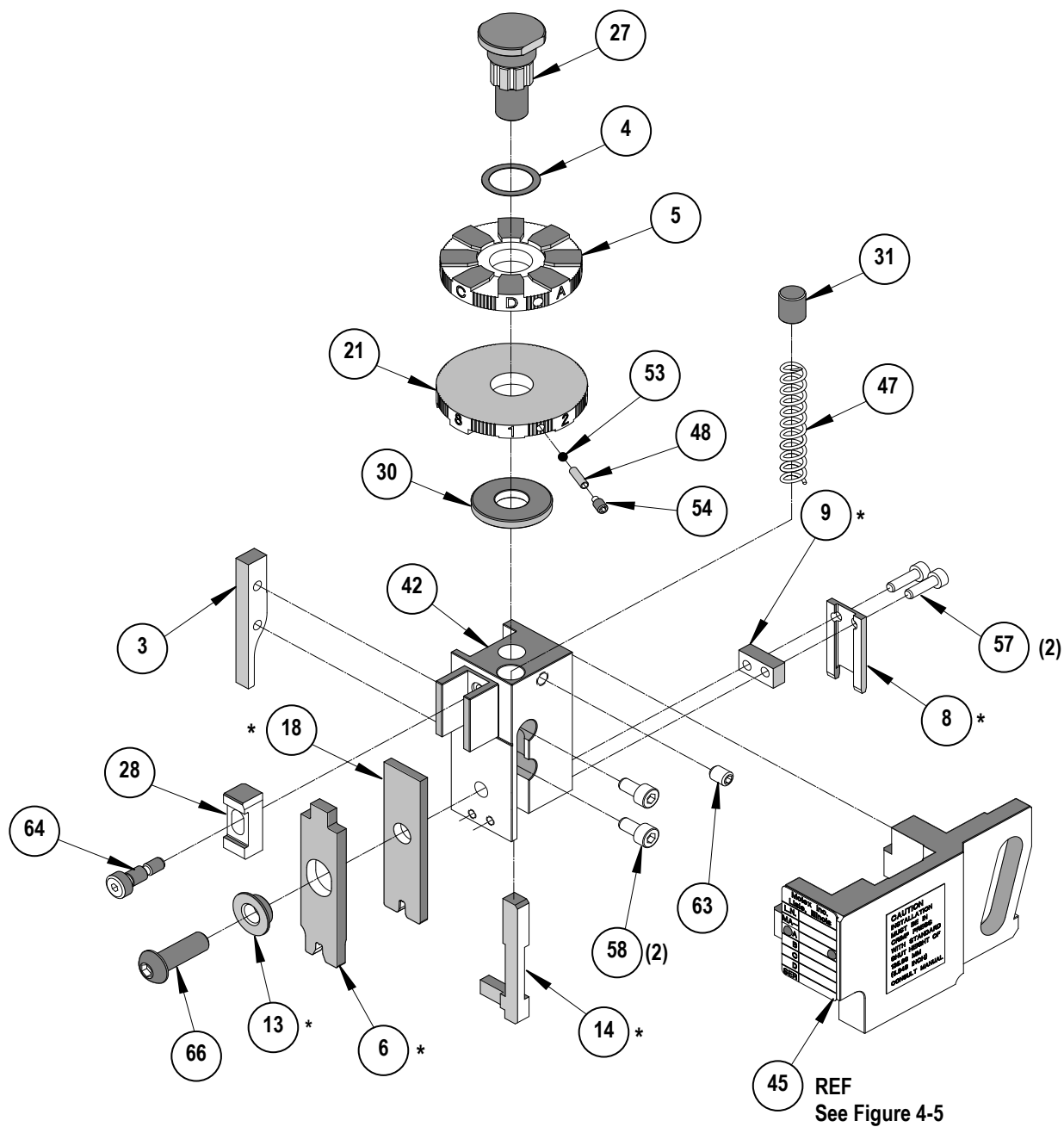


Figure 4-6

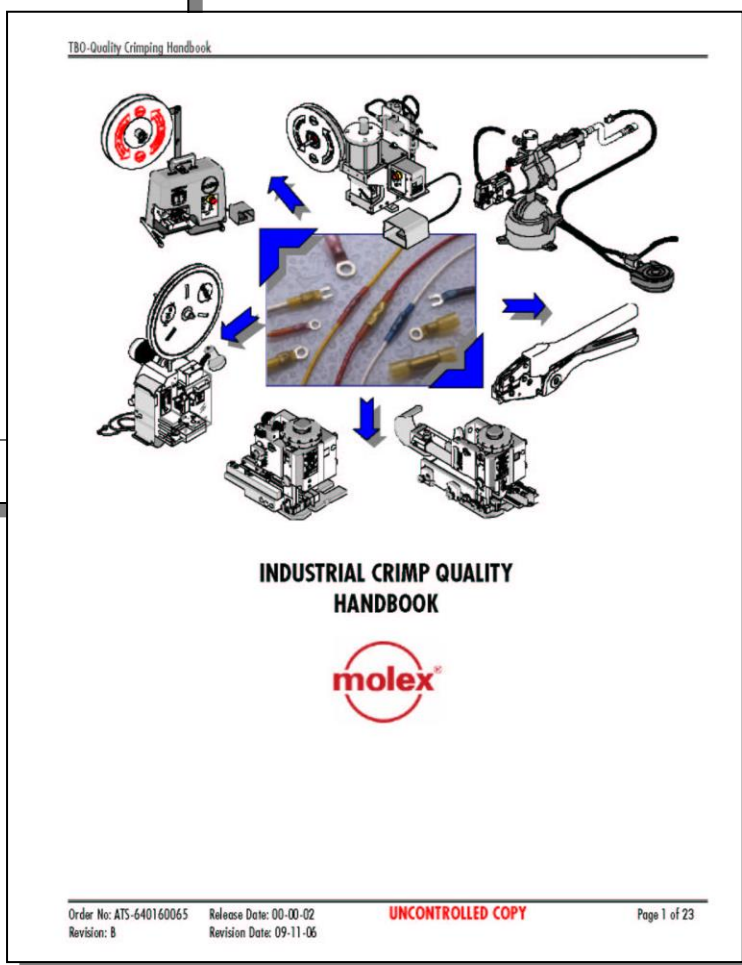
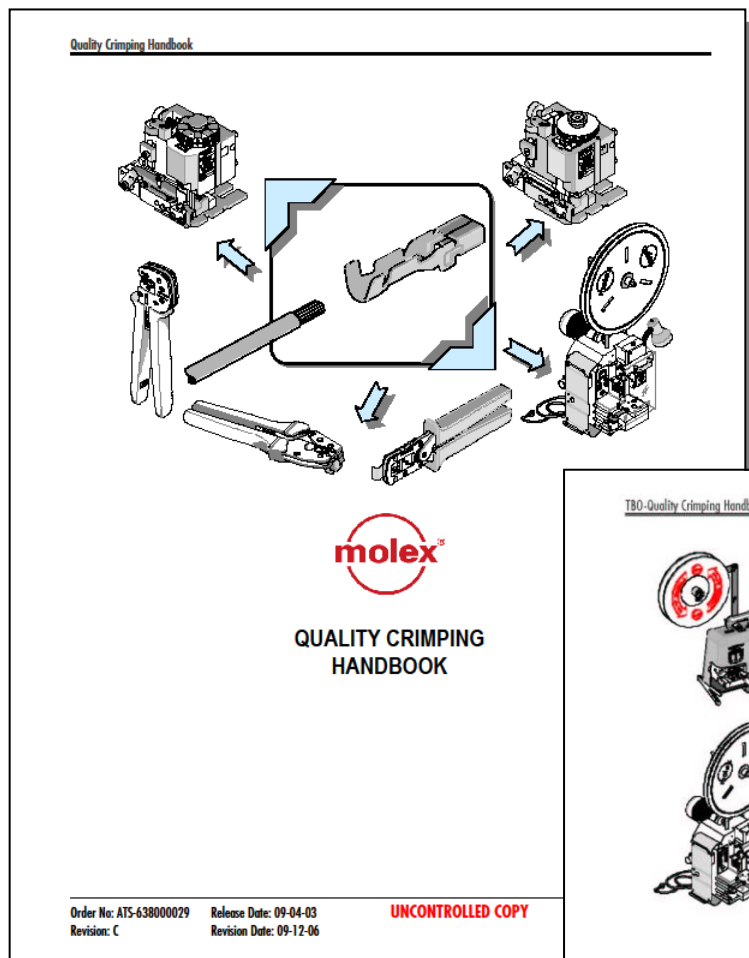


## 4.2 Troubleshooting

Symptom	Cause	Solution
Terminals do not index	▪ Verify terminals are not bent or damaged	Replace terminals
	▪ Feed finger worn or not properly adjusted	Check proper finger setting
	▪ Drag plate holding terminal strip back	Check compression springs. Replace if damaged
	▪ Terminal jammed under cover plate	Clear and reinsert terminals
Excessive flare	▪ Conductor punch worn	Replace
	▪ Terminal track out of position	Adjust base and track for proper alignment with the punches and anvil
Cut-off plunger does not return to original position	▪ Cut-off plunger adjusted to tight against anvil	Readjust
	▪ Cut-off plunger spring damaged or broken	Replace spring
	▪ Cut-off plunger sides or plunger retainer scored	Remove scoring marks. If problem not solved, replace with new cut-off parts
Conductor crimp is too loose	▪ Wrong tooling	Replace with proper tooling
