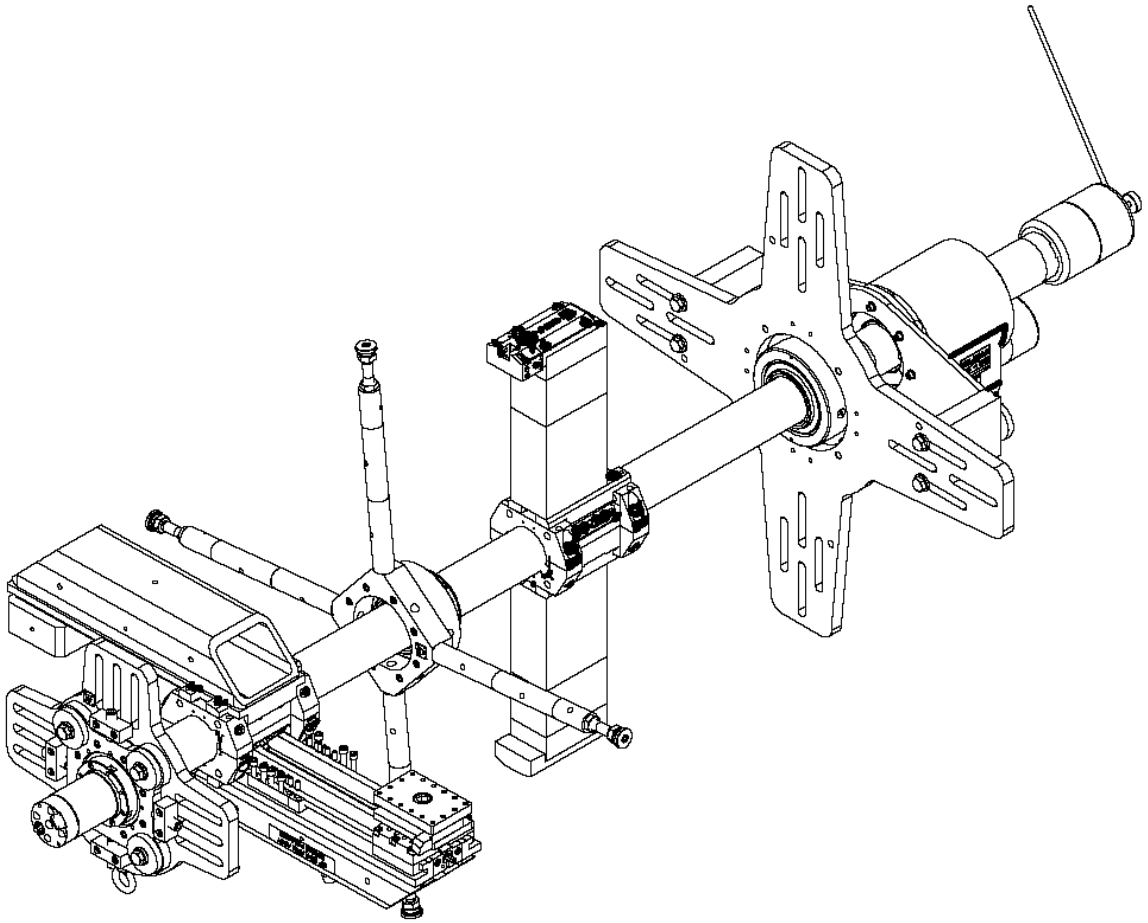
BB6100

BORING BAR

OPERATING MANUAL

ORIGINAL INSTRUCTIONS



CLIMAX

Portable Machining & Welding Systems

PN: 57017 **May 2019** **Revision 3**

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- Your name
- Shipping address
- Telephone number
- Machine model
- Serial number (if applicable)
- Date of purchase

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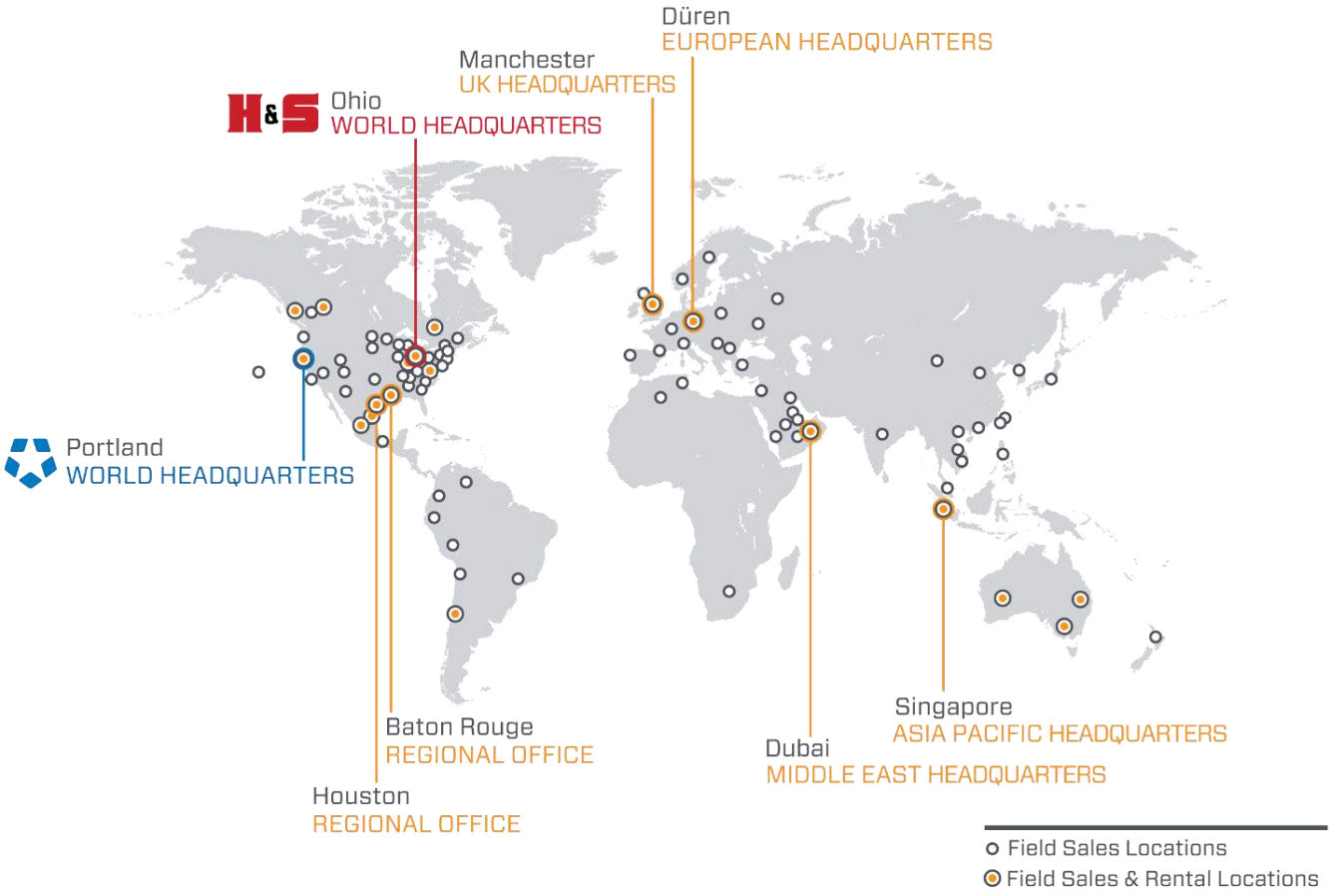
CLIMAX WORLDWIDE LOCATIONS



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1 INTRODUCTION

1.1 Limited Warranty

Climax Portable Machine Tools, Inc. (hereafter referred to as "CLIMAX") warrants that all new machines are free from defects in materials and workmanship. This warranty is available to the original purchaser for a period of one year after delivery. If the original purchaser finds any defect in materials or workmanship within the warranty period, the original purchaser should contact its factory representative and return the entire machine, shipping prepaid, to the factory. CLIMAX will, at its option, either repair or replace the defective machine at no charge and will return the machine with shipping prepaid.

CLIMAX warrants that all parts are free from defects in materials and workmanship, and that all labor has been performed properly. This warranty is available to the customer purchasing parts or labor for a period of 90 days after delivery of the part or repaired machine or 180 days on used machines and components. If the customer purchasing parts or labor finds any defect in materials or workmanship within the warranty period, the purchaser should contact its factory representative and return the part or repaired machine, shipping prepaid, to the factory. CLIMAX will, at its option, either repair or replace the defective part and/ or correct any defect in the labor performed, both at no charge, and return the part or repaired machine shipping prepaid.

These warranties do not apply to the following:

- Damage after the date of shipment not caused by defects in materials or workmanship
- Damage caused by improper or inadequate machine maintenance
- Damage caused by unauthorized machine modification or repair
- Damage caused by machine abuse
- Damage caused by using the machine beyond its rated capacity

All other warranties, express or implied, including without limitation the warranties of merchantability and fitness for a particular purpose are disclaimed and excluded.

Terms of Sale

Be sure to review the terms of sale which appear on the reverse side of your invoice. These terms control and limit your rights with respect to the goods purchased from CLIMAX.

About This Manual

CLIMAX provides the contents of this manual in good faith as a guideline to the operator. CLIMAX cannot guarantee that the information contained in this manual is correct for applications other than the application described in this manual. Product specifications are subject to change without notice.

1.2 Alerts

Pay careful attention to the alerts appearing in this manual. Alert types are defined in the following examples.

⚠ DANGER

concerns a condition, procedure, or practice that, if not avoided or strictly observed, WILL result in injury or loss of life.

⚠ WARNING

concerns a condition, procedure, or practice that, if not avoided or strictly observed, COULD result in injury or loss of life.

⚠ CAUTION

concerns a condition, procedure, or practice that, if not avoided or strictly observed, could result in minor or moderate injury.

NOTICE

concerns a condition, procedure, or practice worthy of special attention.

TIP:

A tip provides additional information that can aid in completion of a task.

1.3 Safety Precautions

CLIMAX leads the way in promoting the safe use of portable machine tools. Safety is a joint effort. You, the machine operator, must do your part by being aware of your work environment and closely following the operating procedures and safety precautions contained in this manual, as well as your employer's safety guidelines.

Observe the following safety precautions when operating or working around the machine.

Training – Before operating this or any machine tool, you should receive instruction from a qualified trainer. Contact CLIMAX for machine-specific training information.

Risk Assessment – Working with and around this machine poses risks to your safety. You, the end user, are responsible for conducting a risk assessment of each job site before setting up and operating this machine.

Intended Use – Use this machine in accordance with the instructions and precautions in this manual. Do not use this machine for any purpose other than its intended use as described in this manual.

Personal Protective Equipment – Always wear the appropriate personal protective gear when operating this or any other machine tool. Eye and ear protection are required when operating or working around the machine. Flame-resistant clothing with long sleeves and legs is recommended when operating the machine, as hot flying chips from the workpiece may burn or cut bare skin.

Work Area – Keep the work area around the machine clear of clutter. Keep all cords and hoses away from the work area when operating the machine.

Lifting – Many CLIMAX machine components are very heavy. Whenever possible, lift the machine or its components using proper hoisting equipment and rigging. Always use designated lifting points on the machine. Follow all lifting instructions in the setup procedures of this manual.

Lock Out/Tag Out – Lock out and tag out the machine before doing maintenance.

Moving Parts – CLIMAX machines have numerous exposed moving parts and interfaces that can cause severe impact, pinching, cutting, and other injuries. Except for operating controls, avoid contact with moving parts by hands or tools during machine operation. Secure hair, clothing, jewelry, and pocket items to prevent them from becoming entangled in moving parts.

Sharp Edges – Cutting tools and workpieces have sharp edges that can easily cut skin. Wear protective gloves and exercise caution when handling a cutting tool or workpiece.

Hot Surfaces – During operation, motors, some housings, and cutting tools can generate enough heat to cause severe burns. Pay attention to hot surface labels, and avoid contact with bare skin until the machine has cooled.

1.4 Machine Specific Safety Practices

This list includes safety practices applicable to CLIMAX Portable Machines.

All aspects of the machine have been designed with safety in mind. Warning signs are affixed to the machine to warn of residual hazards associated with machine relating to operation, setup, whether or not it is in use.

Machine safety features—Never attempt to defeat or override the safety features designed into the machine.

Securing the machine—Never attempt to run the machine without first securing it to a stable work piece.

Personal Protection—Wear safety glasses, earplugs, and safety shoes while operating the machine. Gloves are not a form of protection and should not be worn while operating the machine. Metal chips and debris created by the machine should be disposed using a dust pan and broom.

Keeping clean—Maintain your machine according to the procedures described in this manual to maximize safety and machine longevity.

Keep clear—Keep clear of the machine during operation. Never lean or reach into the machine to remove chips or to adjust the machine while it is running. Doing so can cause serious injury or death.

Controls—Operator controls are located outside the danger zone of the machine. All controls perform a one-to-one action. The machine is not supplied with a power unit and, therefore, does not have an E-stop.

Machine setup and disassembly—With a modular design, the machine can be broken down into components to ease setup.

Machine guards—There are no guards used on this machine.

Clamp Collars—To prevent the bar from sliding through the support bearings, or falling, use P/N 25010 – The collars are used to secure the bar when the machine is in the vertical orientation. Torque these collars to 25 ft-lbs (34 Nm). Clamp collars should be positioned ABOVE at least 2 support bearings when installed in a vertical orientation. Clamp collars should be shouldered against the bearing when in use.

Electrical emissions—There are no electrical components used on this machine.

Operator station—Due to the nature of portable machinery, no designated operator's station exists.

Moving parts—The operator is not exposed to the cutter head when the work piece is being machined. Keep all cords and hoses away from moving parts during operation. If the cords become tangled in the machinery the operator could be seriously injured and the machine extensively damaged.

Fluids—Cutting fluids are required for machine operation. The machine itself does not emit any fluids.

Lifting—When lifting the machine for setup or disassembly, a conventional sling-type lift is suggested for convenience and safety of the operator. Use designated lifting eyes. Do not lift the machine by the turning bar.

Repetitive motion—Individuals can be susceptible to disorders of the hands and arms when exposed to tasks that involve highly repetitive motions and/or vibration. To reduce the likelihood of these disorders, follow these guidelines:

- Use minimum hand grip force
- Keep wrists straight
- Avoid exposure to continue vibration
- Avoid repeated bending of wrists and hands
- Keep hands and arms warm and dry

1.5 Risk Assessment and Hazard Mitigation

Machine Tools are specifically designed to perform precise material-removal operations.

Stationary Machine Tools include lathes and milling machines and are typically found in a machine shop. They are mounted in a fixed location during operation and are considered a complete, self-contained machine. Stationary Machine Tools achieve the rigidity needed to accomplish material-removal operations from the structure that is an integral part of the machine tool.

Portable Machine Tools are designed for on-site machining applications. They typically attach directly to the workpiece itself, or to an adjacent structure, and achieve their rigidity from the structure to which it is attached. The design intent is that the Portable Machine Tool and the structure attached to it become one complete machine during the material-removal process.

To achieve the intended results and to promote safety, the operator must understand and follow the design intent, set-up, and operation practices that are unique to Portable Machine Tools.

The operator must perform an overall review and on-site risk assessment of the intended application. Due to the unique nature of portable machining applications, identifying one or more hazards that must be addressed is typical.

When performing the on-site risk assessment, it is important to consider the Portable Machine Tool and the workpiece as a whole.

1.6 Risk Assessment Checklist

Use these checklists as part of your risk assessment:

TABLE 1. RISK ASSESSMENT CHECKLIST BEFORE SET-UP

	Before Set-up
☐	I took note of all the warning labels on the machine.
☐	I removed or mitigated all identified risks (such as tripping, cutting, crushing, entanglement, shearing, or falling objects).
☐	I considered the need for personnel safety guarding and installed any necessary guards.
☐	I read the Setup section on page 15.
☐	I created a lift plan, including identifying the proper rigging, for each of the setup lifts required during the setup of the support structure and machine.
☐	I located the fall paths involved in lifting and rigging operations. I have taken precautions to keep workers away from the identified fall path.
☐	I considered how this machine operates and the best placement for the controls, cabling, and the operator.
☐	I evaluated and mitigated any other potential risks specific to my work area.

TABLE 2. RISK ASSESSMENT CHECKLIST AFTER SET-UP

	After Set-up
☐	I checked that the machine is safely installed (according to the Setup section) and the potential fall path is clear. If the machine is elevated, I checked that the machine is safeguarded against falling.
☐	I identified all possible pinch points, such as those caused by rotating parts, and informed the affected personnel.
☐	I planned for containment of any chips or swarf produced by the machine.
☐	I followed the Maintenance section with the recommended lubricants on page 49.
☐	I checked that all affected personnel have the recommended personal protective equipment, as well as any equipment required by the site or other regulations.
☐	I checked that all affected personnel understand the danger zone and are clear of it.
☐	I evaluated and mitigated any other potential risks specific to my work area.

2 OVERVIEW

Machining range from 8.8–38" (224–965 mm) diameter and faces from 7.5–42.1" (191–1,069 mm) are quickly restored to original condition with the CLIMAX BB6100 Portable Boring Machine.

This modular machine tool shown in Figure 2-1 is dedicated to on-site restoration of worn internal diameters to precise roundness and dimensional accuracy ready to accept new bearings, sleeves, shafts, or similar mating parts.

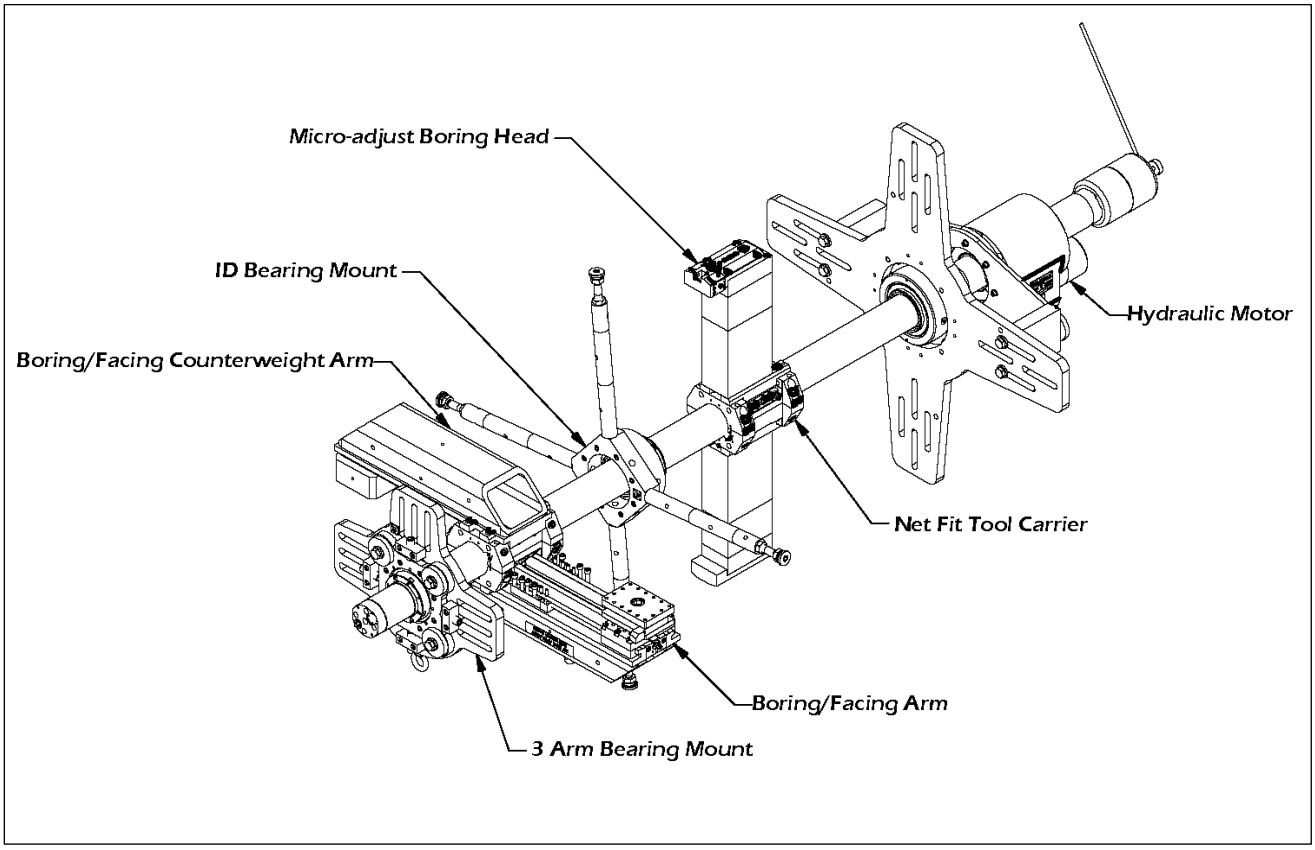


FIGURE 2-1. BB6100 COMPONENTS

Number	Component
1	Boring/facing counterweight arm
2	ID bearing mount
3	Micro-adjust boring head
4	Hydraulic motor
5	Net fit tool carrier
6	Boring/facing arm
7	Three-arm bearing mount

2.1 About this manual

This manual describes the most effective setup and operation of your Model BB6100 Portable Boring Machine. All parts meet CLIMAX's strict quality standards. For maximum safety and performance, read the entire manual before operating this machine.