	▪ Wrong cam setting	Back off one setting
	▪ Press shut height	Calibrate press
Conductor crimp is too tight	▪ Wrong tooling	Replace with proper tooling
	▪ Cam out of adjustment	Readjust conductor cam
	▪ Tooling backwards	Reverse mounting of tooling
	▪ Press shut height	Calibrate press
Insulation crimp is too tight	▪ Cam out of adjustment	Readjust insulation cam
	▪ Wrong tooling	Replace with proper tooling
	▪ Press shut height	Calibrate press
Terminal sticks during crimping	▪ Wrong tooling	Replace with proper tooling
	▪ Gold plating and some high tensile materials	Install a terminal oiler. See Appendix C

## For more information use the Quality Crimping Handbook And Industrial Crimping Handbook

There is no charge for these books, they can be found on the Molex Website ([www.molex.com](http://www.molex.com)) or contact you local Molex sales engineer



## Appendix

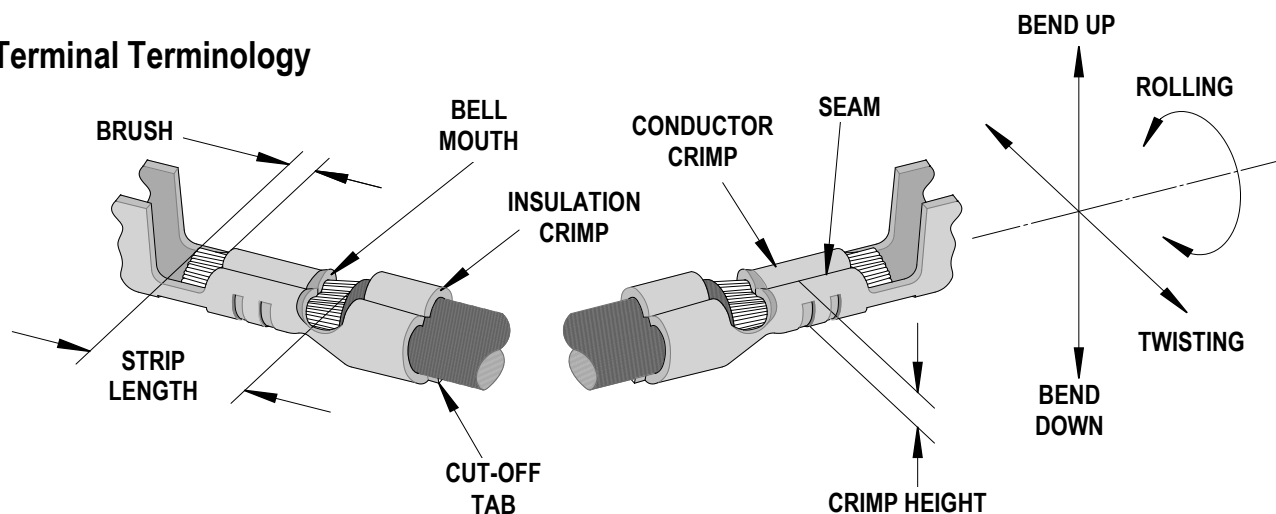
- A Crimp Terminations
- B Terms and Conditions
- C Options
  - 1. Oiler

## **Appendix A**

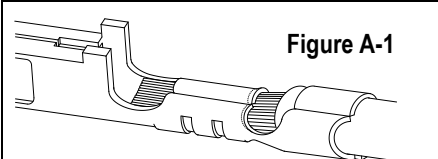
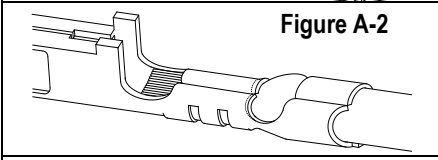
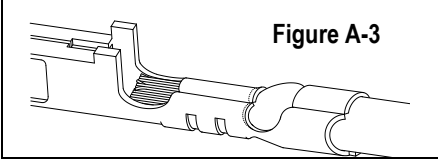
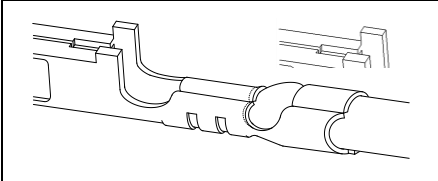
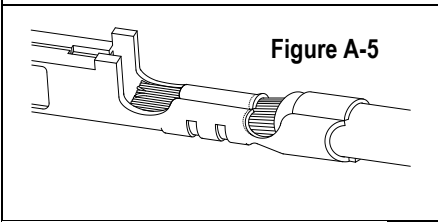
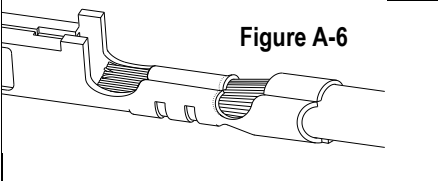
### **Crimp Terminations**

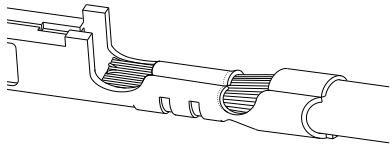
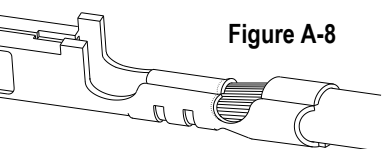
- A.1 Conductor Brush and Terminal Position
- A.2 Conductor Bell mouth and Terminal Cut-off Tab
- A.3 Conductor Crimp Height Measurement
- A.4 Insulation Crimp
- A.5 Pull Force Testing

## Terminal Terminology

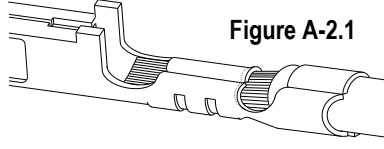
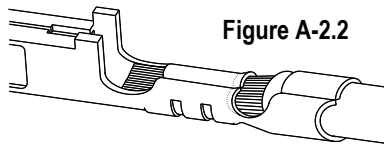
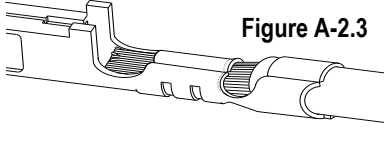
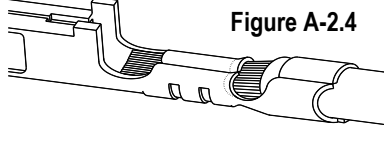
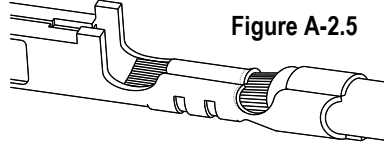


### A.1 Conductor Brush and Terminal Position

 <p><b>Figure A-1</b></p>	<p><b>A-1 Optimum Crimp Setup</b></p> <p>The insulation edge should be centered in the middle of the transition area. The conductor brush should extend past the conductor crimp and not extend into the contact area.</p>
 <p><b>Figure A-2</b></p>	<p><b>A-2 Insulation Under Conductor Crimp Good Conductor Brush Length</b></p> <p><b>Cause:</b> Strip length too short. <b>Solution:</b> Verify strip length specification and adjust as necessary.</p>
 <p><b>Figure A-3</b></p>	<p><b>A-3 Insulation Under Conductor Crimp, Long Conductor Brush Length</b></p> <p><b>Cause:</b> Wire stop position incorrect. <b>Solution:</b> Adjust wire stop to center the insulation in the transition area.</p>
 <p><b>Figure A-4</b></p>	<p><b>A-4 Insulation Under Conductor Crimp, Short or No Conductor Brush Length</b></p> <p><b>Cause:</b> 1) Strip length too short and 2) Wire stop position incorrect. <b>Solution:</b> 1) Verify strip length specification and adjust as necessary. 2) Adjust wire stop to center the insulation in the transition area.</p>
 <p><b>Figure A-5</b></p>	<p><b>A-5 Insulation Edge Centered in the Transition Area, Conductor Brush Too Long</b></p> <p><b>Cause:</b> 1) Strip length too long. 2) Irregular wire cut-off or wire strands pulled from insulation bundle. <b>Solution:</b> 1) Verify strip length specification and adjust as necessary. Readjust wire stop for bench applications 2) Check for worn stripping blades</p>
 <p><b>Figure A-6</b></p>	<p><b>A-6 Insulation Edge in the Center of Transition Area, Conductor Brush Too Short</b></p> <p><b>Cause:</b> Strip length too short. <b>Solution:</b> Verify strip length specification and adjust as necessary. Readjust wire stop for bench applications.</p>