2.1.1 Recommended tools

CLIMAX includes a general tool kit with the machine. You may require additional equipment specific to your worksite and particular setup. Please contact CLIMAX for accessories.

2.2 Receipt and inspection

Your CLIMAX product was inspected and tested before shipment and was packaged for normal shipment conditions. CLIMAX does not guarantee the condition of your machine upon delivery. When you receive your CLIMAX product, perform the following receipt checks.

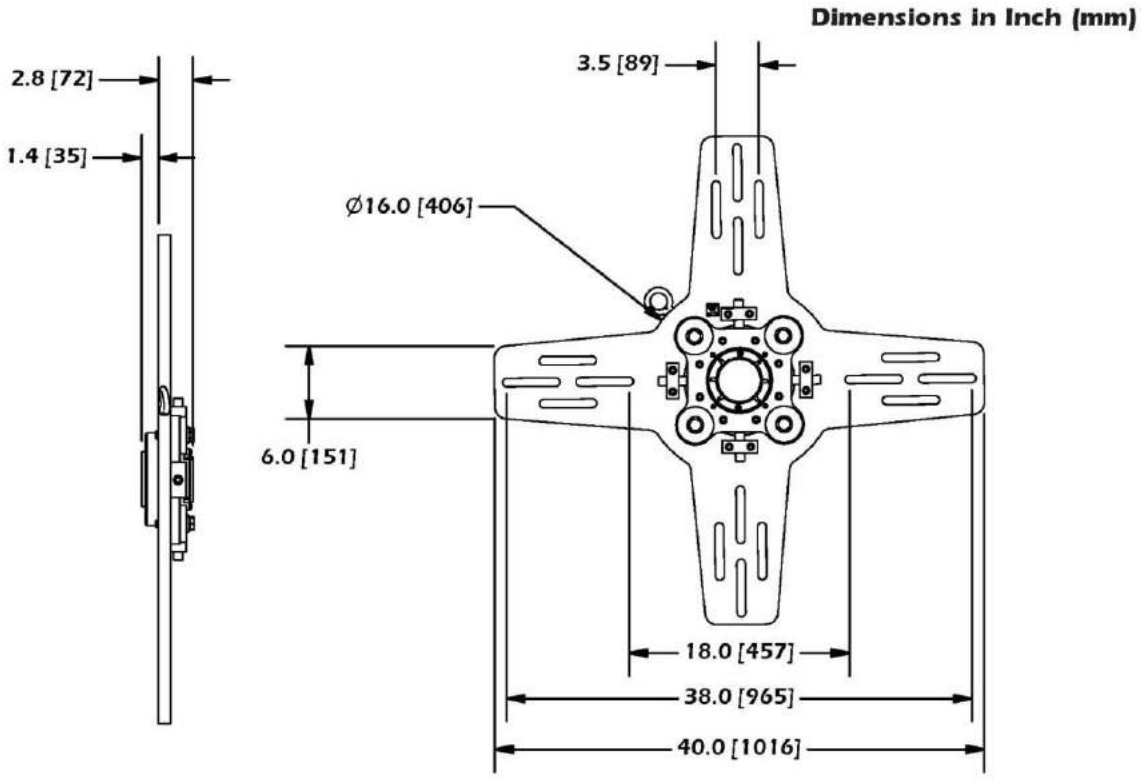
- Inspect the shipping containers for damage.
- Check the contents of the shipping containers against the included invoice to ensure that all components have been shipped.
- Inspect all components for damage.

NOTICE

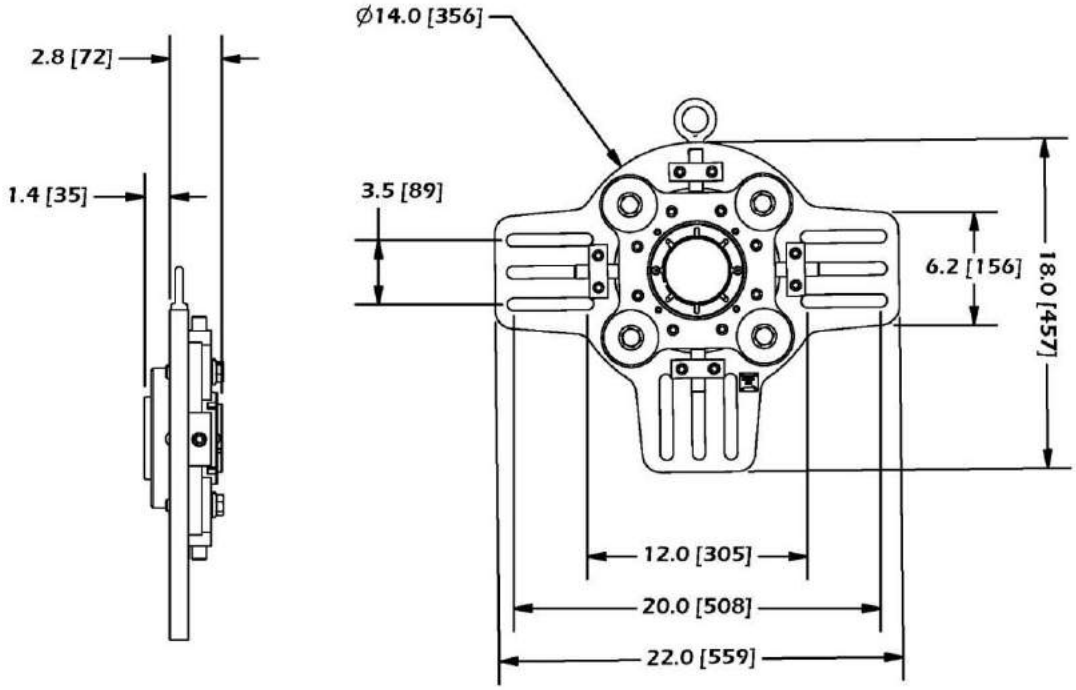
Contact CLIMAX immediately to report damaged or missing components.

2.3 Specifications and Dimensions

	US	Metric
Boring and Facing Ranges:		
Boring diameter range, standard stack block assembly:	8.8 - 40.8 inches	223.5 - 1036.3 mm
Boring diameter range, boring/facing arm assembly:		
with 18 inch (457.2 mm) boring/facing arm	19.9 - 32.1 inches	505.5 - 815.3 mm
with 23 inch (584.2 mm) boring/facing arm	24.8 - 42.1 inches	629.9 - 1069.3 mm
Recommended facing diameter range, using mechanical facing head assy:	10.6 - 38.0 inches	269.2 - 965.2 mm
Facing diameter range, boring/facing arm assembly:		
with 18 inch (457.2 mm) boring/facing arm	17.5 - 32.1 inches	444.5 - 815.3 mm
with 23 inch (584.2 mm) boring/facing arm	17.5 - 42.1 inches	444.5 - 1069.3 mm
Facing diameter range, boring/facing arm assembly, tool post reversed: ("tool post reversed" refers to rotating the tool post so that the tool is on the bar side of the tool post.)		
with 18 inch (457.2 mm) boring/facing arm	7.5 - 20.1 inches	190.5 - 510.5 mm
with 23 inch (584.2 mm) boring/facing arm	7.5 - 30.1 inches	190.5 - 765.5 mm
Performance Data		
Rotational Drive Unit (RDU) gear ratio: Hydraulic motor size affects torque and speed. Theoretical values calculated using a 10 Hp hydraulic power unit producing 2000 psi (13790 kPa) continuous, [normal operation is 1200 psi (8270 kPa)] and pumping 10 gpm (37.9 l/min).	6:1 gear reduction	6:1 gear reduction
Hydraulic motor size range:	3.6 - 17.9 in^3	59.9 - 293.3 cm^3
Boring Bar Torque:	470 - 1820 ft•lb	637.2 - 2467.6 N•m
Max boring rpm:	107 - 21 rpm	107 - 21 rpm
For example, with 11.3 in^3 (185.3 cm^3) hydraulic motor (43457):		
Boring Bar Torque:	1435 ft•lb	1945.6 N•m
Max boring rpm:	33 rpm	33 rpm
Feed Rate of mechanical Axial Feed Unit (AFU):	0.003 - 0.020 inches/rev	0.076 - 0.508 mm/rev
Feed Rate of electric Axial Feed Unit (AFU):	0 - 0.3 inches/min	0 - 7.62 mm/min
Measures		
Shipping Weights (estimated): Machine includes Rotational Drive Unit (RDU), Axial Feed Unit (AFU), boring head set, tool carrier, tool kit, and hydraulic motor.		
for machine (wood crate)	640 lbs	290.3 kg
for machine (metal crate)	740 lbs	335.7 kg
for one 4 arm bearing assembly	160 lbs	72.6 kg
for one 3 arm bearing assembly	80 lbs	36.3 kg
for boring bar	2.5 lbs/inch	0.04 kg/mm
for 10 Hp Hydraulic Power Unit	500 lbs	226.8 kg
Shipping dimensions:		
Machine, in wood crate, W, D, H	18.5 x 34 x 24 inches	469.9 x 863.6 x 609.6 mm
Machine, in steel crate, W, D, H	43.3 x 29.5 x 22.5 inches	1099.8 x 749.3 x 571.5 mm
Bearing (each bearing shipped separately) W, D, H	32 x 32 x 11 inches	812.8 x 812.8 x 279.4 mm
12 foot (3657.6 mm) bar W, D, H	11 x 13 x 154 inches	279.4 x 330.2 x 3911.6 mm
10 Hp Hydraulic Power Unit W, D, H	27 x 33 x 48 inches	685.8 x 838.2 x 1219.2 mm

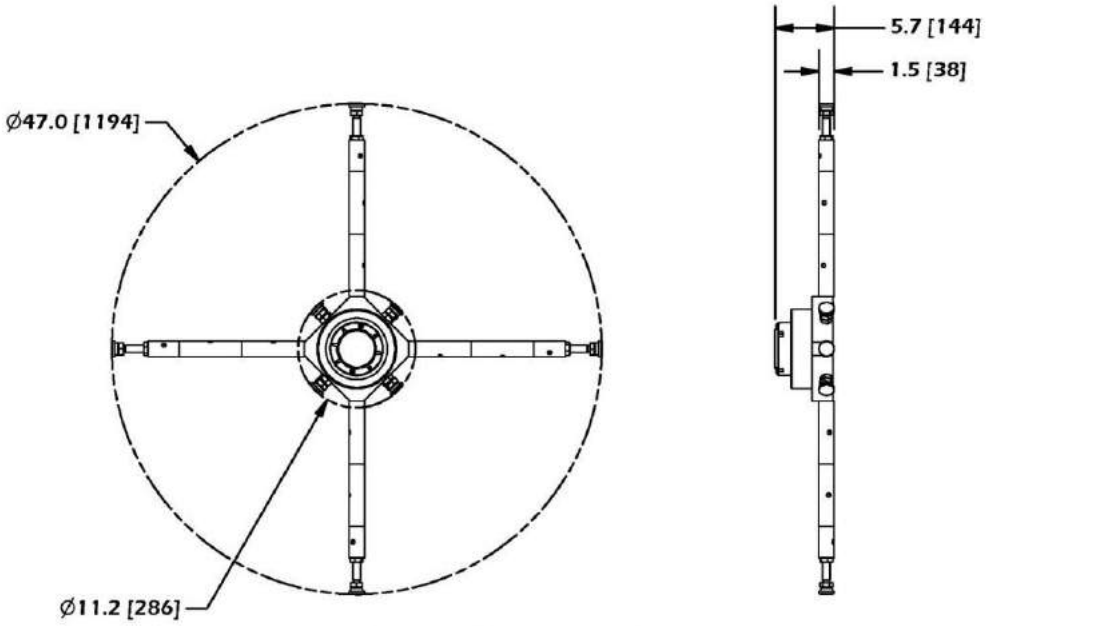


Spider Assembly 4-Arm End Bearing Support

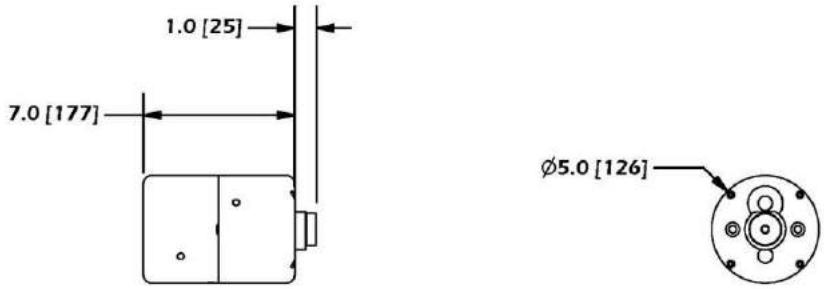


Spider Assembly 3-Arm End Bearing Support

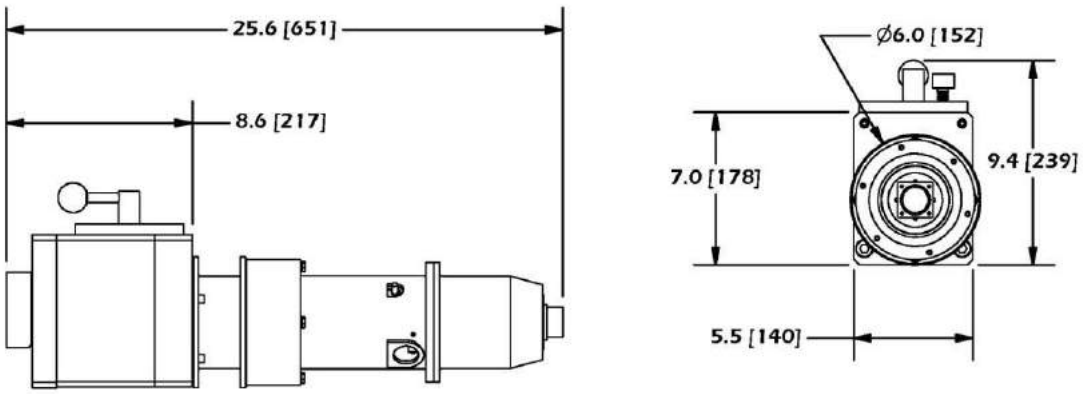
Dimensions in Inch (mm)



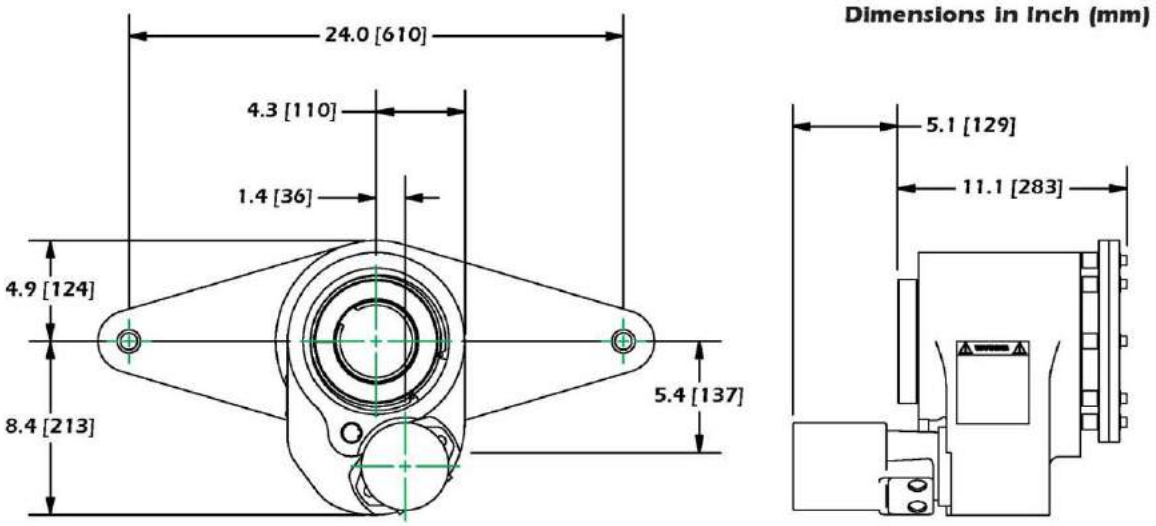
ID Bearing Mount Assembly
For ID diameters of 11.25 - 47 inches (285.8 - 1193.8 mm)