	<p><b>A-7 Insulation Edge Under Insulation Crimp Form, Good or ong Conductor Brush Length</b></p> <p><b>Cause:</b> Strip length too long.</p> <p><b>Solution:</b> Verify strip length specification and adjust as necessary. Adjust the wire stop.</p>
 <p style="text-align: center;"><b>Figure A-8</b></p>	<p><b>A-8 Insulation Edge Under Insulation Crimp Form, Short or No Conductor Brush Length</b></p> <p><b>Cause:</b> 1) Wire stop position incorrect. 2) Verify operator's placement ability, or crimp rate.</p> <p><b>Solution:</b> 1) Adjust the wire stop to center the insulation in the transition area. 2) Operator training, reduce crimping rate.</p>

## A.2 Conductor Bell Mouth and Terminal Cutoff Tab

 <p style="text-align: center;"><b>Figure A-2.1</b></p>	<p><b>A-2.1 Optimum Crimp Setup</b></p> <p>Tooling was set up to produce conductor bell mouth to nominal specification and/or approximately 1x to 2x terminal material thickness. The cutoff tab is approximately 1x terminal material thickness.</p>
 <p style="text-align: center;"><b>Figure A-2.2</b></p>	<p><b>A-2.2 Excessive Bell mouth, Cutoff Tab Flush With Insulation Crimp</b></p> <p><b>Cause:</b> 1) Terminal tooling position. 2) Camber in the terminal strip.</p> <p><b>Solution:</b> 1) Verify pull force. 2) Adjust terminal track into the applicator.</p>
 <p style="text-align: center;"><b>Figure A-2.3</b></p>	<p><b>A-2.3 No or Small Bell mouth, Long Cutoff Tab</b></p> <p><b>Cause:</b> 1) Terminal to tooling position. 2) Camber in the terminal strip.</p> <p><b>Solution:</b> 1) Verify pull force. 2) Adjust terminal track towards operator.</p>
 <p style="text-align: center;"><b>Figure A-2.4</b></p>	<p><b>A-2.4 Excessive Bell mouth, Good Cutoff Tab</b></p> <p><b>Cause:</b> 1) Check for worn conductor punch tooling. 2) Check for correct conductor punch tooling.</p> <p><b>Solution:</b> Replace tooling if necessary</p>
 <p style="text-align: center;"><b>Figure A-2.5</b></p>	<p><b>A-2.5 Excessive Cutoff Tab, Good Conductor Bell mouth</b></p> <p><b>Cause:</b> 1) Check for worn cutoff tooling. 2) Check for correct cutoff tooling.</p> <p><b>Solution:</b> Replace tooling if necessary.</p>

### A.3 Crimp Height Measurement

**NOTE:** Conductor height should be measured with a blade type micrometer or a caliper.

**CAUTION:** Care must be taken not to measure the extrusions

#### A.3.1 Crimp height off target

**Cause:**

- 1) Changed wire type, stranding or vendor.
- 2) Changed insulation color or durometer.
- 3) Changed crimp tooling.
- 4) Changed crimping press.(Shut-height)
- 5) Changed press type. (Manufacturer)
- 6) Changed terminal reel. (Lot code)
- 7) Changed tooling set-up.
- 8) Damaged or worn tooling.

**Solution:** Adjust tooling back to target  
(Refer to Section 2.8 and 2.9)

#### A.3.2 Crimp height variability too high

**Cause:**

- 1) Wire variability.
- 2) Terminal variability.
- 3) Damaged, loose, or worn tooling.
- 4) Measurement error \*.
- 5) Terminal spring back too great \*\*.
- 6) Cut or missing wire strands.

**Solution:**

- 1 or 2) Inspect incoming product for variability.
- 3) Tooling replacement or tightening.
- 4) Gauge capability analysis.
- 5) Tooling crimp height adjustment.
- 6) Stripping process adjustment.

\* Most common cause of crimp height variability

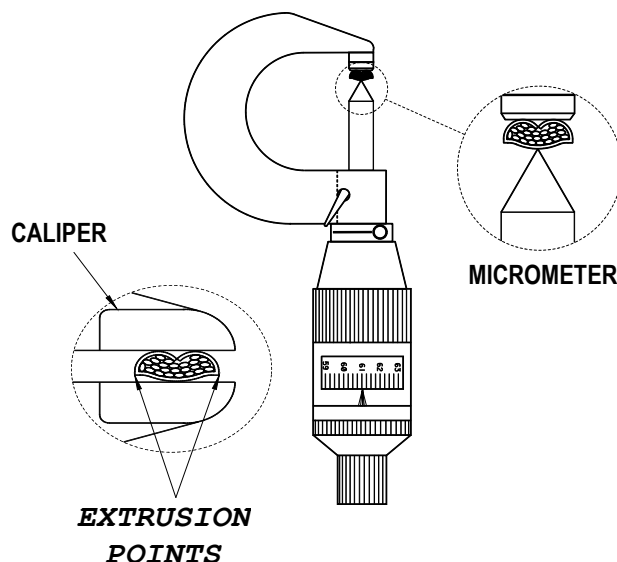


Figure A-3.1  
CRIMP HEIGHT MEASUREMENT

### A.4 Insulation Crimp

#### A.4.1 Preferred Insulation Crimp

It is preferred that the insulation crimp completely surrounds the outside diameter of the insulation. The terminal should hold on to the wire as firmly as possible without cutting through to the conductor strands. It should be noted that a preferred crimp only occurs in a small portion of the full insulation range a terminal can accommodate. A preferred insulation crimp is recommended for high vibration or movement applications.