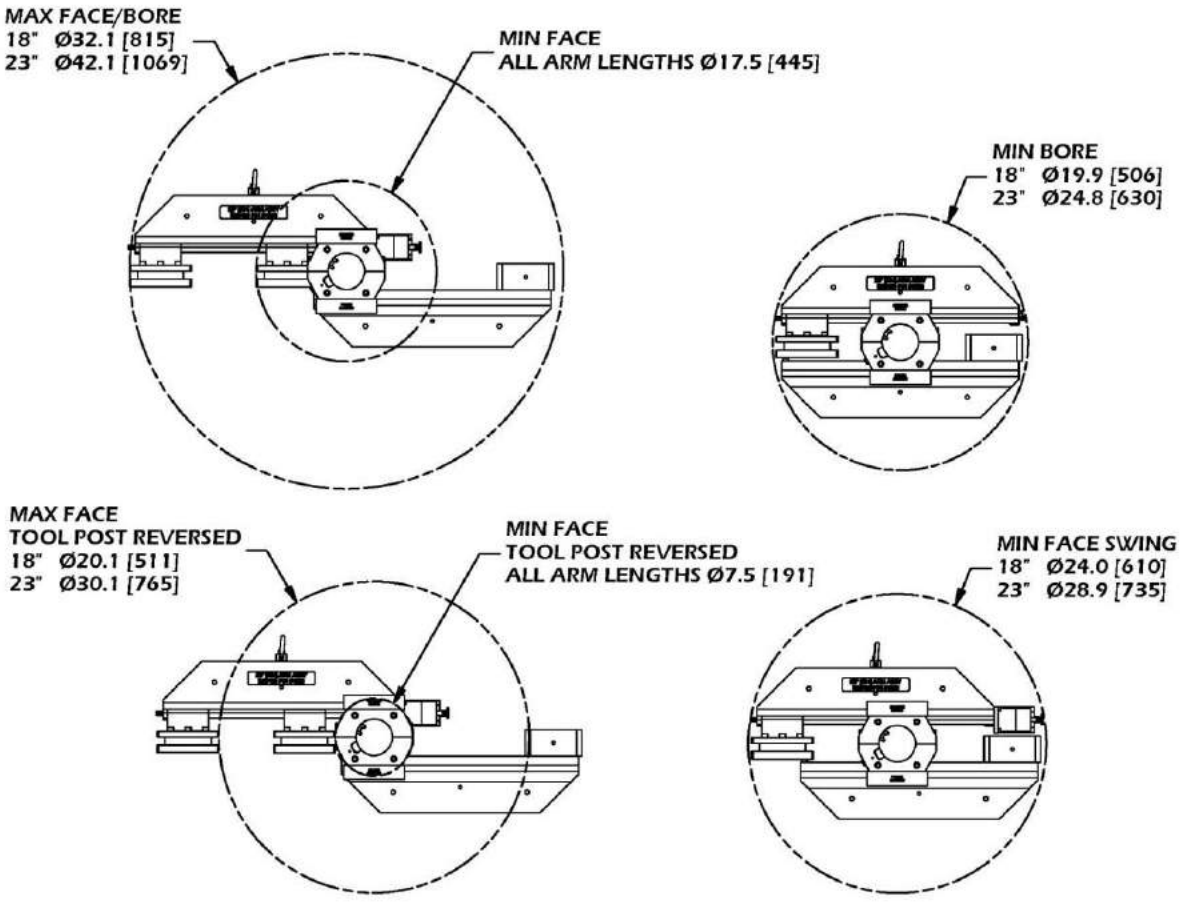
Mechanical Axial Feed Assembly



Electrical Axial Feed Assembly

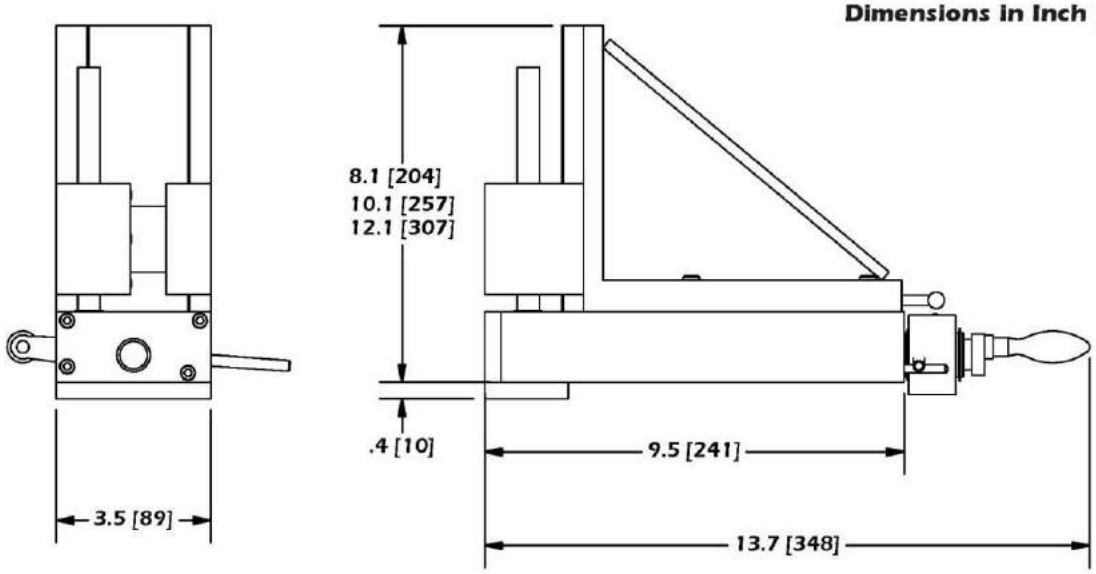


Rotational Drive Unit



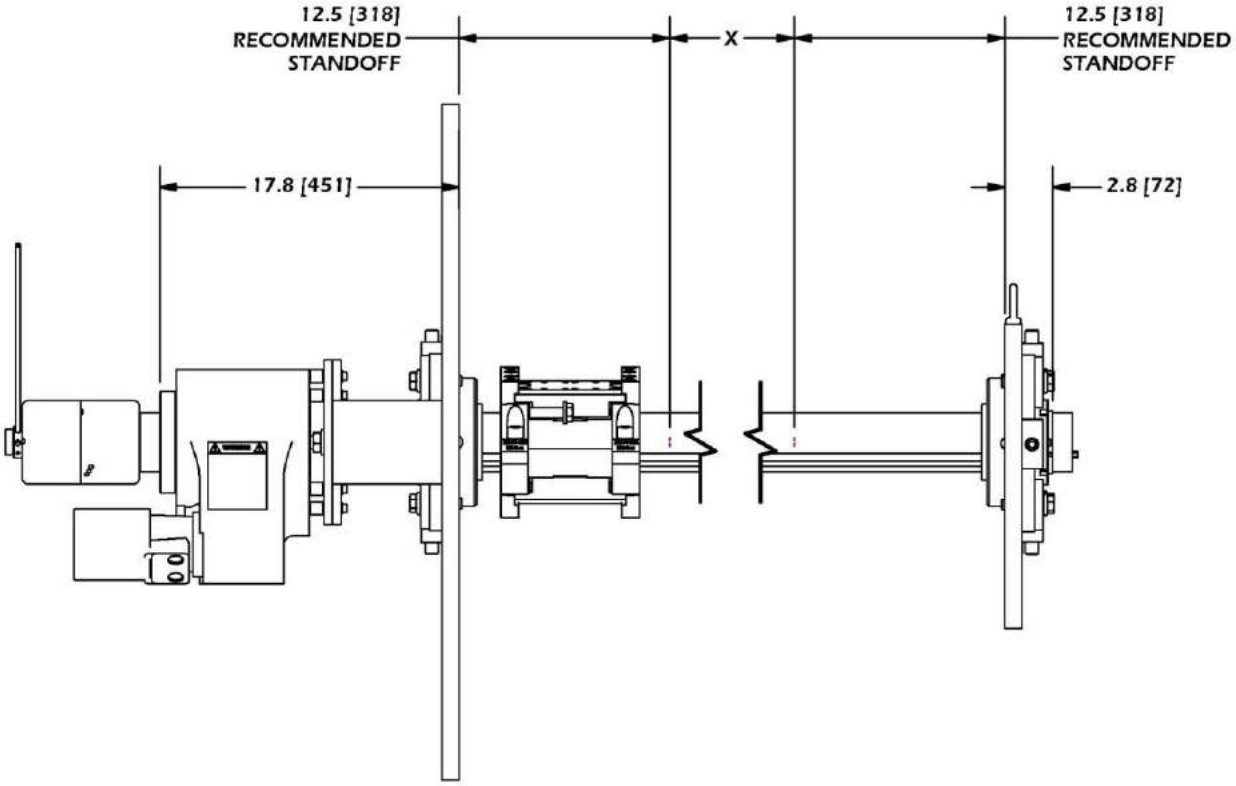
Boring/facing arm configurations

Dimensions in Inch (mm)



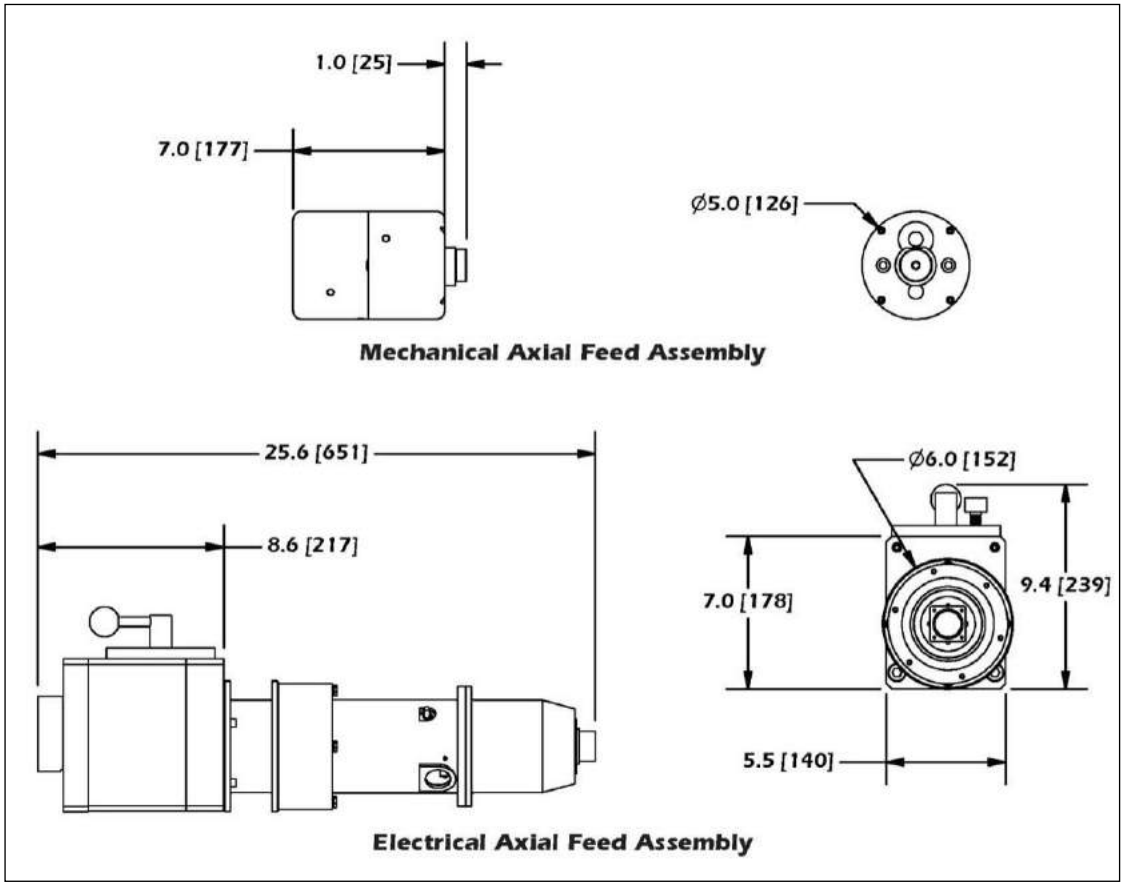
Mechanical Facing Assembly

Determining the Proper Bar Length for your BB6100



BAR LENGTH = X (BORE LENGTH) + 17.8 [451] + 2.8 [72] + STANDOFF

2.4 Axial Feed Assembly



3 SETUP

Before proceeding with set-up of the BB6100, determine the best placement of each module on the bar. The RDU and tool head assemblies can be located anywhere along the bar. Make sure to allow space for them while planning your set-up.

TIP:

A suitable lifting device is critical in the safe setup of the machine. Whenever possible, use a crane or hoist that provides smooth control and fine adjustment such as a hydraulic lift or two-stage winch. A device that is unstable, erratic, or difficult to maneuver can be awkward and consequently put the operator and equipment at risk.

TIP:

In many applications, the machine is effectively set-up using only common measuring devices such as a steel rule or tape measure. On those occasions when more precise alignment and accurate machining is called for, plan to have the following additional tools on hand:

- Magnetic base dial indicator
- Machinist's precision level
- Dial or digital slide calipers

3.1 Clamp collars

The clamp collars (P/N 25010) must be used to secure the bar when the machine is in the vertical orientation.

This will prevent the bar from sliding through the support bearings or falling.

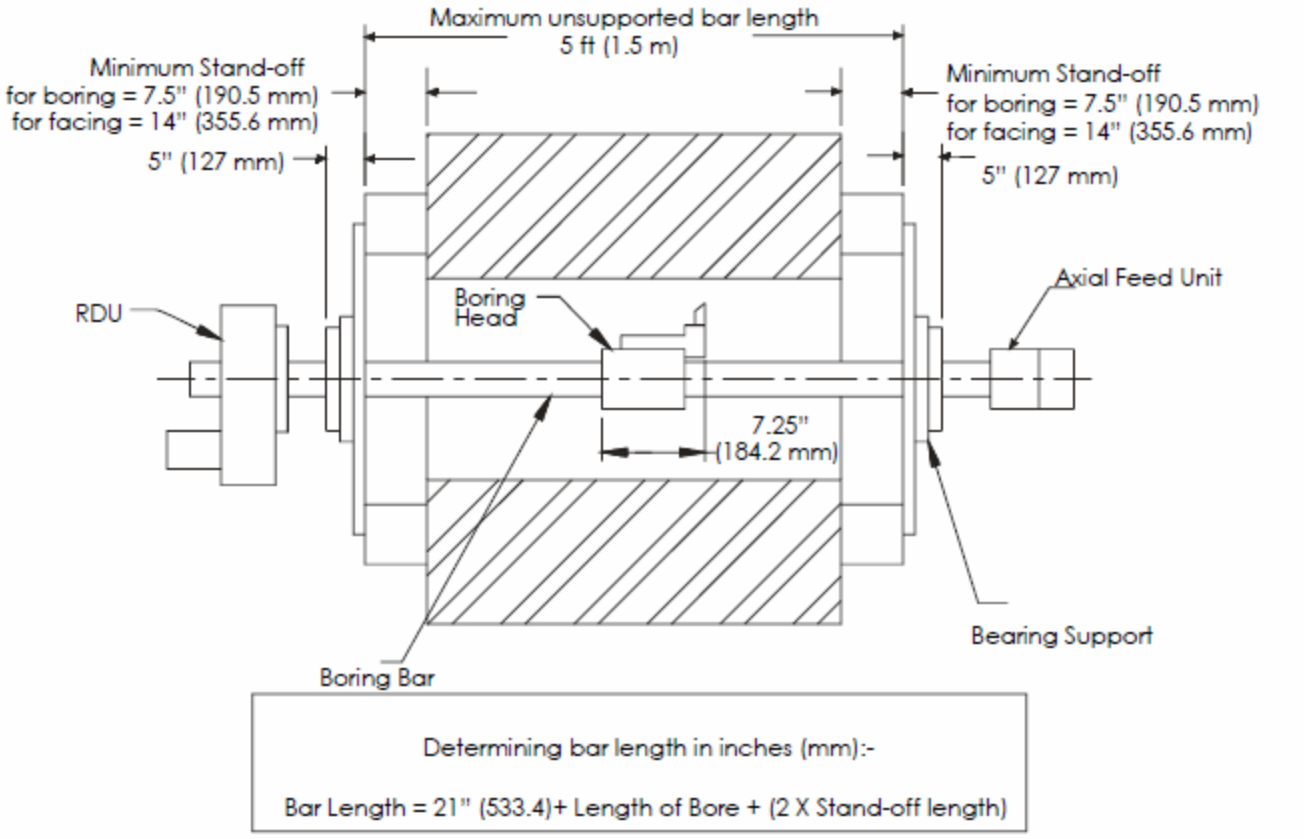
To prevent over tightening of the bearings, the clamp collars should be placed above at least two support bearings in a vertical orientation. ID mounted bearings (P/N 54355, 92850) should not be used to support the boring bar in the axial direction.

⚠ DANGER

To prevent the bar from sliding through the support bearings, or falling, use the two clamp collars provided in the tool kit when using the boring bar in a vertical orientation. Torque to 25 ft.-lbs (34 mm).

3.2 About Boring Machine Support

At least two bearing supports are required to obtain machine stability.



⚠ CAUTION

Bearings spaced too far apart allow extreme deflection of the bar and will decrease bore accuracy. Avoid spacing bearing supports more than 5 feet (1.5 m) apart.

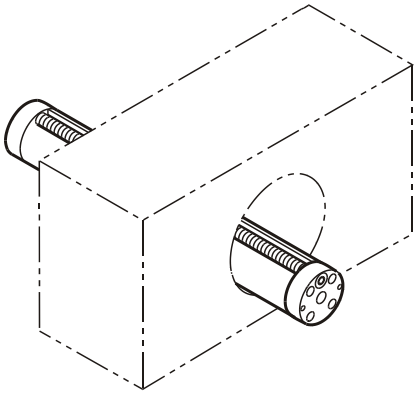
3.3 Installing End-mount Bearing Support

Though the end-mount bearing support attaches to the outside of the work piece, it can be positioned anywhere on the boring bar.

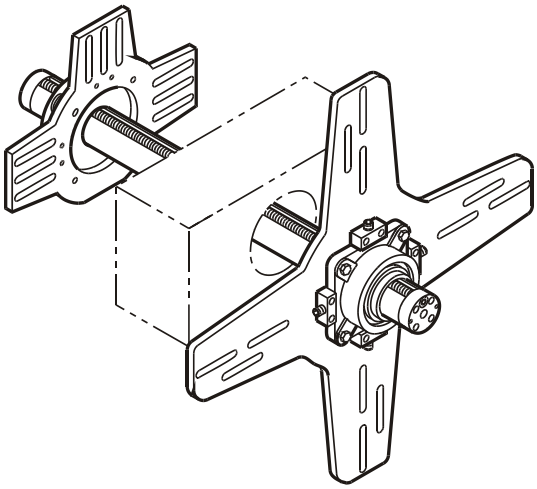
3.3.1 To install the end-mount bearing support

1. Clean the bore with solvent to remove grease, oil, and dirt.
2. Inspect the bar for nicks or cuts. Dress the bar smooth with a honing stone if necessary. Clean the bar with solvent to remove dirt and chips. A bar with nicks or gouges can severely damage mating parts, including the tool carrier and RDU.

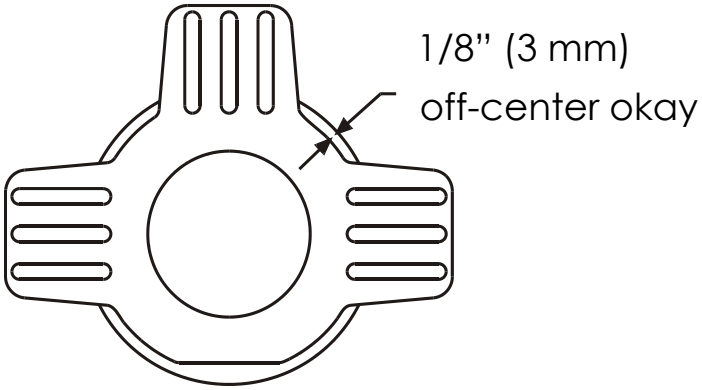
3. Slide the boring bar into the workpiece.



4. Slide the bearing supports onto the ends of the bar.



5. Using a hoist, hold the bar and bearings in the approximate center of the bore. Alignment within 1/8" (3 mm) is sufficient.



⚠ WARNING

Uncontrolled swinging or falling machinery can cause serious injury. Securely wrap the hoist around the bar and/or bearings before lifting the machine.

6. Use existing holes if they align with slots in the spider bearing supports. Otherwise, drill and tap new holes or weld to work piece. If holes are to be drilled and tapped, with the spider against the work, and mark their alignment.
7. Pull the bearing supports from the boring bar. Remove the boring bar from the work piece.
8. If necessary, drill and tap suitable mounting holes in the end of the work piece to align with slots in the spider bearing supports.
9. Mount one bearing support to the end of the work piece.
10. Slide the boring bar through the bearing support.
11. If the RDU is to be mounted between supports, mount it now.
12. Make sure the RDU shaft collars are on the drive hub. See Section 3.6 on page 24 for mounting information.
13. For mounting another end-mount bearing support, repeat steps #8 through #10. If using an ID-mount bearing assembly, see Section 3.4 on page 19. CLIMAX recommends no fewer than two support assemblies to obtain adequate machine stability. The maximum recommended unsupported bar length is 5 feet (1.5 m). See Section 3.2 on page 15.
14. Slide the boring bar through all bearing assemblies and position axially. Use an additional bar clamp as necessary when the bar is in a vertical orientation (see Section 3.1 on page 15).
15. Do the following to clamp the bearing support onto the bar:
    a. Align two setscrews in the bearing with the indentation in the bearing ring.
    b. Adjust the bearing ring (and screws) so it is 90° to the lead screw in the bar.
    c. Tighten the setscrews evenly until the bar is held firmly.

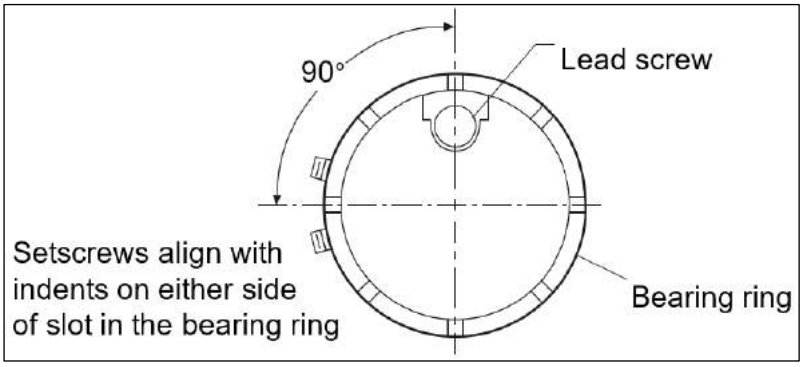


FIGURE 1. LEAD SCREW (TOP) AND BEARING RING (RIGHT)

16. Do the following to precisely align the boring bar:
    a. Use a dial indicator and four adjusting screws to center the boring bar in the bore.
    b. Tighten the four locking screws.

3.3.2 Clamping the bearing assembly to the bar

Do the following to clamp the bearing assembly to the bar:

1. Remove the screws holding the lock plate.
2. Slide the lock plate away from the lock nut.
3. Rotate the lock nut using both hands until it is snug. This is the zero reference point.
4. Mark or note the angular position of the lock nut.
5. Use the offset spanner wrench in the tool kit to rotate the lock nut approximately 1.25—1.5 additional turns.
6. Reapply the lock plate. If necessary, additionally tighten the lock nut until a slot in the lock plate is aligned with the retaining screw holes.
7. Reinstall the retaining screws.

3.4 ID-mount bearing support

The ID-mount bearing support assembly can be placed inside of the workpiece at any position along the bar.

1. Clean the bore with solvent to remove grease, oil, and dirt.
2. Examine the bar for nicks or cuts. Dress the bar smooth if necessary. A bar with nicks or gouges can severely damage mating parts, including the tool carrier assembly and RDU. Clean the bar with solvent to remove dirt and chips.
3. Measure the diameter of the bore into which the bearing is to fit.
4. Use the following table to select components required.

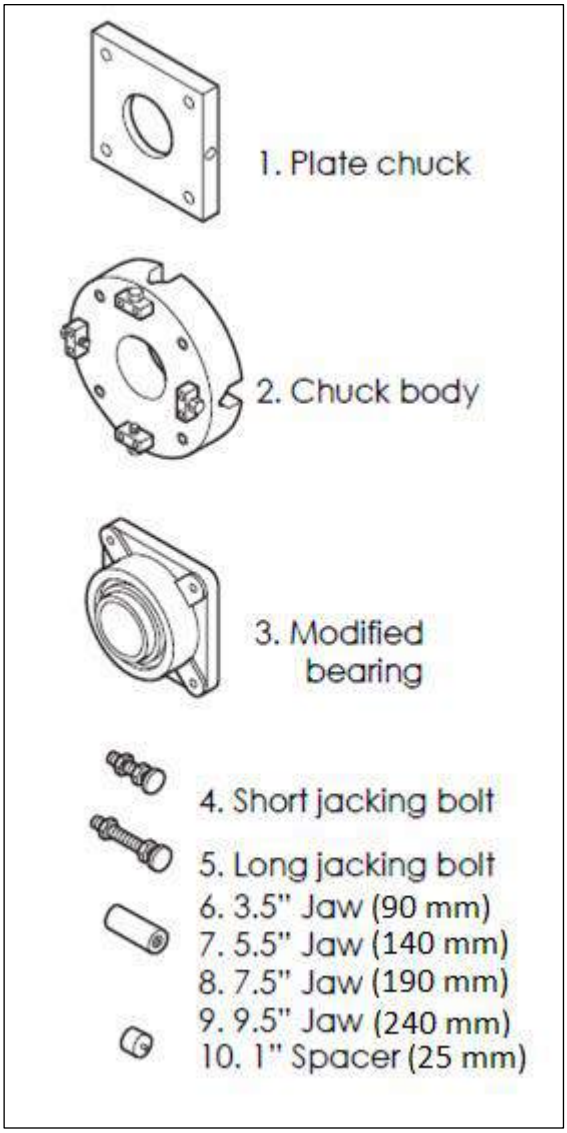


FIGURE 2. ID-MOUNT BEARING COMPONENT

ID-Mount Bearing Assembly Bore Diameter Table	
Bore Range Inch (mm)	**Components required**
12.0 - 14.53 (304.8 - 369.1)	1,3,4
14.53 - 16.53 (369.1 - 419.9)	2, 3, 6, 4
16.53 - 18.53 (419.9 - 470.7)	2, 3, 5, 6
18.53 - 20.53 (470.7 - 521.5)	2, 3, 4, 7
20.53 - 22.53 (521.5 - 572.3)	2, 3, 5, 7
22.53 - 24.53 (572.3 - 623.1)	2, 3, 5, 7, 10
24.53 - 27.53 (623.1 - 699.3)	2, 3, 4, 8
27.53 - 29.53 (699.3 - 750.1)	2, 3, 5, 8
29.53 - 31.53 (750.1 - 800.9)	2, 3, 5, 8, 10
31.53 - 33.53 (800.9 - 851.7)	2, 3, 4, 9
33.53 - 35.53 (851.7 - 902.5	2, 3, 5, 9
35.53 - 37.53 (902.5 - 953.3)	2, 3, 5, 9, 10

TABLE 3. ID-MOUNT BEARING COMPONENT FIGURE IDENTIFICATION

Number	Component
1	Plate check
2	Chuck body
3	Modified bearing
4	Short jacking bolt
5	Long jacking bolt
6	3.5" (90 mm) jaw
7	5.5" (140 mm) jaw
8	7.5" (190 mm) jaw
9	9.5" (240 mm) jaw
10	1" (25 mm) spacer

If using the small plate chuck, do the following before moving on to step 5:

a. Screw short or long jacking bolts into the sides of the plate chuck.

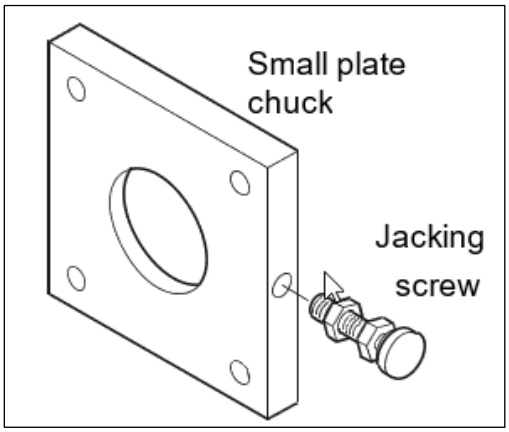
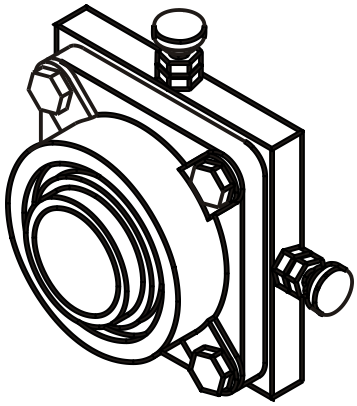


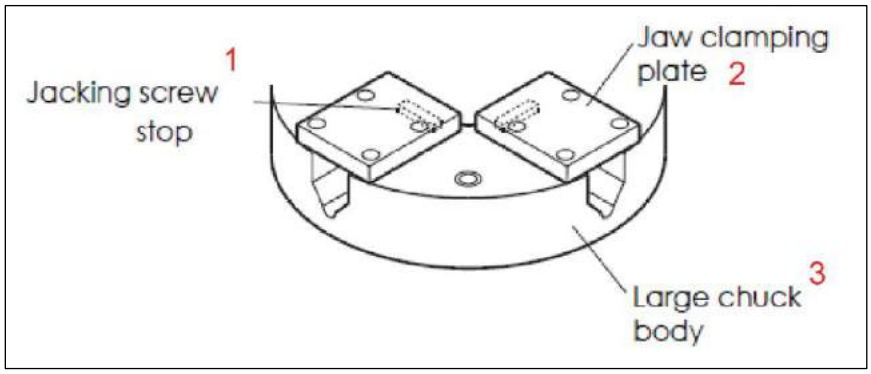
FIGURE 3. SMALL PLATE CHUCK (LEFT) AND JACKING SCREW (RIGHT)

b. Loosely mount the bearing to the plate using the spring washers, flat washers, and screws (if necessary).



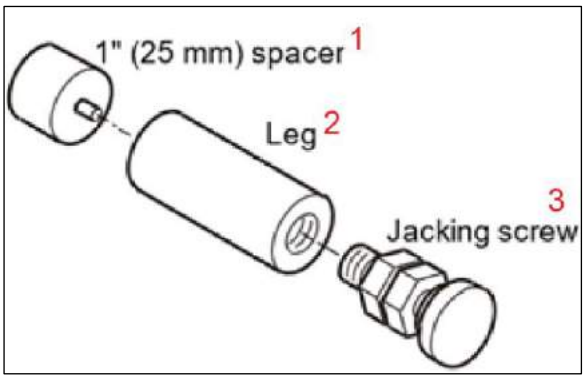
If using the large chuck body, do the following before moving on to step 5:

a. Loosely mount the jaw clamping plates to the chuck body. Check that the stop plates on the end of the clamping plates face toward the center of the chuck and toward the leg slot.



Number	Component
1	Jacking screw stop
2	Jaw clamping plate
3	Large chuck body

b. Screw the jacking screws into the legs. When spacers are being used, attach them to the other end of the legs.



Number	Component
1	1" (25 mm) spacer
2	Leg
3	Jacking screw

c. Slide jacking screw assemblies into the slots in the chuck body. The legs should fit up against the stop block on the back of the jaw clamping plates.

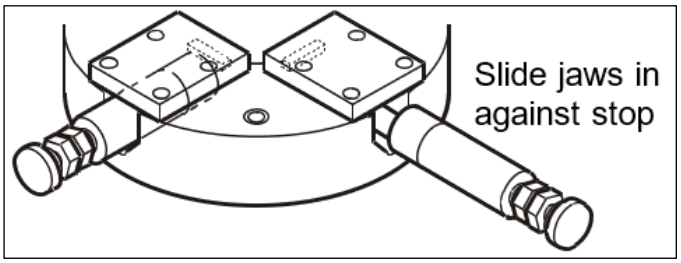
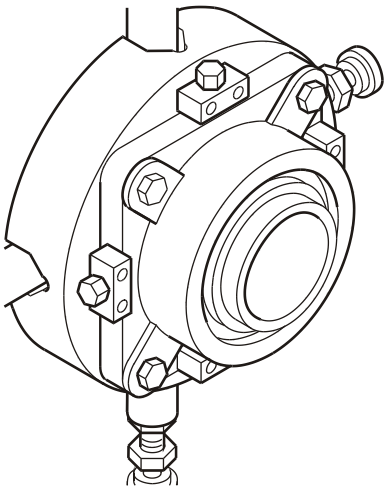


FIGURE 4. SLIDE JAWS IN AGAINST THE STOP BLOCK

d. Tighten the jaw clamping screws.

e. Mount the bearing to the chuck body using spring washers, flat washers, and screws.



5. Slide one bearing support assembly onto the boring bar.
6. Position the bearing in the bore.
7. Use a dial indicator to precisely align the boring bar to the bearing.

8. Center the bar by evenly adjusting the jacking screws then tighten the hex-head cap screws.
9. Slide the bar and bearing support into the work piece.
10. Using a dial indicator and the jacking screws, center the bar inside the work piece. Tighten the jacking screw against the inside of the bore. Do not exceed 22 ft-lbs (30 Nm) of torque.
11. If mounting the RDU between the bearing supports, do so now. See Section 3.6 on page 24 for instructions.
12. If mounting another ID-mount bearing, repeat the above steps.

3.4.1 If mounting an end-mount bearing

Do the following to set up an end-mount bearing support assembly:

1. Re-check the bar for center by sweeping a dial indicator inside the bore.
2. Adjust the jacking screws, if necessary.

⚠ CAUTION

Bearings placed too far apart allow the bar to deform, reducing bore precision. To keep the bar from deflecting, do not space the bearing supports more than 5 feet (1.5 m) apart.

3.4.2 Clamping the bearing assembly to the bar

Do the following to clamp the bearing assembly to the bar:

1. Remove the screws holding the lock plate.
2. Slide the lock plate away from the lock nut.
3. Rotate the lock nut using both hands until it is snug. This is the zero reference point.
4. Mark or note the angular position of the lock nut.
5. Use the offset spanner wrench in the tool kit to rotate the lock nut approximately 1.25—1.5 additional turns.
6. Reapply the lock plate. If necessary, additionally tighten the lock nut until a slot in the lock plate is aligned with the retaining screw holes.
7. Reinstall the retaining screws.

3.5 Preload bearing kit

The preload bearing kit is only used on bearing assemblies using the bearing cartridge P/N 23570. It is appropriate in those applications demanding greater machine stability, especially facing operations. The kit contains a pair of 3.5" (89 mm) hinged clamp collars, one standard and the other with tensioning screws. This kit can be used in either the vertical or horizontal positions.

Do the following:

1. Determine if the hinged clamp collars are to be mounted to the inside or outside of the bearing supports. Both collars must be either inside or outside the mount bearings.
2. Set up the bar and bearings as described. See Section 3.3 on page 16.

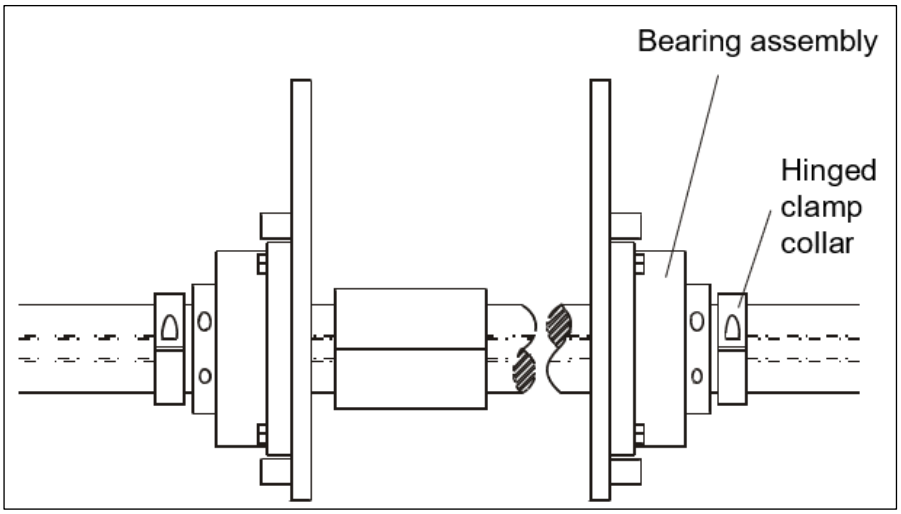


FIGURE 5. ID-MOUNT BEARING SUPPORT ASSEMBLY (LEFT) AND HINGED CLAMP COLLAR (RIGHT)

3. Mount the hinged clamp collar to the bar and tighten it.
4. Slide the bar through the bearing assemblies until the collar is against the bearings.
5. Tightly clamp the modified collar onto the bar on opposite side (either outside or inside).
6. Tighten the collar tensioning screws until there is slight resistance on the screws.
7. Rotate the bar by hand and check for resistance. If the bar will not rotate, back off the screws in the hinged clamp collar.

3.6 RDU Setup

The RDU can be placed anywhere along the boring bar.

⚠ CAUTION

The boring bar is not hardened. To prevent damage to the bar, do not strike it against the bearing supports or the work piece.

TIP:

When mounting the RDU, the slot in the drive hub must align with the lead screw slot in the bar.

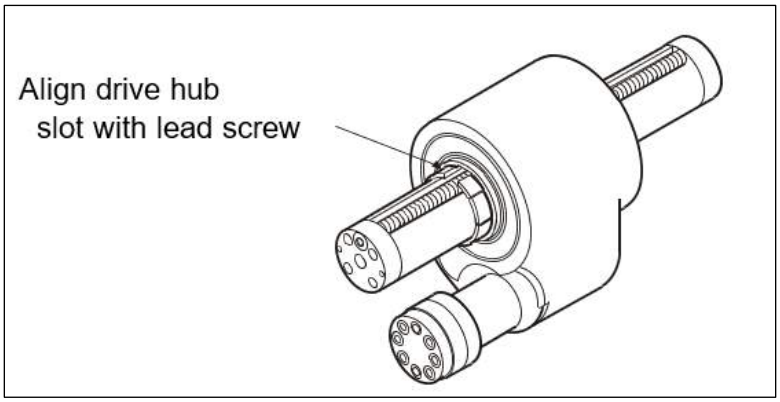


FIGURE 6. ALIGN THE DRIVE HUB SLOT WITH THE LEAD SCREW

1. Inside the torque arms are mounted to (radial direction is optional) RDU housing.
2. Mount the hydraulic motor to the RDU.
3. Slide the RDU onto the boring bar.
4. Make sure the key slots in the boring bar and the RDU drive hub are aligned.
5. Push the bar drive key into the key slot.

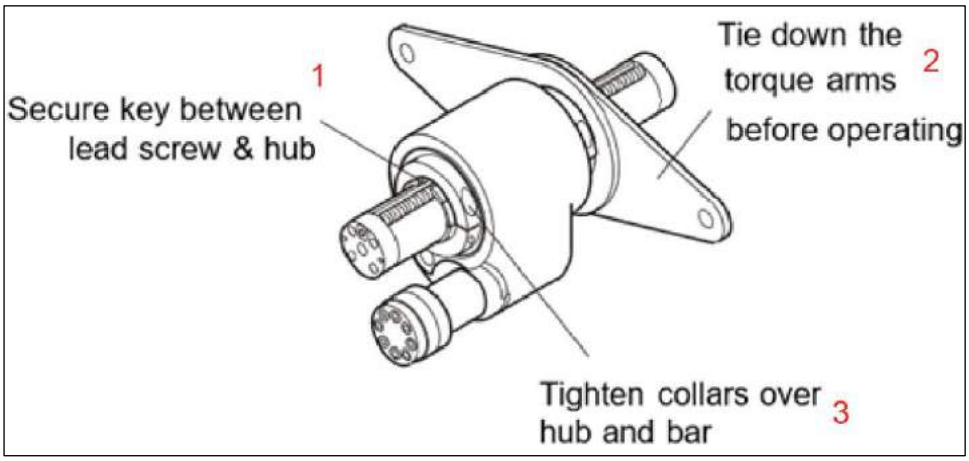
⚠ CAUTION

The rotational drive key must be in place before operating the boring bar. Failure to do so may damage the machine.

6. Adjust the shaft collars into place in the RDU. Tighten the clamping screws to lock the shaft collars to the boring bar.
7. Secure the torque arms to insure the RDU does not rotate when energized.

⚠ WARNING

Loose torque arms can seriously injure the operator and damage the machine. Secure the torque arms to a stationary structure strong enough to withstand the full torque of the RDU.



Number	Component
1	Secure key between the lead screw and hub
2	Tie down the torque arms before operating
3	Tighten collars over hub and bar

8. Connect the hydraulic lines to the hydraulic power unit. See the Hydraulic power section on page 43 for preparation and how to connect the lines.

⚠ CAUTION

To avoid damage to the hydraulic power unit pump, connect the motor to the power unit before plugging in and turning it on.

3.7 Mounting the Mechanical Axial Feed Unit

The axial feed unit can be mounted to either end of the boring bar. The hexagon hole in the output shaft fits onto the hexagon end of the bar lead screw.

1. Place the axial feed unit in NEUTRAL so the lead screw drive can rotate in either direction. See Section 3.7.1 on page 27.
2. While holding the axial feed unit against the bar end cap, turn the output shaft until the hexagons fit together.
3. Tighten the mounting cap screws.
4. Secure the stop rod to a stationary object to engage the feed mechanism.

TIP:

If the axial feed unit is moved to the opposite end of the bar, the feed direction will be reversed. Check the feed direction before operating the machine.

⚠ WARNING

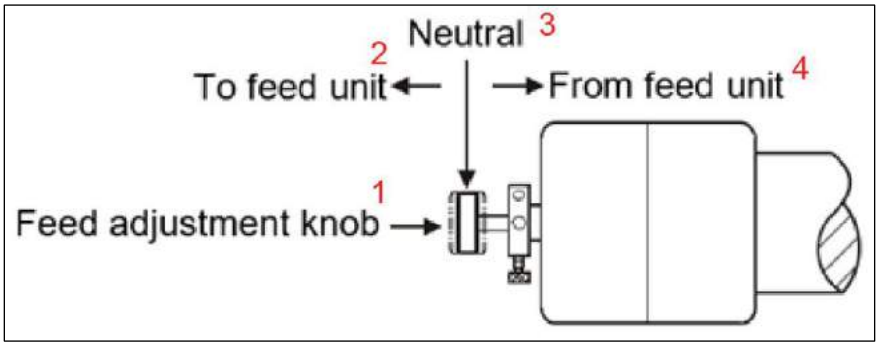
A loose trip rod can cause damage and injury. Secure the trip rod to a fixed object.