An overlap insulation crimp is normally only developed for high vibration or movement applications where the wire diameter is near the lower terminal specification limit.

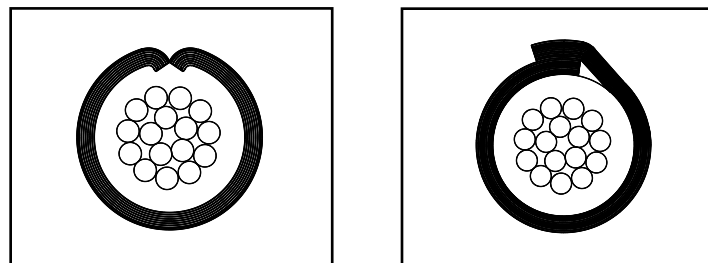


Figure A-4.1 Preferred Insulation Crimp

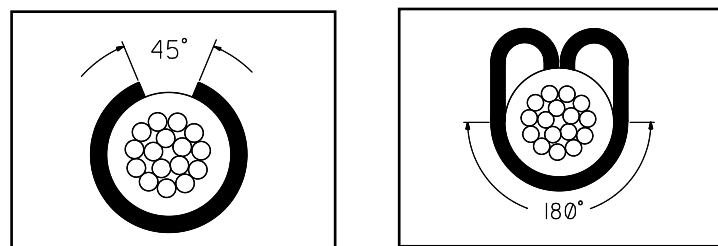


Figure A-4.2 Acceptable Insulation Crimp



#### A.4.2 Acceptable Insulation Crimp

A terminal is normally specified to cover a wide range of insulation wall thickness over a range of wire sizes. Within this specified range, an insulation crimp may not completely surround the wire or fully hold the full diameter of the wire. This condition will still give an acceptable insulation crimp for most applications.

- A large insulation crimp should firmly grip at least 88% of the wire.
- A smaller insulation crimp should firmly grip at least 50% of the wire and firmly hold the top of the wire.

#### A.4.3 Marginal Insulation Crimp

An insulation diameter near the maximum and minimum specification of a terminal may cover less than what is normally considered acceptable. These strain reliefs should only be used on applications that have low vibration or movement.

- An insulation crimp that covers less than 88% of a large insulation diameter.

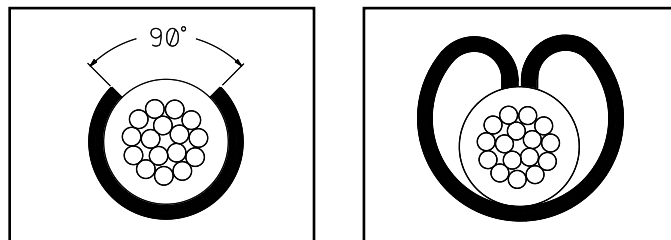


Figure A-4.3 Marginal Insulation Crimp

**Cause:** Not enough terminal grip length.

**Solution:** 1) Evaluate if the same terminal is available in a different wire range.

- Try crimping the wire one setting tighter. This will embed the terminal more into the insulation. The insulation wall thickness is normally enough; therefore cutting strands is not a worry. Terminal insulation grips kicking back away from the terminal or slight insulation bulging may be noticed. Evaluate the terminal loaded into a housing for acceptability

- An insulation crimp that covers less than 50% of a small insulation diameter.

**Cause:** Too much terminal grip.

**Solution:** 1) Find out if the same terminal is available in a different wire range.

- Find out if overlap crimp tooling is available.

#### A.4.4 Marginal Insulation Crimp

For insulation diameters that are small, thin-walled insulated wire. A loose crimp ensures no strand damage and offers insulation containment. Insulation crimps that pierce through the insulation will offer more strain relief. In some cases insulation terminal grips will push the strands to the side. Yet, there is always the possibility that a wire strand could be nicked. In severe cases, a wire strand may be cut. Careful application evaluation is needed for both of these cases.

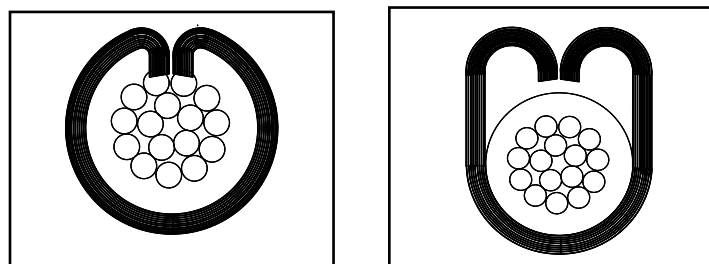


Figure A-4.4 Marginal Insulation Crimp

**Cause:** 1) Crimp tooling adjustment.

- Wire diameter variability.

## A.5 Pull Force Testing

### A.5.1 Pull Force Procedure

Wire connectors and soldering lugs for use with copper conductors. (Per UL486A October 8, 1991) UL Section 12 Pullout Test.

12.1 The connectors subjected to the static heating test or secureness test shall be subjected to a direct pull of the value specified for one minute. Only those conductors that have been subjected to the secureness test are to be subjected to the pullout test. The connector is acceptable if it does not become separated from the conductor or conductors after completion of the test.

12.2 For an insulated connector in which the insulation is assembled to the connector during installation, the test should be conducted with the insulation in place if it is always supplied with the connector by the manufacturer. Otherwise, the test should be conducted without the insulation assembled to the connector. Breaking or tearing of the insulation of an insulated connector is acceptable in the pullout test. The pull is to be exerted by means of a tension testing machine or equivalent, so that there will be no sudden application of force or jerking during the test.