3.7.1 Setting feed direction and rate

Feed direction and feed rate are set using the feed adjustment knob. Axial feed rate is variable from 0.003–0.020" (0.076–0.508 mm) per revolution.

⚠ CAUTION

To avoid permanent damage to the axial feed unit, do not leave the wrench in the lead screw dial.



Number	Component
1	Feed adjustment knob
2	To feed unit
3	Neutral
4	From feed unit

3.7.2 Neutral (no feed)

In neutral, the lead screw can turn in either direction. To verify this, insert a hex wrench into the lead screw dial and turn the dial. If the machine is in neutral, the wrench will turn freely in either direction.

3.7.3 Feed away from the axial feed unit

Engage the feed by pushing the feed adjustment knob with one hand and slightly turning the lead screw dial with a wrench until you feel the unit engage. When the feed unit engages, the dial will turn counter-clockwise only.

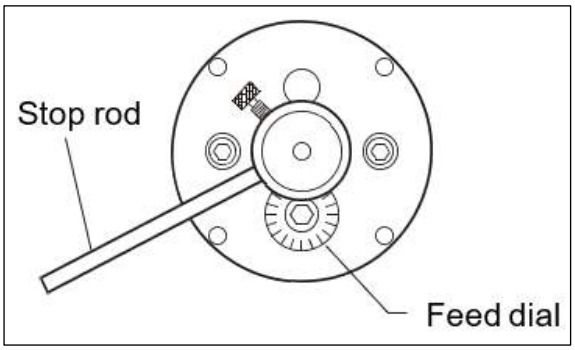


FIGURE 7. STOP ROD (LEFT) AND FEED DIAL (RIGHT)

3.7.4 Feed toward the axial feed unit

Engage the feed by pulling the feed adjustment knob with one hand and slightly turning the lead screw dial with a wrench until you feel the unit engage. When the feed unit engages, the dial will turn clockwise only.

3.7.5 Disengaging the feed under load

If the machine is stopped while the feed box is under load, it may be difficult to disengage the feed.

⚠ CAUTION

To avoid internal damage to the feed box, do not force the feed adjustment knob.

To disengage a feed box under load:

1. Insert a wrench into the dial socket.
2. Turn the wrench in the direction the lead screw was turning while pushing or pulling the feed adjustment knob.

Upon disengagement, the feed box will rotate freely in either direction.

If the feed box does not disengage:

1. Unbolt the feed box from the end of the bar.
2. Shift the feed into NEUTRAL.
3. Re-install the feed box.

3.7.6 Setting the feed rate

To reduce the rate of feed, pull the plunger and lock in the out position then turn the adjustment knob clockwise. To increase the feed rate, pull the plunger and lock in position then turn the adjustment knob counterclockwise. The feed is adjustable while the machine is running.

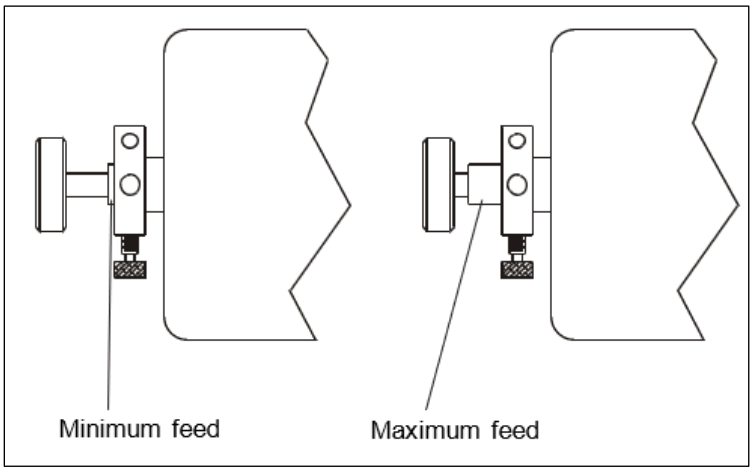


FIGURE 8. MINIMUM FEED (LEFT) AND MAXIMUM FEED (RIGHT)

3.7.7 Stopping the feed

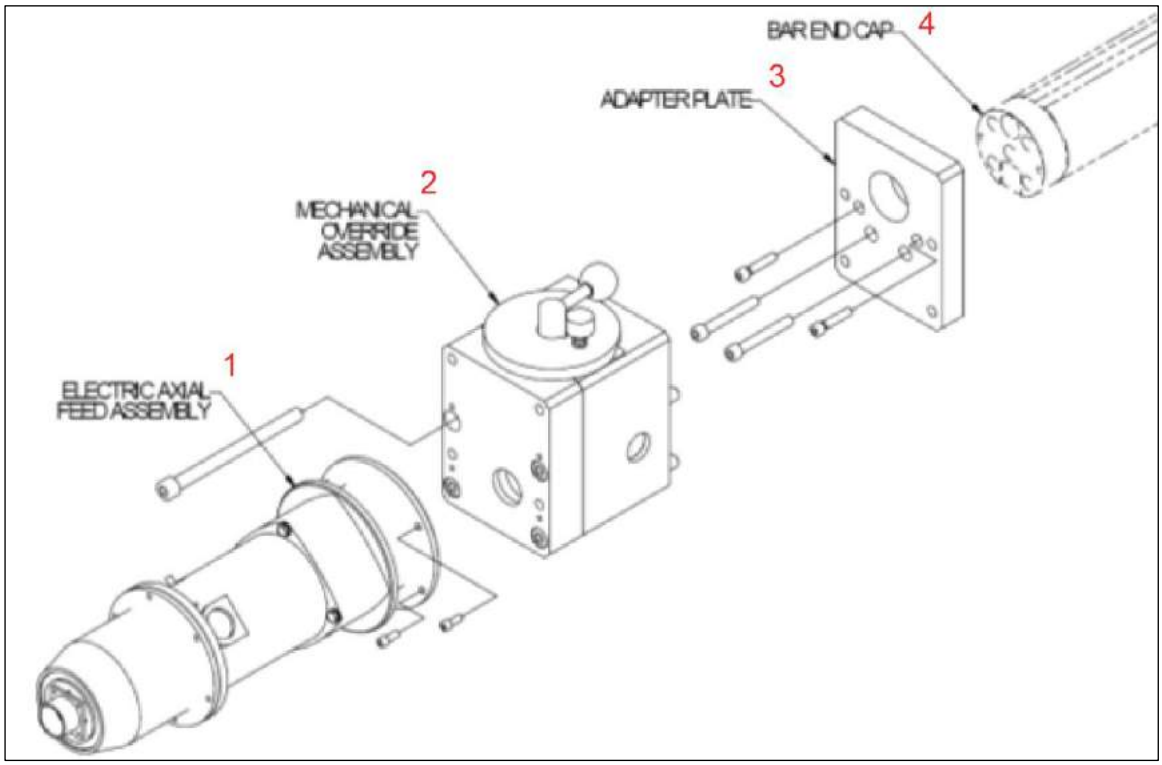
To quickly stop the boring head from feeding, pull the stop rod out of the torque hub on the axial feed unit. This is helpful when cutting up to a shoulder.

3.8 Mounting the Electric Axial Feed Assembly

The electric feed unit consists of the adaptor plate, manual override, electric motor assembly, and remote pendant control.

The axial feed unit can be mounted to either end of the boring bar. The locating nose and hex nut hole of the feed unit fit into the locating nose seat and protruding hex shaft of the boring bar end cap.

1. Mount the adapter plate to the end of the bar using the ¾-10 cap screw and two ½-13 cap screws.
2. Mount the mechanical override assembly to the adaptor plate. Make sure the hex in the mechanical override is aligned with the hex on the lead screw.
3. Mount the electric axial feed assembly to the back of the mechanical override with four cap screws.
4. Make sure to align the key way in the coupling.
5. Attach the pendant electrical cable to the rear of the electric axial feed.



Number	Component
1	Electrical axial feed assembly
2	Mechanical override assembly
3	Adapter plate
4	Bar end cap

NOTICE

If the axial feed unit is moved to the opposite end of the bar, the feed direction will reverse. Check feed direction before operating the machine.

3.8.1 Setting the Axial Feed Rate

The feed potentiometer controls the axial feed rate. Turning the knob counterclockwise decreases the feed rate; turning the knob clockwise increases the feed rate.

Axial feed rate is adjustable and variable from 0.010–0.500" (0.25–13 mm) per minute.

3.9 Tool Head Setup

Do the following:

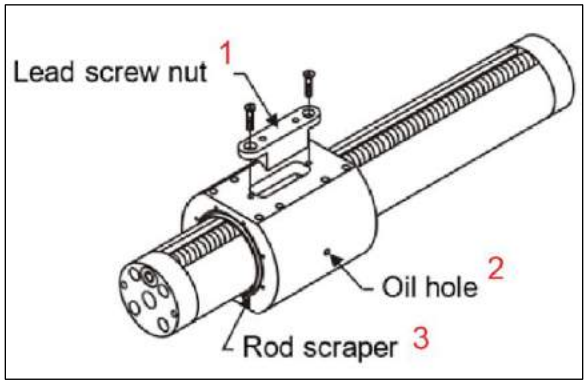
1. Check for lead screw endplay (loose axial lead screw nuts)
2. Attach carrier assembly, lifting eyes + drive key to boring bar
3. Adjust brass shoes for 0.001-0.002 clearance. (Note: Adjust for contact of each pad against the boring bar, and back off 10 degrees for 0.0015 clearances).
4. Spray with antirust lubricant.

The boring and facing heads require a tool carrier to mount them to the boring bar.

3.9.1 Small bore tool carrier setup

Do the following to mount the tool carrier:

1. Check the bar for nicks, burrs, or cuts. Smooth the bar if necessary. A bar with nicks, cuts or gouges can damage mating parts, including the tool carrier and RDU, beyond repair. Clean the bar with solvent to remove dirt and chips.
2. Mount the axial lead screw nut to the top of the tool carrier. Tighten the mounting screws.
3. Be sure the scraper halves are mounted securely to the ends of the tool carrier.
4. Mount the tool carrier onto the boring bar. Be sure the lead screw nut engages the lead screw.
5. Tighten the socket-head cap screws.

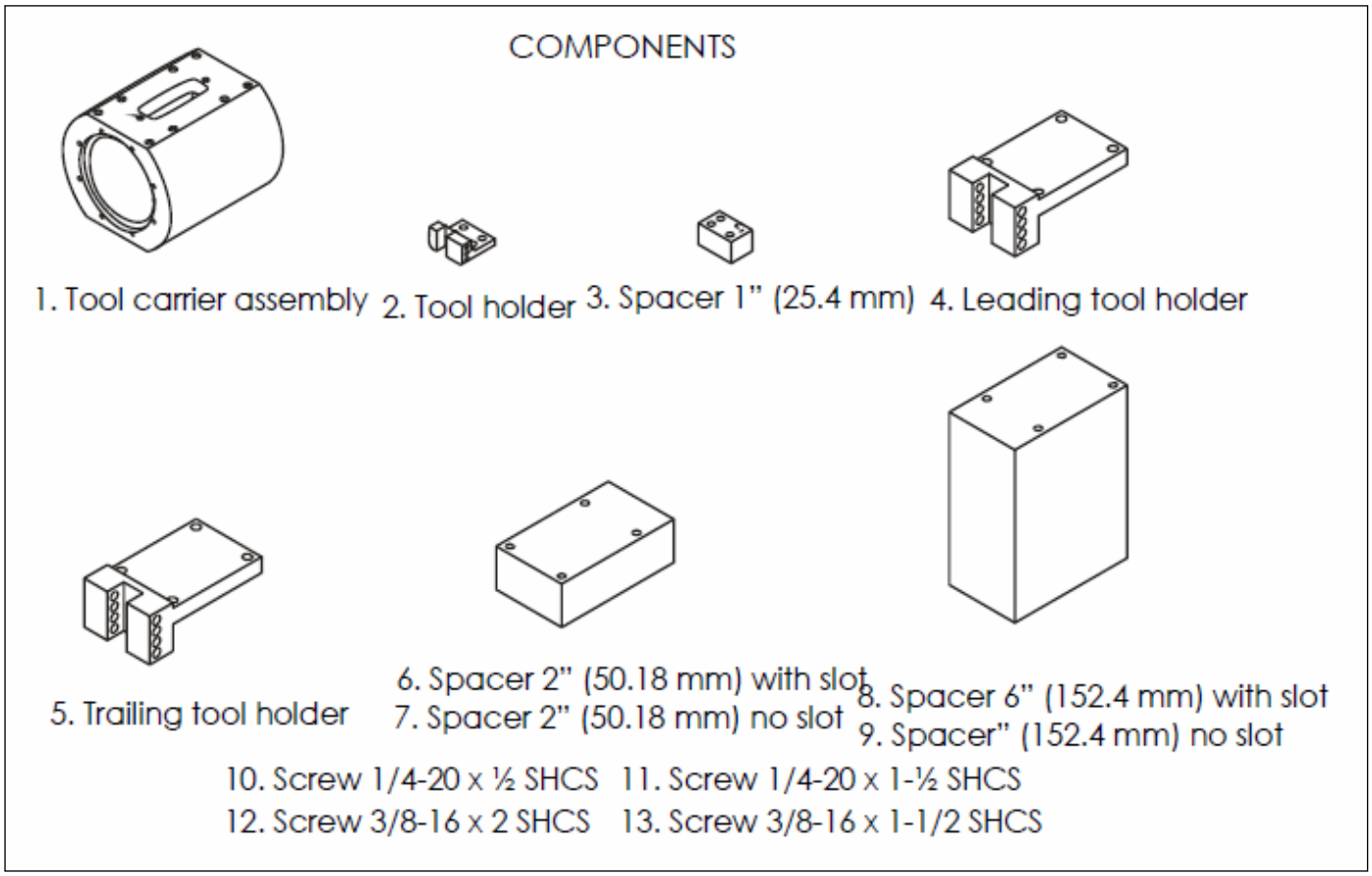


Number	Component
1	Lead screw nut
2	Oil hole
3	Rod scraper

6. Lightly oil the boring bar and lead screw so the tool carrier will move freely.

3.9.2 Small bore tool carrier boring head setup

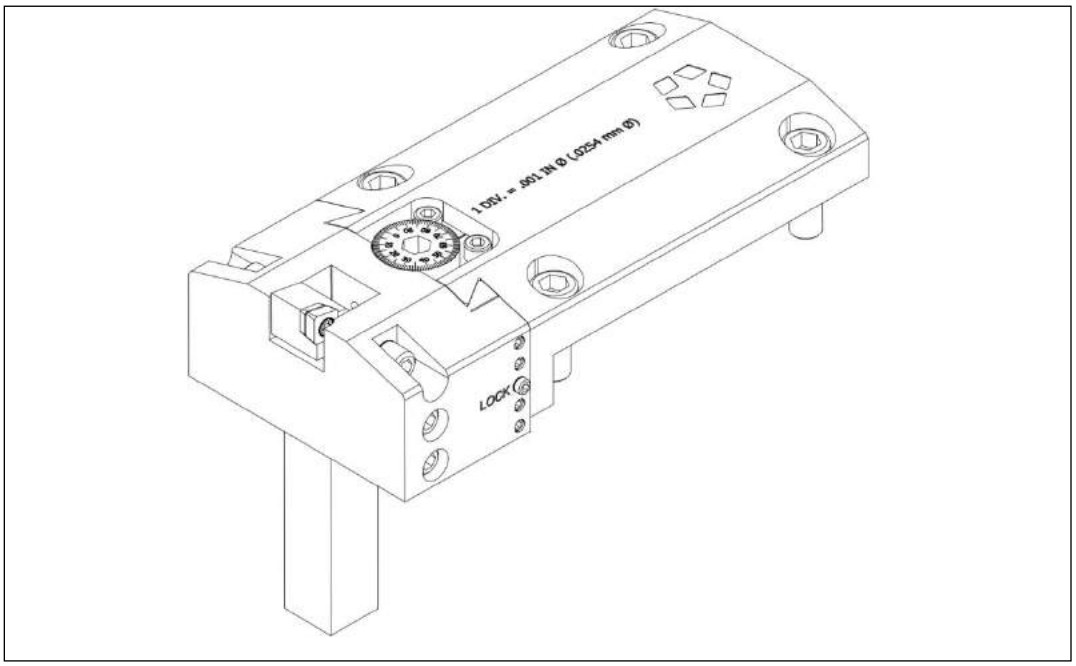
The boring head requires a tool carrier. See “Tool carrier setup” on page 31 for information.



Number	Component
1	Tool carrier assembly
2	Tool holder
3	1" (25.4 mm) spacer
4	Leading tool holder
5	Trailing tool holder
6	2" (50.18 mm) spacer with slot
7	2" (50.18 mm) spacer no slot
8	6" (152.4 mm) spacer with slot
9	6" (152.4 mm) spacer no slot
10-13	Socket head cap screws (different sizes)

3.10 Micro-adjust boring head

The micro-adjust boring head offers the possibility to micro-adjust readily available off-the-shelf square shank tooling for boring. The micro-adjust travel is 0.5" (13 mm), and the ability to slide the tool without having to change the setup provides a total tool travel of more than 2" (51 mm) per setup.



To set the tool to the desired diameter, simply feed the dial screw until reaching it and then lock the middle dove tail set screw with the provided T handle hex drive. Each division in the dial screw resolves in 0.001" (0.025 mm) change in diameter. The dove tail adjustment set screws are set to the correct load by CLIMAX and should not be necessary to re-adjust them. These set screws have Vibratite-VC3 in order to avoid losing tension during vibration. The lock also has this compound, and it might be necessary to re-apply it occasionally, if necessary.

The BB6100 micro-adjust boring head comes with a 3/4" (19 mm) square shank tool holder. A bolt-on shim is provided the 3/4 tool holder so that it can be easily converted to a 1/2" (13 mm) tool holder.

To set up leading and trailing, simply shift the boring heads against the mounting screws in opposite directions.

There is a small set screw that stops the tool carriage from being removed from its holder, and the boring head should never be operated without it on.

Proper maintenance would involve cleaning and lubricating the dove tail surfaces and the dial screw threads and groove, and if the lock set screw feels loose after a while, applying the provided Vibrative VC-3.

BB6100 Micro adjust boring head tool range table 8.8–40.8" (224–1,036 mm) diameter			
Bore range diameter	**Number of spacer blocks required**		
	2" (51 mm) block	**4" (102 mm) block**	**8" (203 mm) block**
8.8–12.8" (224–325 mm)	0	0	0
12.8–16.8" (325–427 mm)	1	0	0
16.8–20.8" (427–528 mm)	0	1	0
20.8–24.8" (528–630 mm)	1	1	0
24.8–28.8" (623–732 mm)	0	0	1
28.8–32.8" (732–833 mm)	1	0	1
32.8–36.8" (833–935 mm)	0	1	1
36.8–40.8" (935–1036 mm)	1	1	1

Tip:

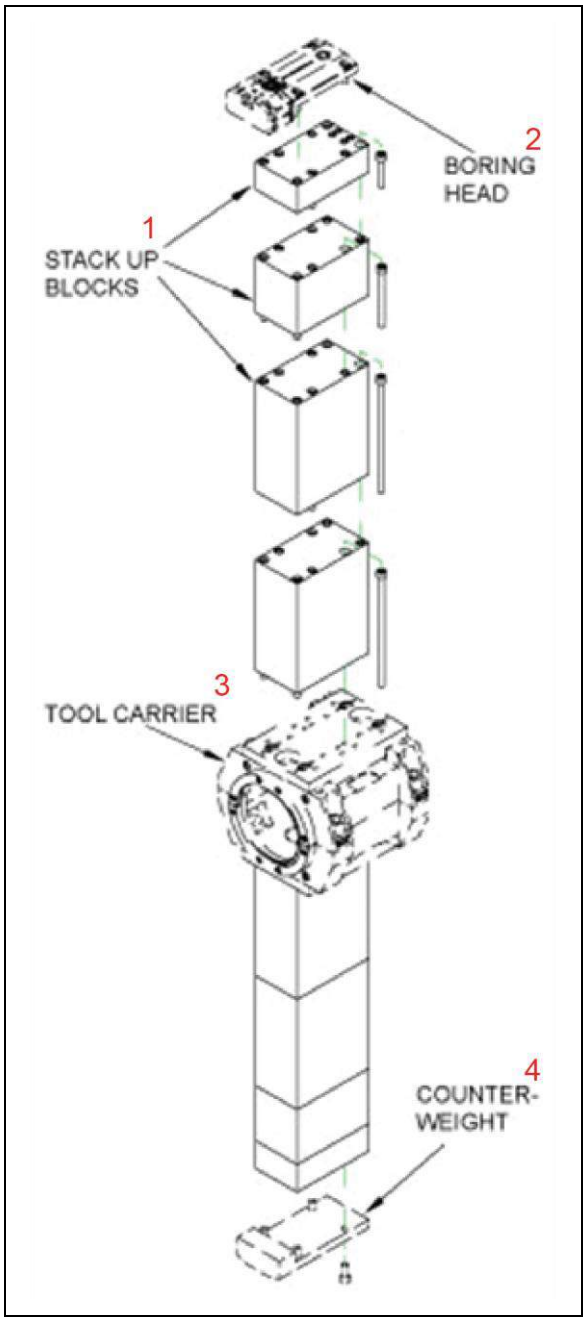
The bar can rotate in either direction. Be sure the tool bits face the correct direction.

BB6100 Solid tooling boring head tool range table 9.7–42.2" (246–1,072 mm) diameter				
Bore range diameter	**Number of spacer blocks required**			
	0.75" (19 mm) block	**2" (51 mm) block**	**4" (102 mm) block**	**8" (203 mm) block**
9.7–12.7" (246–323 mm)	0	0	0	0
11.2–14.2" (285–361 mm)	1	0	0	0
13.7–16.7" (348–424 mm)	0	1	0	0
15.2–18.2" (386–462 mm)	1	1	0	0
17.7–20.7" (450–526 mm)	0	0	1	0
19.2–22.2" (488–564 mm)	1	0	1	0
21.7–24.7" (551–627 mm)	0	1	1	0
23.2–26.2" (589–665 mm)	1	1	1	0
25.7–28.7" (653–729 mm)	0	0	0	1
27.2–30.2" (691–767 mm)	1	0	0	1
29.7–32.7" (754–831 mm)	0	1	0	1
31.2–34.2" (792–869 mm)	1	1	0	1
33.7–36.7" (856–932 mm)	0	0	1	1
35.2–38.2" (894–970 mm)	1	0	1	1
39.2–42.2" (996–1,072 mm)	1	1	1	1

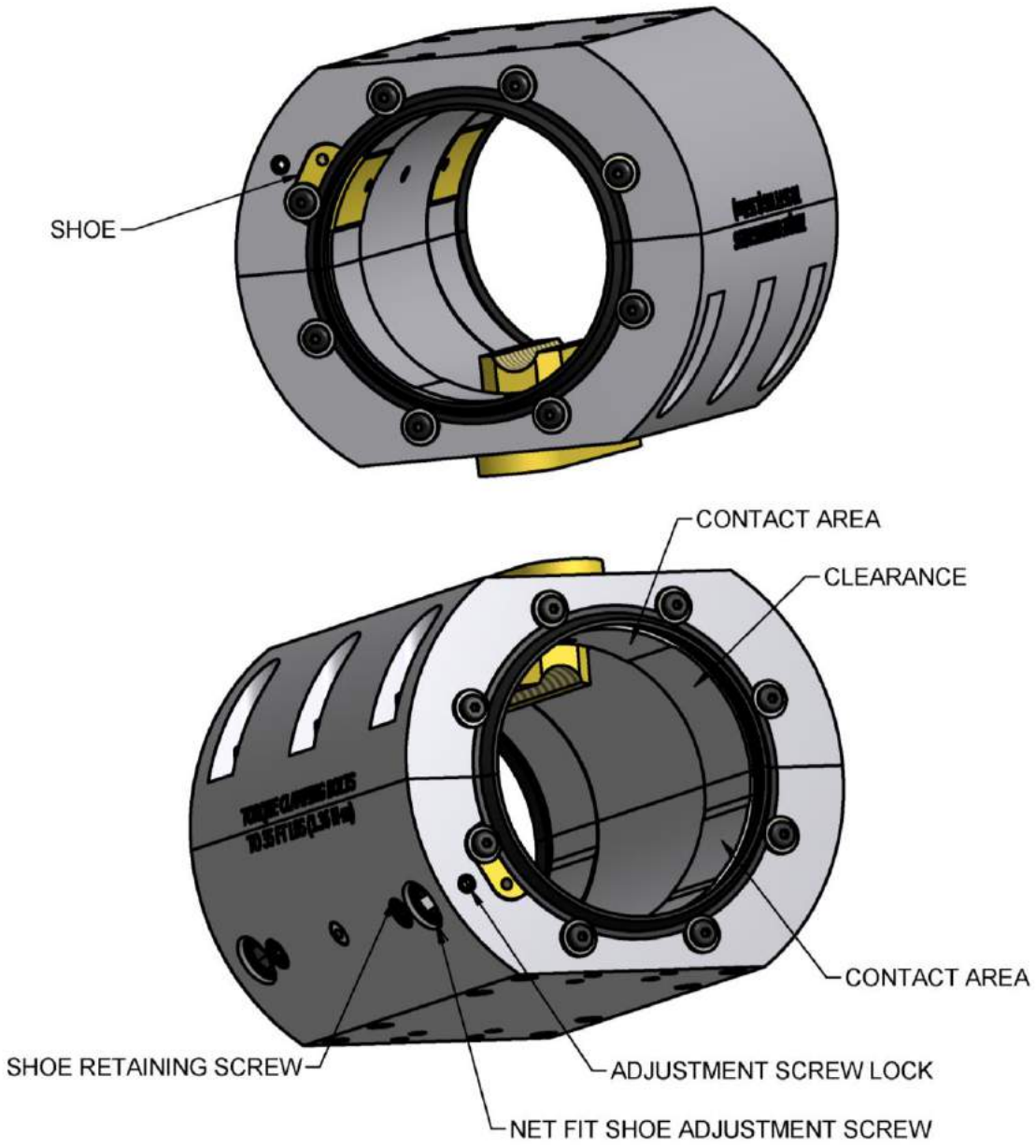
3.11 Boring head setup

1. Select the required parts using the “Boring head tool range” table.
2. Using the drawing as a guide, assemble the stack up blocks on to the tool carrier symmetrically on both sides of the tool carrier, from tallest to shortest.
3. Mount the boring head and the counterweight on the stack up blocks.

Number	Component
1	Stack-up blocks
2	Boring head
3	Tool carrier
4	Counterweight



BB6000 NET FIT CARRIER
3 POINT ADJUSTABLE CONTACT AT EACH END OF THE CARRIER



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3.11.1 To lock the tool carrier on the bar for other operations

1. Loosen the lock screw on the side of the tool carrier.
2. Tighten or loosen the adjustment screw.
3. Tighten the lock screw to keep the adjustment screw in position.

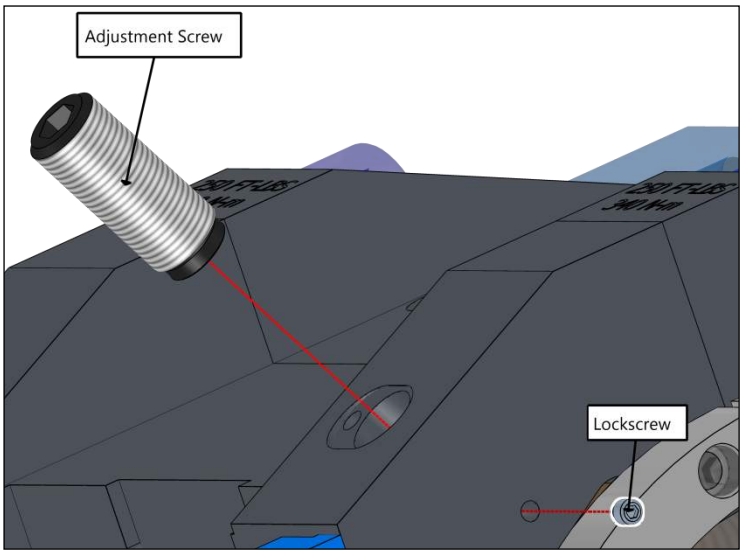


FIGURE 9. ADJUSTMENT SCREW (LEFT) AND LOCK SCREW (RIGHT)

3.11.2 Do the following to remove the brass nut:

1. Do not remove all the screws.
2. Remove the screws on each end of the brass nut.

(If there is too much play in the brass nut, the center set screw can be tightened.)

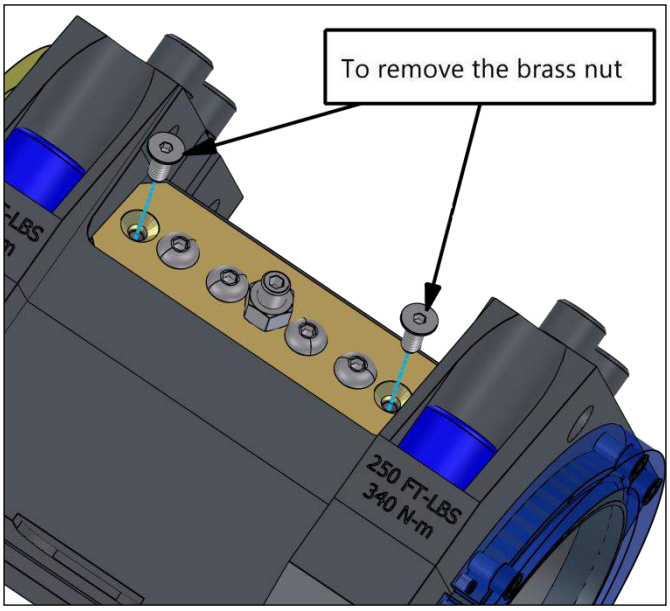
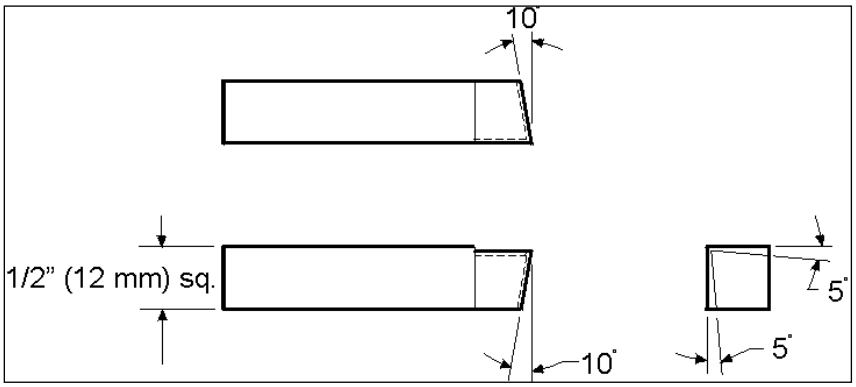


FIGURE 10. REMOVING THE BRASS NUT

3. Using the previous boring head tool range table, select the required spacers and screws. Clamp all parts tightly to the tool carrier.
4. Grind a 1/2" square HSS tool bit (see following illustration) or install inserted carbide tool holder with insert.



TIP:

Geometry shown is for a left-hand tool.

5. Secure the tool bit in the tool holder. Using a dial indicator, adjust the tool cutting depth. The maximum recommended cut is 0.125" (3 mm).

TIP:

Precision bores are best achieved by several roughing cuts and one or more shallow finishing cuts.

3.12 Install the slide arm onto the tool carrier

1. Using a device such as a crane, place arm onto tool carrier flush with carrier surface as shown.

NOTICE

Always use the lifting eyes when lifting the arms. The rotating lifting eyes provide the flexibility and safety during setup operations.

2. Secure arm with clamp bar (P/N 53074) with 1/2-20 x 1-3/4 screws (P/N 18225), four per clamp bar, and torque to 100 ft-lb. (135 N-m).

⚠ DANGER

Failure to properly torque the four ½-20 x 1-1/4 SHCS (P/N 18225) to 100 ft-lb (135 Nm) can result in unexpected slippage of the tool arm which can result in injury or be fatal.

3.13 Adjusting the tool carrier for perpendicularity

The tool carrier is equipped with four set screws that allow you to adjust the slide arm perpendicularity if required.

3.14 Feedbox assembly

Mount and secure the feedbox (see Section 7 on page 55).

3.15 Feedbox and trip arm set-up

Install the counterweight arm onto the tool carrier

1. Rotate the tool carrier on the bar to allow the counterweight arm to be mounted on the receiving surface of the tool carrier.
2. Attach the lifting eye onto counterweight arm and install arm.

NOTICE

Always use the lifting eyes when lifting the arms. The rotating lifting eyes provide the flexibility and safety during setup operations.

3. Using a lifting device such as a crane, lift the counterweight assembly to the arm. Fasten the counterweight assembly to the arm using the fasteners shown in the exploded views.

Note that you can position the counterweight itself anywhere along the arm as needed to balance the assembly.

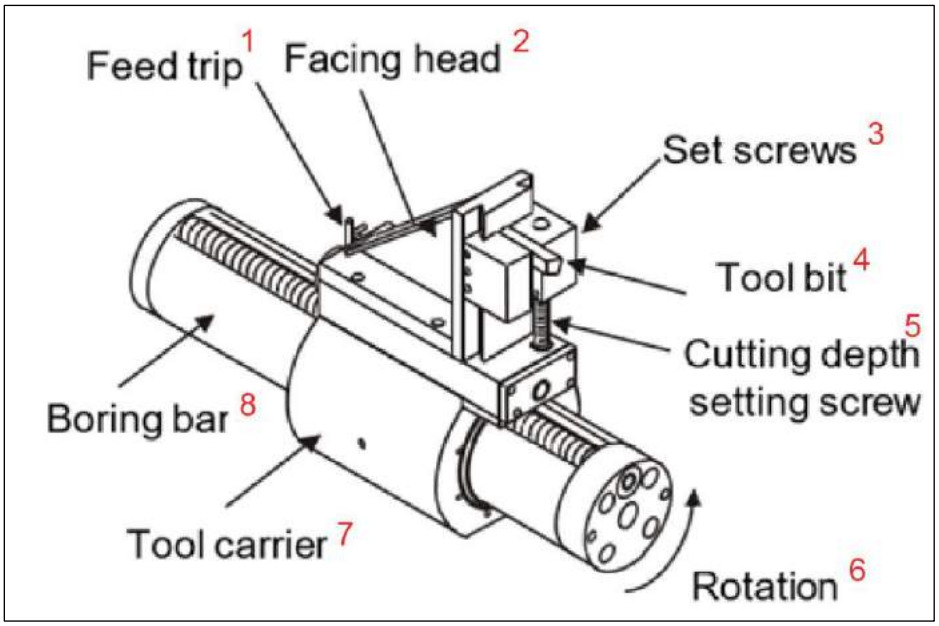
3.16 Mechanical facing head setup

The mechanical facing head assembly requires either a one-piece or the two-piece tool carrier.

1. Assemble the facing head as necessary. (See the following Facing Head Tool Range Table and Mechanical Facing Head exploded view drawing to see how the parts fit together).
2. Mount the facing head onto the tool carrier.
3. Secure a sharpened tool bit in the tool carrier.

⚠ CAUTION

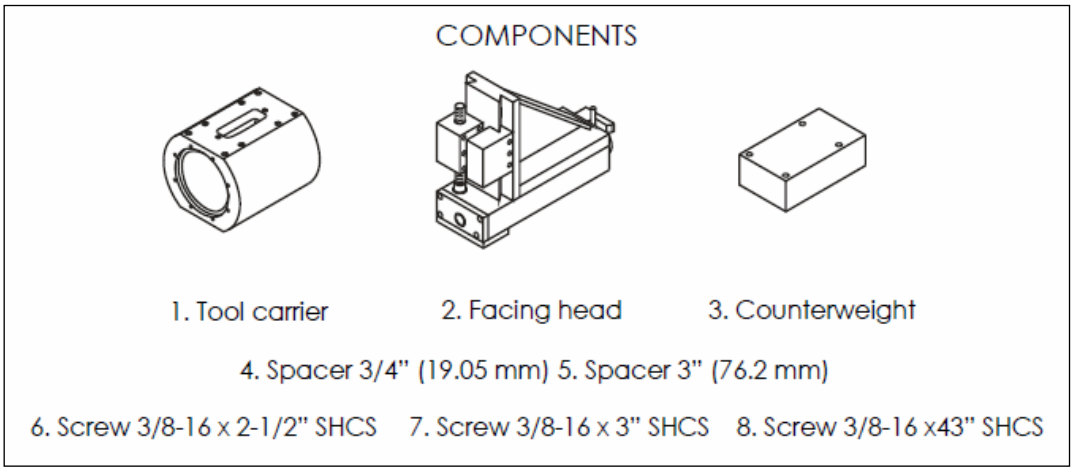
The facing head is operational in only one direction. Check that the bar rotates in the correct direction the tool bit faces appropriately.



Number	Component
1	Feed trip
2	Facing head
3	Set screws
4	Tool bit
5	Cutting depth setting screw
6	Rotation
7	Tool carrier
8	Boring bar

4. Set the depth of cut by adjusting the screw.
5. Engage the automatic feed trip. The trip mechanism produces radial feed from 0 (no trip) to 0.010" (0.254 mm). The farther down the trip rod catches on the trip, the greater the feed. Multiple trip rods increase the rate of feed.

Facing head tool range table for 4" (102 mm) model	
Face diameter range	**Components required**
10.5–22.5" (267–572 mm)	1, 2, 3, 7
16.5–28.5" (419.1–724 mm)	1, 2, 3, 5, 6, 7
24–36" (610–914 mm)	1, 2, 3, 4, 5, 5, 6, 8



Number	Component
1	Tool carrier
2	Facing head
3	Counterweight
4-5	Spacers (different sizes)
6-8	Socket head cap screws (different sizes)

Tip:

The counterweight mounts on the side of the tool carrier opposite of the facing head. The components figure shows spacers for one side only. Use an identical spacer stack for each side.

The facing head can bore diameters as small as 23.25" (590.55 mm).

3.17 Hydraulic power preparation and connection

⚠ CAUTION

Connect the hydraulic motor to the power unit pump prior to turning on the power unit. Failure to do so will damage the pump and void all warranties.

The hydraulic motor mounts to the rotational drive unit. Hydraulic hoses with quick disconnect fittings connect to hydraulic power unit and the hydraulic motor. Before connecting or disconnecting the hoses, turn off the power unit.

The return and pressure lines are interchangeable. If you switch these lines, the boring bar will rotate in the opposite direction.

Do the following to reverse bar rotation:

1. Turn off the hydraulic power unit
2. Switch the hoses at the motor end.

The control pendant's START/STOP push buttons run the hydraulic power unit. The 20-foot (6 meter) cable allows remote operation of the motor.

Make sure to check the direction of bar rotation and tool head feeding before operating the boring bar. Check that the electrical supply matches the requirements of the power unit.

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4 OPERATION

4.1 Using the remote pendants

Operator controls for the machine are located on the remote pendants, described below.

⚠ CAUTION

The bar rotation and the axial feed are independent of each other. Be sure the feed is OFF when the bar is not running.

4.1.1 Feed pendant

The following is a description of the feed pendant controls:

FEEDBOX PENDANT

Symbol	Feature	Description
∿∿	Feed speed override	A momentary button which overrides the feed rate potentiometer and runs the axial power feed at maximum rate, regardless of the potentiometer setting.
← ○ →	Feed direction	A 3-position switch that determines the direction of the axial or radial feed. In the STOP position, the motor will not move under power from the pendant. Feed direction may be changed during operation.
	Speed	The Feed potentiometer controls the axial feed rate. Counterclockwise decreases the feed rate; clockwise increases the feed rate.

⚠ CAUTION

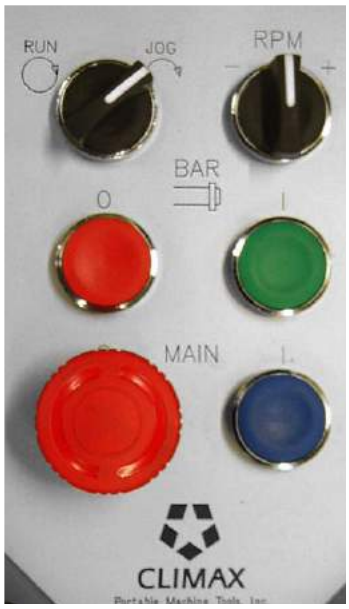
Damage to the cutter, the boring machine and your work piece may occur if the bar rotation is stopped while the power feed is engaged and the cutting tool is in contact with the work piece.