The following is the procedure Molex uses for the qualification of pull force:

1. Cut wire length approximately 150mm (6.0") long.
2. Strip one end to 13mm (.50"), or long enough so no wire insulation is under the insulation grip.
3. Terminate the appropriate terminal to the wire to the nominal crimp height.
4. Visually inspect the termination for bell mouth, wire brush and cut strands.
5. Set pull tester to 25.4mm (1.0") per minute. For most applications, a higher rate will not have a significant impact on the data. Verify higher pull rates with data taken at 25.4mm (1.0") per minute.
6. Knot the non-terminated end of the wire.
7. Regardless of pull tester type, both wire and terminated end must be securely clamped. (Note: If Clamp terminal contact interface, do not clamp conductor crimp.)
8. Activate pull test.
9. Record a minimum of 25 readings of maximum pull force. After the application has been qualified, a minimum of 5 pull force measurements should be done to confirm each setup.
10. Compare lowest reading to minimum pull force specification.

### A.5.2 Pull Test Problems

#### A.5.2.1 Wire breaks before conductor grip pull force low

##### Material Evaluation

**Cause:** Wire material properties, and/or coatings.

**Solution:** Test non-terminated wire for breaking strength.

##### Stripping Evaluation

**Cause:** Cut or nicked strands from stripping operation.

- 1) Wire being manually stripped.
- 2) Poor automatic stripping cutoff.
- 3) Worn strip tooling.

**Solution:** 1) Switch to semiautomatic or automatic wire stripping machine.  
2) Correct stripping machine setup.

Test Values For Pullout Test UL486A			
Conductor Size		Pullout Force	
AWG	mm <sup>2</sup>	N	LB
30	0.05	6.7	1.5
28	0.08	8.9	2
26	0.13	13.4	3
24	0.20	22.3	5
22	0.324	35.6	8
20	0.519	57.9	13
18	0.823	89.0	20
16	1.31	133.5	30
14	2.08	222.6	50
12	3.31	311.5	70
10	5.261	356.0	80
9	8.367	400.5	90

#### A.5.2.2 Wire pulls out of conductor grip, crimp height good

##### Material Evaluation

**Cause:** 1) Terminal material thickness too small.  
2) Terminal serration depth/form.  
3) Terminal plating thickness.  
4) Gold plating application.

**Solution:** 1) Evaluate a new terminal.  
2) Or 3) Contact terminal manufacturer.  
4) Evaluate selective Gold application.

##### Stripping Evaluation

**Cause:** Wrong strip length, poor conductor brush.

**Solution:** Adjust strip length.

## Appendix B

### Statistical Process Control (Summary)

- 1 Crimp Process Control
- 2 Process Capability
- 3 Production

## 1 Crimp Process Control

The crimp process is the interaction of a terminal, wire, tooling, personnel, methods and procedures, and environmental attributes that, when controlled, produce a quality termination. Quality control is an important aspect of quality crimping. It should not take excessive setup or inspection time to implement, and can save a harness manufacturer thousands of dollars in potential rework or re-manufacturing.

The key to quality is to target nominal specifications while continuously reducing variability. Achieving target is determined by the adjustability of the tooling. The Mini-Mac Applicator allows crimp height adjustment to .005 mm (.0002") of target.

Variability is the slight changes that occur from crimp to crimp. There are two types of variability, common and special. Common sources of variation are those causes that affect the process uniformly, and are created from numerous small sources. Common variability is inherent tolerances within a reel of wire or terminals. In addition, common variability is created by the natural tolerances of the stripping and crimping machines. Reduction of variability at the common level normally has to come from changes at the wire, terminal, and tooling manufacturer.

The second source of variability is referred to as special cause. Unlike common cause, special sources of variation occur irregularly and unpredictably. Without checks throughout a run, a tool becoming loose after the first hundred crimps, or a damaged tool from a jam, may be undetected until thousands of crimps are made.

This section assumes that crimp height is being measured with a resolution of .0025 mm (.0001"), and pull force is measured with a resolution of one N (.25 lbs).

## 2 Process Capability

Molex qualifies each Mini-Mac Applicator design for pull force and crimp height.

This qualification is performed on a common wire stranding, and is targeted at two CpK. Before a new crimping tool is put in production, it is recommended that the customer using their specific wire in their

process should do a capability study. A capability study is based on the assumption of a normal distribution (bell-type curve). It provides an estimate on the probability of a measurement being outside of specification.

CpK	+/- Sigma	% Yield	PPM
0.67	2	95.45	45,500
1	3	99.73	2,699
1.33	4	99.99	63
1.67	5	99.99+	0.57
2	6	99.99++	0

PPM - Parts per million potential defects.

A minimum of a 25 piece sample should be run off the crimping process. The average and standard deviation should be calculated for each specification.

A capability index is defined by the formula below. Cp may range in value from 0 to infinity, with a larger value indicating a more capable process. A value greater than (>)1.33 is normally considered acceptable.

$$\frac{\text{Tolerance}}{6 \times \text{Standard Deviation}}$$

The CpK index indicates whether the process will produce units within the tolerance limits. CpK has a value equal to Cp if the process is centered on the mean of specification; if CpK is negative, the process mean is outside the specification limits; if CpK is between 0 and 1 then some of the 6 sigma spread falls outside the tolerance limits. If CpK is larger than 1, the 6 sigma spread is completely within the tolerance limits. CpK is calculated with the lesser of the following formulas:

$$\frac{(\text{USL} - \text{MEAN})}{3 \times \text{Standard Deviation}} \quad \frac{(\text{LSL} - \text{MEAN})}{3 \times \text{Standard Deviation}}$$

USL = Upper Specification Limit, LSL = Lower Specification Limit

Six sigma is a goal of many companies because it represents virtually zero defects. The ability of a company to achieve a six sigma level is dependent on the amount of common variability in their process. Hand stripping of the wire will produce more variability than a stripping machine. A

crimping hand tool will produce more variability than a press and die set. Bench terminations will produce more variability than a wire processing machine.