4.2 HPU pendant

NOTICE

Additional information about the HPU function, construction, and maintenance schedule can be found in the HPU manual.

The hydraulic power unit comes with a standard control pendant.



Feature	Description
Run/Jog	
RPM	Increases or decreases the rotational speed.
Bar Off (red)	Turns off the hydraulic power unit
Bar On (green)	Turns on the hydraulic power unit
Off (red)	Turns off the electric motor
On (blue)	Turns on the electric motor

4.3 Manual override (electrical feed only)

The manual override consists of 2-position gear lever that disengages the electric drive from the boring bar. When disengaged, a hand-drill can be installed for manual rapid operation. When the gear box is in the manual override position, the pendant functions are not active.

⚠ CAUTION

Do not force the shift lever to engage. Forceful engagement can damage the mechanical override mechanism.

To move the tool carrier rapidly, shift the feed lever on the top of the gearbox to the back position. With a socket on the hexagon shaft, run with an electric drill or speed wrench. To re-engage the feed, remove the socket, turn the feed on slow, and shift the feed lever to the forward position.

4.4 Pre-startup checks

Do the following before operating the boring bar:

1. Tie down the RDU torque arms and the axial feed unit stop rod.
2. Use only properly sharpened tool bits.
3. Secure all machine parts, including the bearing assemblies, the tool carrier, and the boring head. See that moving parts move freely.
4. Check that electric cords and cables are in good condition and correctly connected.
5. Turn the hydraulic power unit OFF.
6. Check that the power unit wiring matches the electric source. Plug the power unit into a grounded outlet.
7. Check that the reservoir level is filled above the red bar with UNAX AW32 hydraulic oil or equivalent.
8. Check that the power unit is set level.
9. Clean the hydraulic hoses and fittings before connecting them.
10. Check that the electric pump motor on the hydraulic power unit is turning as indicated by the arrow on the case.
11. If using the boring bar in a vertical orientation, check that the two clamp collars are in place to secure the bar (see Section 3.1 on page 15).

4.4.1 Running the machine

1. Set the feed direction and feed rate on the axial feed unit (see Section 3.7.1 on page 27).
2. Press START on the hydraulic power unit pendant.
3. Adjust the bar rotation using the speed control hand wheel on the hydraulic power unit or the knob on pendant.
4. As cutting begins, lubricate the work piece and cutting tool with plenty of cutting oil. Apply cutting oil with a squirt can.

4.4.2 Stopping the machine

1. Press STOP on the pendant to stop the power unit.
2. After all parts of the machine have stopped, use a brush to remove chips.
3. If you will be machining the work piece again, see Section 4.4.4. If you are done machining, see Section 4.5.

4.4.3 Repetitive machining

4. Reverse the boring head feed direction.
5. Manually or automatically feed the boring head back to where it started cutting.

6. Sharpen the tool bit, if necessary.
7. Use a dial indicator to reset the tool bit cutting depth. The maximum recommended cutting depth is 0.125" (3 mm).
8. Operate the boring bar as described in Section 4.4.2.

4.5 Disassembly

4.5.1 Standard disassembly

1. Turn off and unplug the hydraulic power unit.
2. Disconnect the hydraulic lines from the motor.
3. Remove the tool bit.
4. Remove the tool head and tool carrier.
5. Remove the axial feed unit from the bar.
6. Support the boring bar, bearing supports, and RDU with hoists.
7. If the RDU is between the bearing support assemblies, loosen one support first. Remove that support from the work piece and bar.
8. Secure the RDU with a hoist. Loosen the shaft collars. Remove the drive key. Carefully slide the RDU off the bar.
9. Loosen the remaining bearing support assemblies. Remove the boring bar.
10. Remove the bearing supports from the work piece.

4.5.2 Optional disassembly

In some cases, it is better to remove the bearings before removing the bar.

1. Turn off and unplug the hydraulic power unit.
2. Disconnect the hydraulic lines from the motor.
3. Remove the tool bit.
4. Remove the tool head and tool carrier.
5. Securely support the boring bar, bearing supports, and RDU with hoists.
6. Remove the axial feed unit from the bar.
7. If the RDU is between the bearing support assemblies, remove one support first. Remove the support from the work piece and bar.
8. Secure the RDU with a hoist. Loosen the shaft collars. Remove the drive key and carefully slide the RDU off the bar.
9. Loosen the bearing support jacking screws.
10. Place a wooden support in the bottom of the bore to support the bar.
11. Remove the bearing supports from the work piece.
12. Slide the bar out of the bore using the wooden support.

5 MAINTENANCE

5.1 Recommended lubricants

Lubricant	Brand	Where used
Gear grease	Polytac EP #2	Rotational drive, axial feed units
Light Oil	LPS 2	Unpainted surfaces
Cutting oil	UNOCAL KOOLKUT	Tool bits, work pieces
Hydraulic oil	Union UNAX AW32 Anti-wear hydraulic oil	Hydraulic motor
Anti-seize lubricant	Moly Grade Anti-seize	Jacking bolts

5.2 Boring bar/lead screw assembly

Clean the lead screw and boring bar frequently during operation. Keep chips away from the lead screw threads. Lubricate the lead screw periodically with light oil to ensure smooth travel of the tool carrier assembly. Before storage, lightly oil the bar to prevent rusting. Do not grease the leadscrew.

5.3 Axial feed unit

Under normal conditions, the mechanical axial feed unit is maintenance free.

5.4 Rotational drive unit

The RDU has sealed lubrication. Under normal use, it is maintenance free.

5.5 Bearing support assembly

Before using the boring bar and periodically during long machining operations, grease the bearings. Add grease slowly while the bar is rotating until a slight bead of grease forms at the seals.

Periodically apply anti-seize to jacking bolts of the ID-mounting bearing.

5.6 Tool head assembly

5.6.1 Boring head assembly

Lightly oil all parts to prevent rusting.

5.6.2 Mechanical facing head assembly

Before machining and frequently during operation, lubricate the tool head carrier at the grease fitting. Brush chips from the lead screw frequently to prevent thread damage. Lightly oil the lead screw.

5.6.3 Tool carrier maintenance

Before operating the boring bar, pump light oil into the oiler in the side of the carrier. Be careful not to damage the scrapers.

Before storage, lightly oil all parts to prevent rusting.

5.7 Hydraulic power unit and motor

See the HPU manufacturer's documentation for information about your HPU and its maintenance.

6 STORAGE

Proper storage of the portable boring bar will prevent undue deterioration or damage.

Before storing, wipe the machine down with solvent to remove grease, metal chips, and moisture.

To prevent rusting, spray with a moisture-displacement material such as JET-LUBE 550 for short-term storage, LPS 3 for long-term storage.

Store the machine in the container provided.

Place desiccant bags or vapor wrap around the machine to absorb moisture.

6.1 Tool kit

TABLE 4 . BB6100 TOOL KIT (P/N 54262)

P/N	DESCRIPTION	QTY	UOM
10855	WRENCH EXTENSION 3/8 DRIVE X 6	1	Piece
11856	WASHER 5/8 FLTW	4	Piece
12339	WASHER 3/4 FLTW	2	Piece
12800	WRENCH END 15/16	1	Piece
12835	WRENCH END 1-1/8 COMBINATION LONG (KB)	1	Piece
14735	WRENCH EXTENSION 1/2 DRIVE X 10	1	Piece
14818	WRENCH RATCHET 1/2 DRIVE	1	Piece
15367	WRENCH STRAP 1-3/4 WIDE X 48 LONG	1	Piece
15781	WRENCH HEX BIT SOCKET 3/8 X 3/8 (KB)	1	Piece
16792	WRENCH END 3/8 COMBINATION	1	Piece
17378	SCREW 5/8-11 X 2-1/4 HHCS	4	Piece
19261	WRENCH SOCKET 3/8 6 PT X 3/8 DRIVE	1	Piece
19700	CONTAINER SHIPPING FLAT ROOF 20 X 8.75 X 10.5	1	Piece
20869	WRENCH HEX SET 5/64 TO 3/4 15 PIECES	1	Piece
21406	SCREW 3/4-10 X 2 HHCS	2	Piece

P/N	DESCRIPTION	QTY	UOM
23659	FUSE AXIAL FEED 3-1/2 BAR	1	Piece
24751	WRENCH RATCHET 3/8 DRIVE	1	Piece
25010	CLAMP COLLAR SPLIT HINGED 3-1/2ID	2	Piece
29661	WRENCH HINGE HANDLE 1/2 DRIVE 17 IN HANDLE (KB)	1	Piece
54411	STANDOFF RDU 6IN	1	Piece
54412	STANDOFF RDU 6.5IN	1	Piece
54717	TOOL BEARING BB6100	1	Piece
56734	WRENCH SPANNER FOR 3.5 DIA DODGE IMPERIAL BRG OFFSET 1 IN	1	Piece
57017	MANUAL INSTRUCTION BB6100 BORING BAR	1	Piece

6.2 Spare Parts

Parts listed below include items most frequently required due to wear, loss, or damage. To avoid unscheduled down time you may want to stock any or all of the parts listed.

TABLE 5. SPARE PARTS KIT

Where used	P/N	DESCRIPTION	QTY
Boring bar assembly	22143	NUT LEADSCREW BRG ADJUSTING 3/4 DIA	2
	22403	KEY DRIVE 3-1/2 BORING BAR	1
	22814	HOIST RING 3/4-10 X 1-1/2 1-3/4 ID 3-1/4 OD 6-3/8 OAL 5000 LBS SWIVEL	1
	22815	SPACER BOLT EYE 1/2 THK	1
Mechanical axial feed assembly	22409	DIAL FEED	1
	14303	ROD STOP	1
Net fit tool carrier	54217	SHOE ADJUSTABLE TOOL CARRIER BB6100	1
	54221	SET NUT AXIAL LEAD SCREW 3/4-5 ACME BB6100	2
	14771	SCREW 5/16-18 X 3/4 BHSCS	4
Small bore tool carrier	22205	NUT AXIAL LEADSCREW	1
	22384	WIPER ROD 3.5 ID MOLYTHANE	2
	10453	SCREW 3/8-16 X 1-1/4 SHCS	6
Boring/facing arms	45691	ASSY FEEDBOX REVERSE CLUTCH INPUT	1
	54178	NUT HALF FACING HEAD BB7100	1
	55094	TRIP ARM STEEL 3 INCH	1
Hydraulic power unit	NA	See the HPU operator manual.	NA
Tooling	79020	BORING HEAD MICRO ADJUST 3/4 INCH TOOLING (1/2 INCH READY) LARGE BB	1

Where used	P/N	DESCRIPTION	QTY
	31859	BIT TOOL HSS 1/2 X 4.0 LH FINISHING SINGLE TC	1
	31868	BIT TOOL HSS 1/2 X 4.0 LH ROUGHING SINGLE	1
	33996	HOLDER INSERT 3/4 SQ SHANK NEG RAKE RIGHT HAND	1
	33997	HOLDER INSERT 3/4 SQ SHANK NEG RAKE LEFT HAND	1
	41407	INSERT CARBIDE 80 DEG 1/2 IC 1/64 NOSE RADIUS KC5010	10
	50741	INSERT CARBIDE 80 DEG 3/8 IC 1/64 NOSE RADIUS CPGM-3251 KC5010	10

7 EXPLODED VIEWS AND PARTS LISTS

The following diagrams and parts are for your reference purposes only. The machine Limited Warranty is void if the machine has been tampered with by anyone who has not been authorized in writing by CLIMAX to perform service on the machine.

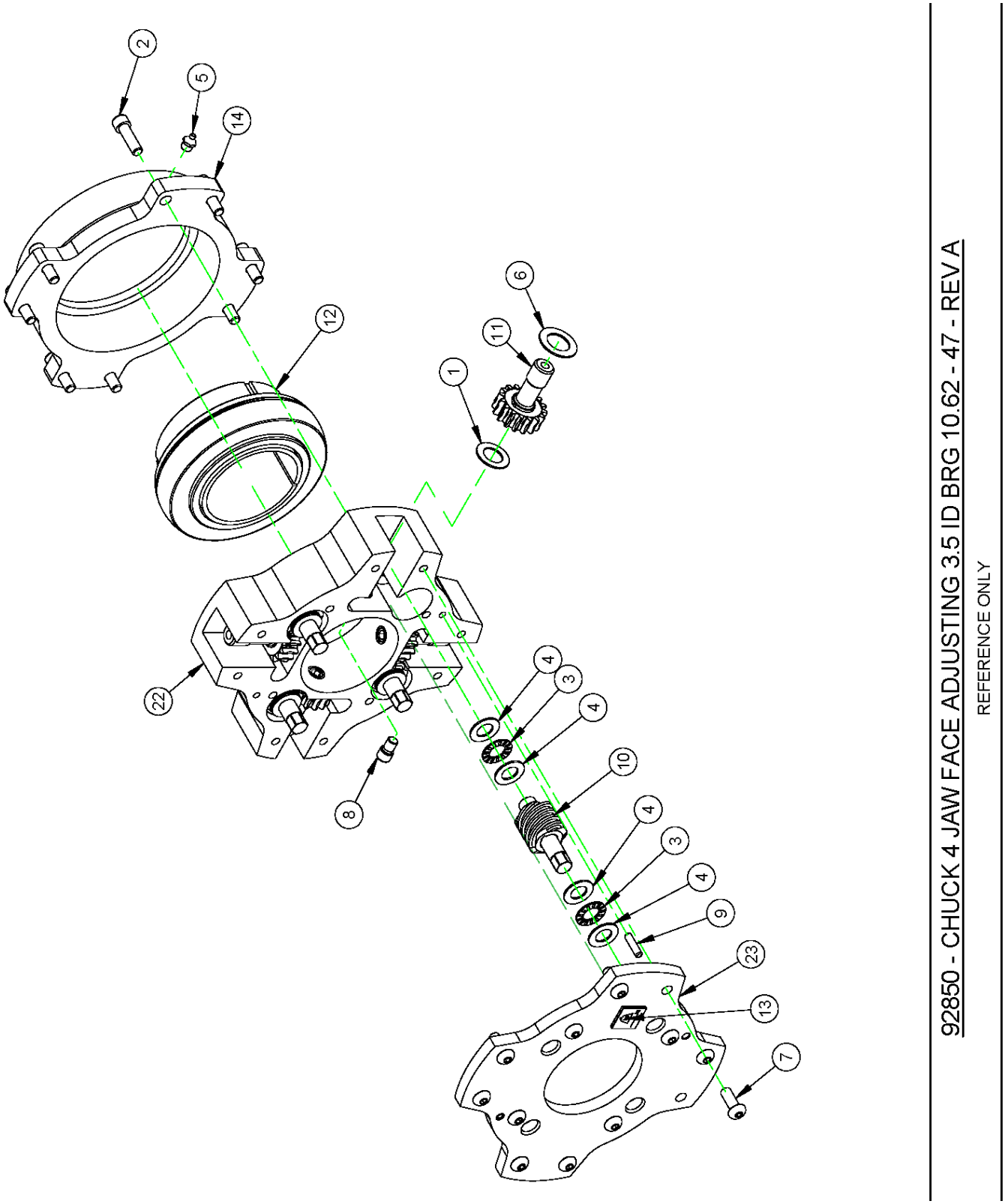
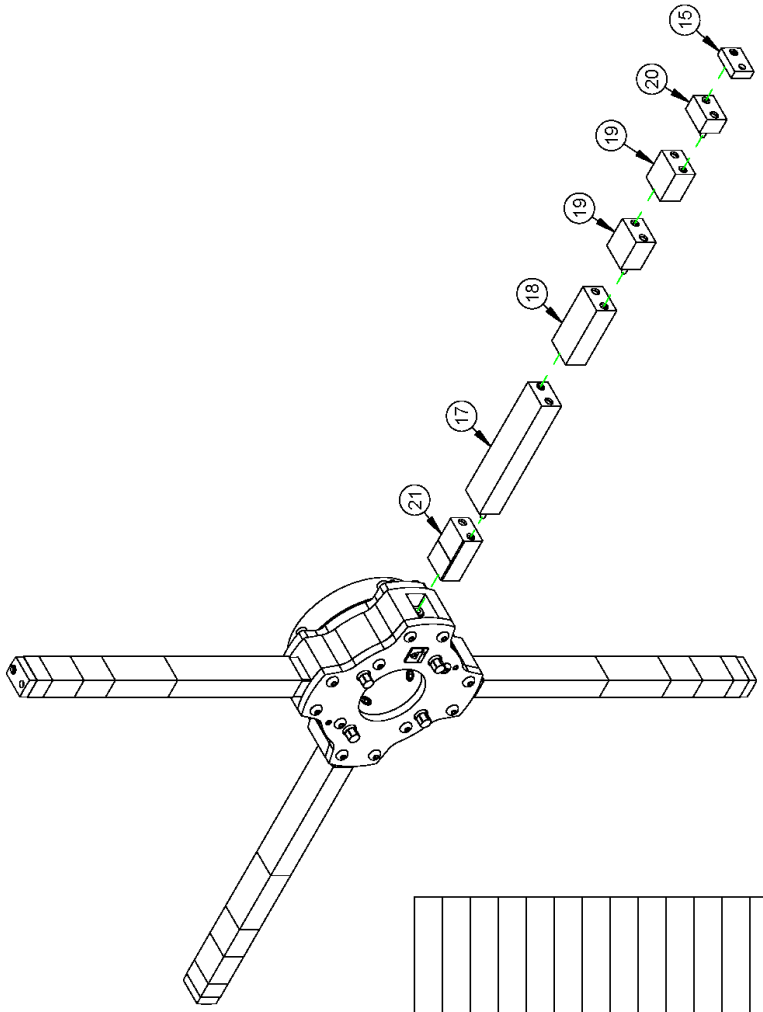
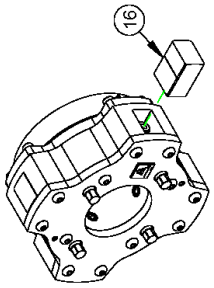


FIGURE 11. 4-JAW CHUCK FACE ADJUSTING 3.5 ID BEARING ASSEMBLY (P/N 92850)