A portion of the variability in crimping will come from what instruments are used to measure the parts and the ability of an operator to repeat the measurement. A crimp micrometer will measure more accurately than a dial caliper. An automatic pull force system will measure better than a hook type scale. It is important that the measurement gauge has enough resolution. Two operators may measure the same part differently, or the same operator may measure the part different when using two types of gauges. A gauge capability study is recommended to identify what part of the variability is coming from measurement error. Micro-terminals crimped to small wire sizes need a tight crimp height range to maintain pull force. The variability from measurement error can keep CpKs low.

The capability of the crimping tools should be re-confirmed if the production data is significantly different from the capability study.

### 3 Production

Once the level of capability is established, the tool is ready for production.

Many harness manufacturers run only a few hundred or few thousand wires at one time. In this case, it is not practical or economical to run a twenty-five-piece capability with every set-up.

#### Setup Confirmation

After the setup of the crimping process, crimp five terminals with a loose insulation crimp. Visually inspect or measure bell mouth, cut-off tab length, conductor brush, insulation position, and conductor crimp height. Make the appropriate adjustments to the machine. (Refer to trouble shooting sections if needed). After all adjustments have been made, crimp five more samples for pull force evaluation. The pull force is a good indicator for cut or nicked strands, short conductor brush, small bell mouth, or incorrect crimp height. Calculate the average. Compare the average and minimum reading with the capability study data.

After the pull force has been confirmed, set the insulation crimp to the appropriate setting. Re-check crimp height and make adjustments if necessary.

Crimp five more samples and document the average crimp height, the maximum reading, and the minimum reading.

The range is considered the maximum reading minus the minimum reading. With a crimp micrometer and an experienced operator, the range for crimp terminations is normally only a few ten thousandths of an inch. This data becomes the first point on the control chart.

#### Production (Control Charting)

It should be normal procedure for the operator to visually fan each bundle of crimped wires and visually check bell mouth, conductor brush, insulation position, and cut-off tab length and insulation crimp. Crimp height should be checked throughout the run. The frequency of each check is determined by the risk you wish to take for scraping parts. A check every 250 to 500 parts is recommended.

#### Control Charting

Crimp height is normally control charted since it is a quick nondestructive measurement and is critical for the electrical reliability of the termination.

There are three primary purposes for control charting. First, the number of setup samples are normally small, and its statistical value is limited. Second, since special cause effects on a process are irregular and unpredictable, it is necessary to have a means of catching changes in the process as soon as they occur. This prevents thousands of terminations from being scrapped after the run is over. Third and most important, this data is necessary to assess and improve the crimp process.

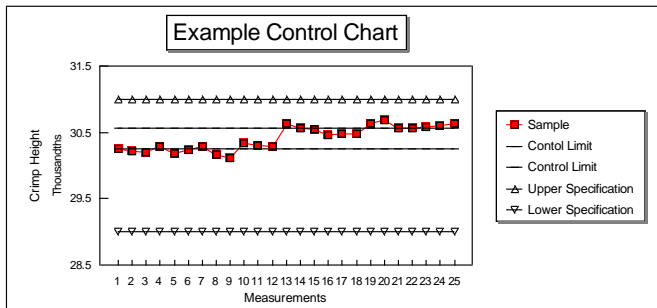
Once the tooling process is set-up and the wire size is not changing, keep one control chart for wire color changes, wire length changes, terminal material changes, or setup adjustments. Record the data point on the chart before a crimp height adjustment is made. If data is recorded after each adjustment, the process most

likely will assume control and provide little data for improving the process.

Write as many notes on the chart as possible. The only truly effective and economically sensible manner of managing a manufacturing process is to understand, monitor, and reduce sources of variability inherent to the process itself. Every minute the process is down for setup or adjustment is unproductive.

What does this sample chart tell us? A process shift occurred between measurement 12 and 13. This type of shift could occur due to a change in wire, a change in terminal lots, a jam in the machine that damaged the tooling, a change in operators, or an adjustment to the insulation crimp. Since the measurements are still within specification, would you stop production to adjust crimp height?

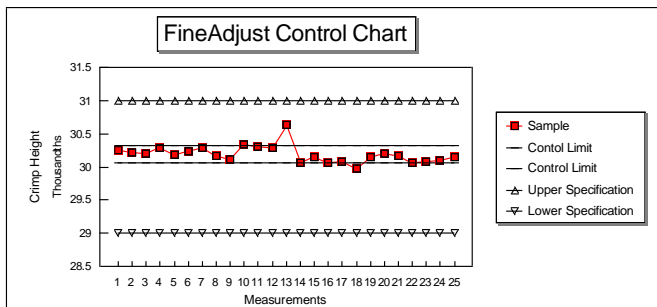
A shift in the process due to a change in material may arrant a crimp height adjustment. A shift after a jam would not indicate an adjustment, but a close evaluation of the tooling.



#### X and R Chart

Control Limit for sample of 5 = Avg (Avg. of 5 readings)  
 $\pm .577 \times \text{Avg (Ranges)}$

A shift in the process between operators would not indicate an adjustment, but an evaluation of measurement capability.



The idea of the control chart is to identify what caused the shift to justify if a adjustment to the process is warranted.

The Mini-Mac Applicator is extremely easy to adjust. It is just as important to chart and document process control with the Mini-Mac applicator.

If the process shift is due to a jam or a change in operators, more evaluation may be necessary than an adjustment.

Many crimping processes have been producing product within specification for decades. Today, with statistical process control, the philosophy of quality is being within specification is being replaced by being on target with continuous reduction in variability. Control charting is a tool that truly allows a company to understand their process.

#### ATTENTION

Reference must always be made to product application / crimp specification to determine crimp parameters.



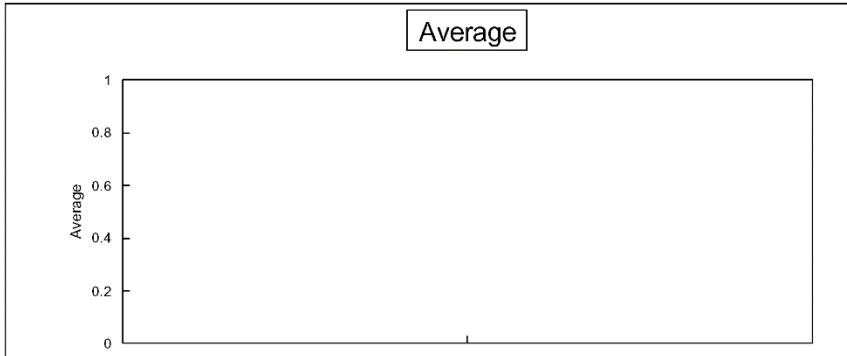


### CONTROL CHART FOR VARIABLES DATA

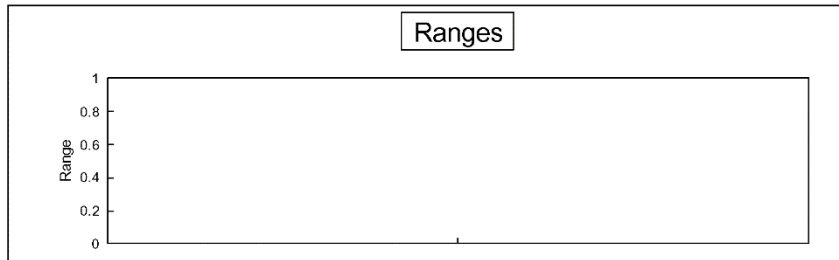
Machine No.  
Operator  
Upper Spec  
Lower Spec

StdDev(Values) ERR  
StdDev(Means) ERR  
Sample Size 5

Avg. of Avg. = ERR UCL = ERR LCL = ERR



Avg. Range = ERR UCL = ERR LCL = 0



Date/Time	1-5	15-19	30-34	45-49	60-64	75-79	90-94	105-109	120-124	135-139
1										
2										
3										
4										
5										
Avg.	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
Range	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR

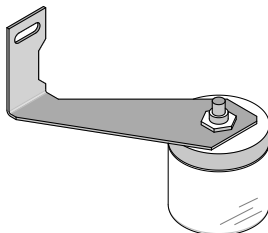
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## Appendix C

### Options

1 Oiler

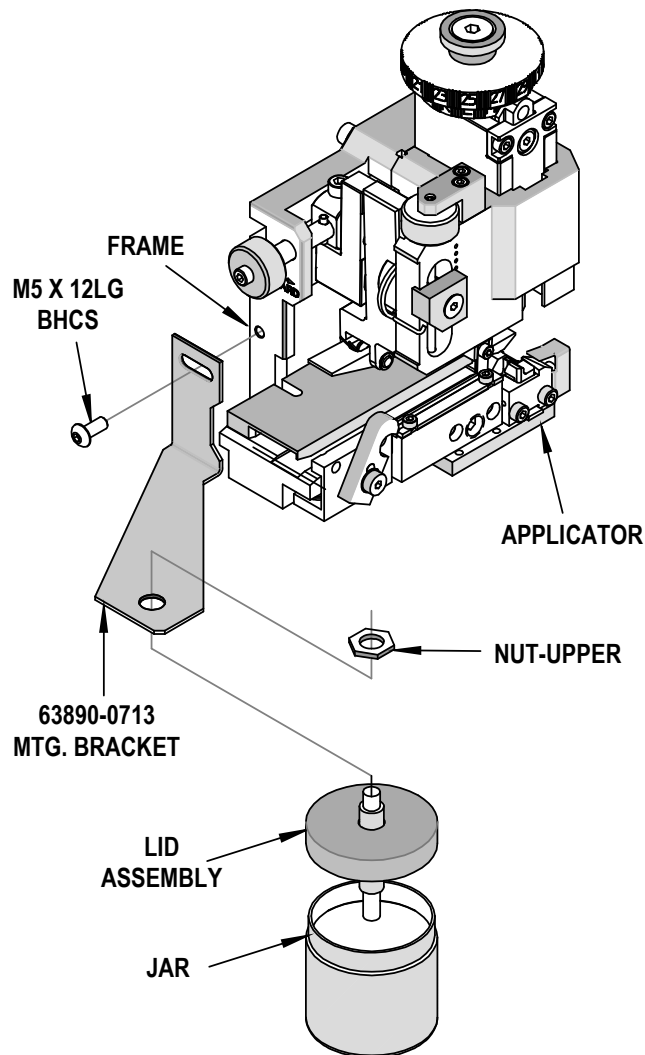
<b>Terminal Oiler For FineAdjust and Mini-Mac Applicators</b>	<b>molex</b> <sup>®</sup>	
	<b>Application Tooling Information Sheet</b>	

## Terminal Oiler

To install a Terminal Oiler (Order No. 63890-0719) to any FineAdjust or Mini-Mac Applicator, use the following procedure.

1. Remove lid assembly from the oiler jar.
2. Remove upper oiler nut from lid assembly.
3. Place oiler mtg. bracket over tube, replace upper nut, and tighten securely.
4. Place lid assembly with mtg. bracket on the oiler jar and turn until hand tight. Do not over tighten.
5. Mount terminal oiler assembly with bracket on the frame of the FineAdjust or Mini-Mac Applicator.
6. Recommended lubricant oil:

Product Name: Transdraw B-19  
Vendor: Mid-Town Petroleum  
 9707 South 76<sup>th</sup> Avenue  
 Bridgeview, IL 60455  
 Toll-Free: 877-255-3533  
 Direct: 708-599-8700  
 Fax: 708-599-1040  
 E-mail: sales@midtownoil.com  
 www.midtownoil.com  
 www.precisionlubricantsinc.com



7. For replacement wicks use part no. 63890-0727 (package of 25).

### Application Tooling Support

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