LARGEST CONFIGURATION



SMALLEST CONFIGURATION

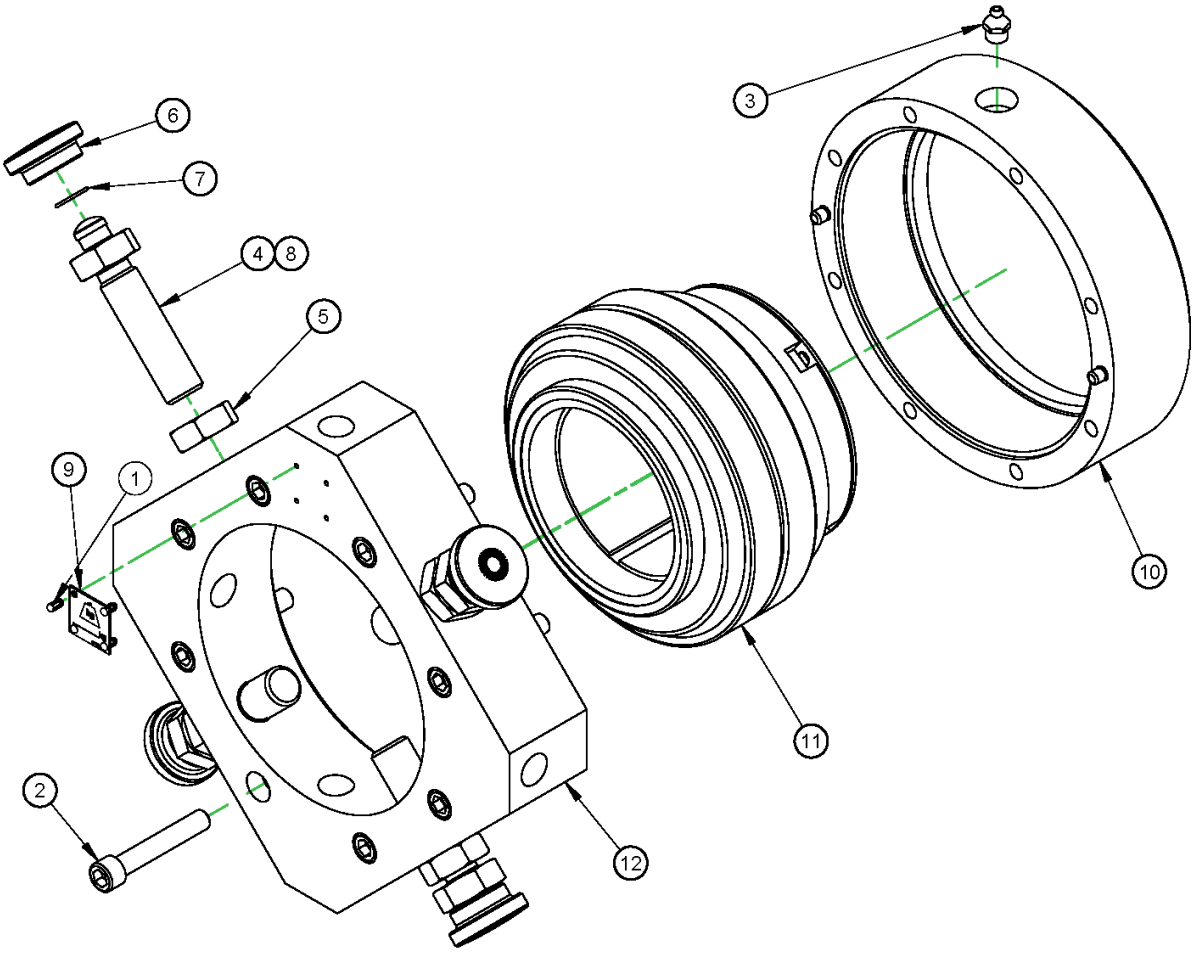
PARTS LIST

ITEM	QTY	P/N:	DESCRIPTION
1	4	10136	WASHER THRUST .750 ID X 1.25 X .060
2	8	10453	SCREW 3/8-16 X 1 1/4 SHCS
3	8	10538	BRG THRUST .625 ID X 1.125 OD X .0781
4	16	11165	WASHER THRUST .625 ID X 1.125 OD X .060
5	1	11898	FTG GREASE 1/8 NPTM
6	4	13175	WASHER THRUST .875 ID X 1.437 OD X .060
7	12	13340	SCREW 3/8-16 X 1 BHSCS
8	4	16402	PIN JAW SCREW
9	2	17152	PIN DOWEL 1/4 DIA X 1
10	4	38484	WORM SHAFT ASSY
11	4	38493	SCREW WORM GEAR JAW EXTENSION
12	1	85689	BRG INSERT 3-1/2" X 160MM OD GRIP TITE ADAPTER
13	1	91217	PLATE MASS CE 1.0 X 1.0 KG ADHESIVE BACKED
14	1	92538	HOUSING BRG SPHERICAL 3.5 BAR
15	4	92575	LEG EXTENSION FACE ADJ CHUCK END CAP
16	4	92595	LEG EXTENTION FACE ADJ ID CHUCK
17	4	92611	LEG EXTENSION FACE ADJ CHUCK 200MM
18	4	92612	LEG EXTENSION FACE ADJ CHUCK 100MM
19	8	92701	LEG EXTENSION FACE ADJ CHUCK 50MM
20	4	92809	LEG EXTENSION FACE ADJ CHUCK 25MM
21	4	92822	LEG EXTENTION FACE ADJ ID CHUCK BASE
22	1	92853	CHUCK ID MOUNT FACE BODY
23	1	92948	PLATE RETAINER ID MOUNT CHUCK FACE ADJ

92850 - CHUCK 4 JAW FACE ADJUSTING 3.5 ID BRG 10.62 - 47 - REV A

REFERENCE ONLY

FIGURE 12. 4-JAW CHUCK FACE ADJUSTING 3.5 ID BEARING ASSEMBLY PARTS LIST (P/N 92850)

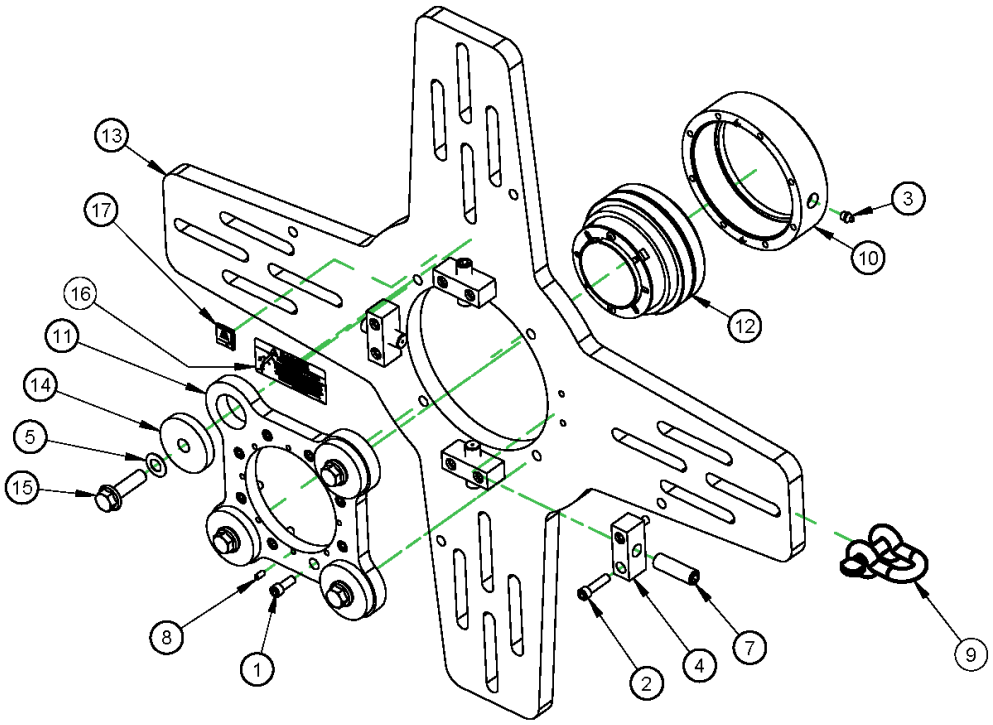


PARTS LIST			
ITEM	QTY	P/N:	DESCRIPTION
1	4	10588	SCREW DRIVE #2 x 1/4 HOLE SIZE .089
2	8	11196	SCREW 3/8-16 X 2-1/4 SHCS
3	1	11898	FTG GREASE 1/8 NPTM
4	4	14991	BOLT JACKING SHORT
5	8	14996	NUT 3/4-10 JAMN
6	8	15058	PAD THRUST
7	8	15059	RING SNAP 5/8 WIRE RING
8	4	26801	BOLT JACKING LONG
9	1	29152	PLATE MASS CE
10	1	53681	BEARING HOUSING 3.5" BAR
11	1	53689	IMPERIAL BRG INSERT 070904 FOR 3.5 IN BAR
12	1	54356	SPIDER ID 11.25-47 INCH BB6100
13	4	54357	(NOT SHOWN) SPACER 3 INCH ID MOUNT BB6100
14	8	54358	(NOT SHOWN) SPACER 6 INCH ID MOUNT BB6100

54355 - MOUNT ID BEARING ASSY 11.25-47 INCH BB6100 - REV A

FOR REFERENCE ONLY

FIGURE 13. ID-MOUNT BEARING ASSEMBLY (P/N 54355)

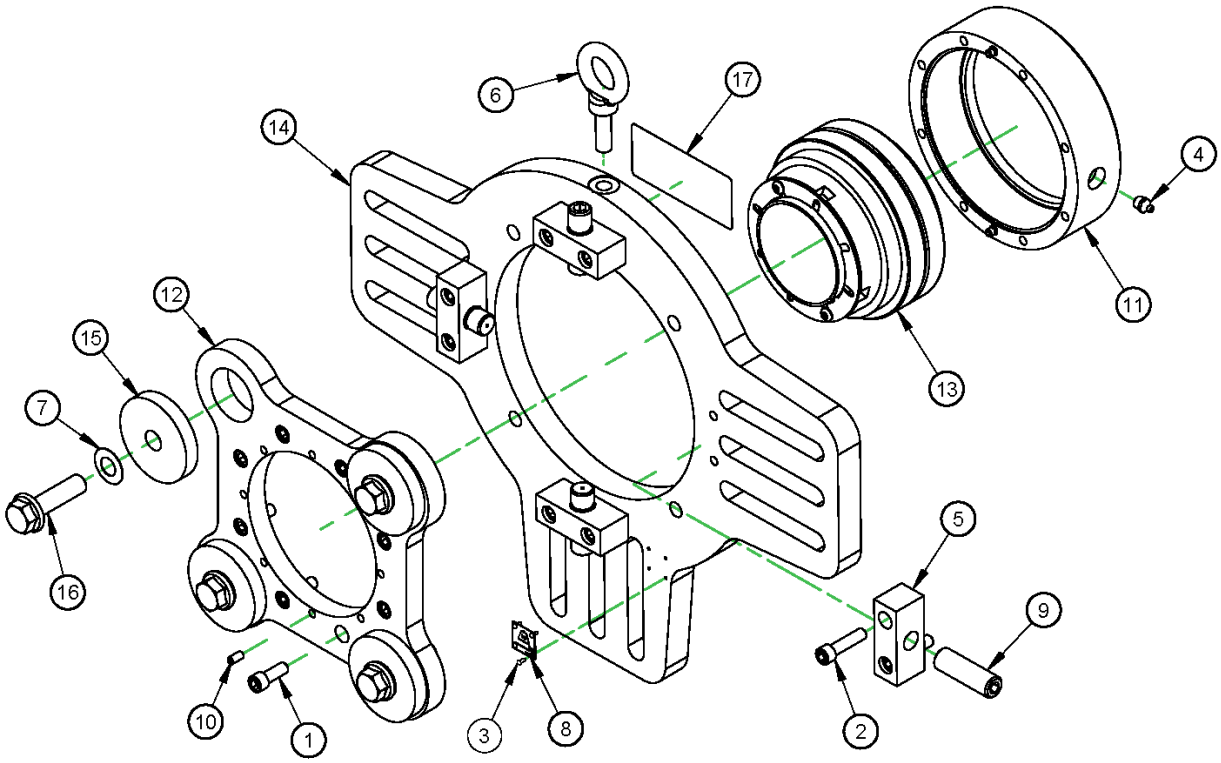


PARTS LIST			
ITEM	QTY	P/N:	DESCRIPTION
1	8	10191	SCREW 3/8-16 X 1 SHCS
2	8	10474	SCREW 3/8-16 X 1-1/2 SHCS
3	1	11898	FTG GREASE 1/8 NPTM
4	4	20956	BLOCK ADJUSTING
5	4	27172	WASHER SPRING BELLEVILLE 5/8 X 1-1/4 X .040
6	1	33304	(NOT SHOWN) CRATE 32 X 32 X 12 5/8 PLY HINGED BB6000 & BB6100 BEARINGS
7	4	42212	SCREW MOD SSSCP 3/4-10 UNC X 2.5
8	8	45004	SCREW 1/4-28 X 1/2 SSSFP
9	1	53135	SHACKLE D FORGED 5/8 PIN 7170 LB LOAD
10	1	53681	BEARING HOUSING 3.5" BAR
11	1	53686	COVER BRG 3.5" HOUSING EXTERNAL
12	1	53689	IMPERIAL BRG INSERT 070904 FOR 3.5 IN BAR
13	1	53707	SPIDER END BRG SUPPORT 3.5" BAR DIA
14	4	54239	WASHER 5/8 FLTW .7 ID 3.0 OD .5 THICK
15	4	60761	SCREW 5/8-11 X 2-1/4 HHCS FLANGED BLK OX
16	1	66767	LABEL LARGE BORING BAR CRUSH HAZARD
17	1	91217	PLATE MASS CE 1.0 X 1.0 KG ADHESIVE BACKED

53710 - SPIDER ASSY END BRG SUPPORT 38" BB6100 - REV B

FOR REFERENCE ONLY

FIGURE 14. SPIDER BEARING ASSEMBLY END SUPPORT (P/N 53710)

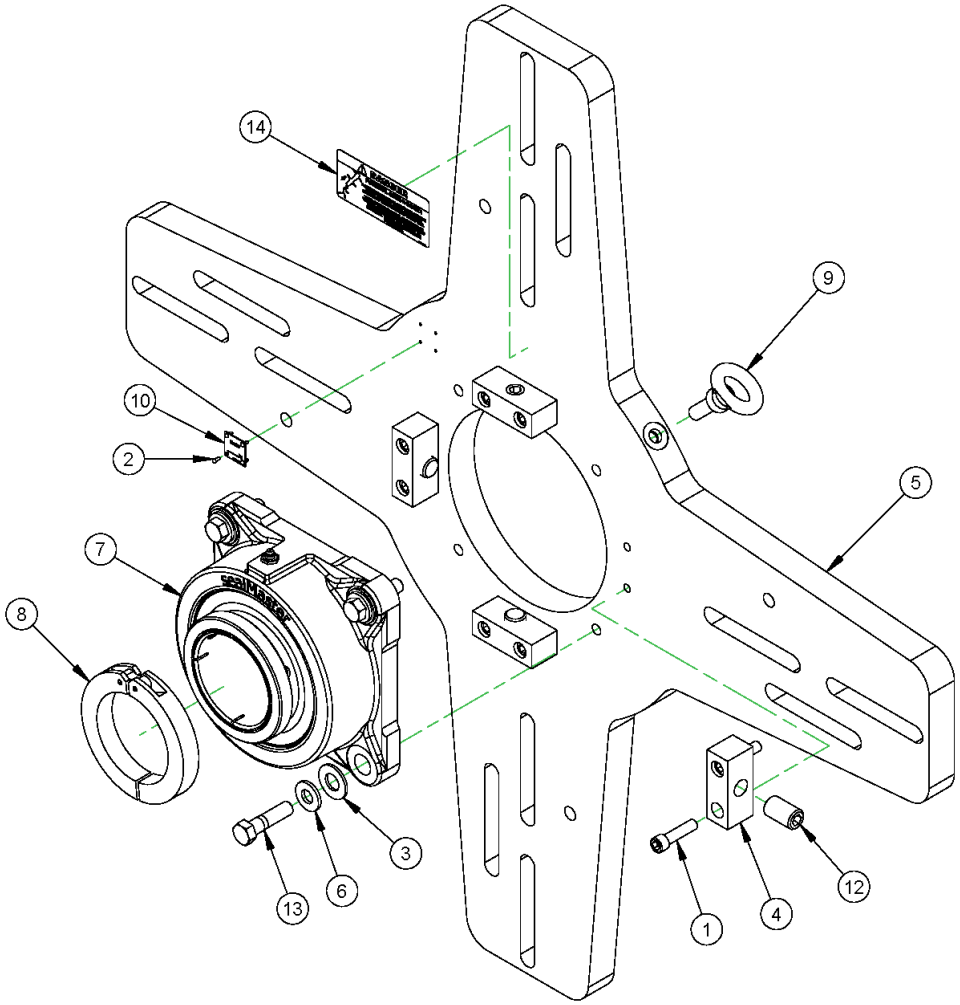


PARTS LIST			
ITEM	QTY	P/N:	DESCRIPTION
1	8	10191	SCREW 3/8-16 X 1 SHCS
2	8	10474	SCREW 3/8-16 X 1-1/2 SHCS
3	4	10588	SCREW DRIVE #2 x 1/4 HOLE SIZE .089
4	1	11898	FTG GREASE 1/8 NPTM
5	4	20956	BLOCK ADJUSTING
6	1	25211	EYE LIFTING 1/2-13
7	4	27172	WASHER SPRING BELLEVILLE 5/8 X 1-1/4 X .040
8	1	29152	PLATE MASS CE
9	4	42212	SCREW MOD SSSCP 3/4-10 UNC X 2.5
10	8	45004	SCREW 1/4-28 X 1/2 SSSFP
11	1	53681	BEARING HOUSING 3.5" BAR
12	1	53686	COVER BRG 3.5" HOUSING EXTERNAL
13	1	53689	IMPERIAL BRG INSERT 070904 FOR 3.5 IN BAR
14	1	53839	SPIDER END 3 ARM BRG SUPPORT 3.5" BAR DIA
15	4	54239	WASHER 5/8 FLTW .7 ID 3.0 OD .5 THICK
16	4	60761	SCREW 5/8-11 X 2-1/4 HHCS FLANGED BLK OX
17	1	66767	LABEL LARGE BORING BAR CRUSH HAZARD

53840 - SPIDER ASSY END 3 ARM BRG SUPPORT 20" BB6100 - REV A

FOR REFERENCE ONLY

FIGURE 15. SPIDER BEARING THREE-ARM END SUPPORT ASSEMBLY (P/N 53840)

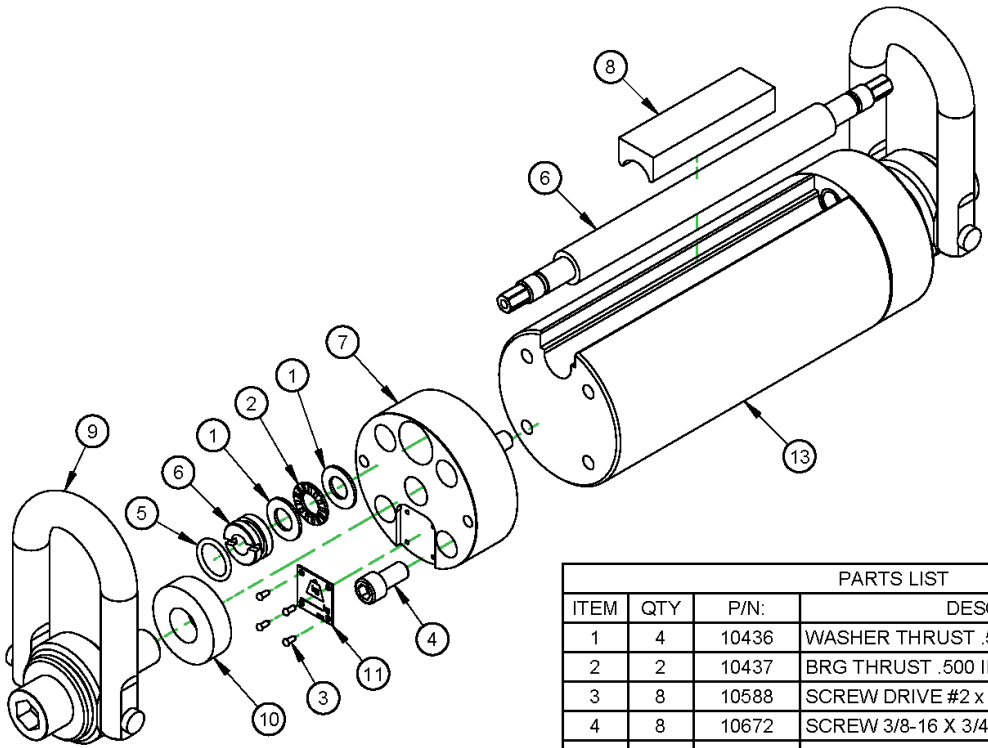


PARTS LIST			
ITEM	QTY	P/N:	DESCRIPTION
1	8	10474	SCREW 3/8-16 X 1-1/2 SHCS
2	4	10588	SCREW DRIVE #2 x 1/4 HOLE SIZE .089
3	4	15208	WASHER 5/8 SAE FLTW HARDENED
4	4	20956	BLOCK ADJUSTING
5	1	22092	SPIDER PATTERN BRG SUPPORT
6	4	22662	WASHER 1/2 FLTW HARDENED 1-1/8 OD X 1/8 THK
7	1	23570	BRG ASSY 3-1/2 ID FLANGE MNT W/COLLET TYPE CLAMP
8	1	25010	CLAMP COLLAR SPLIT HINGED 3-1/2 ID
9	1	25211	EYE LIFTING 1/2-13
10	1	29152	PLATE MASS CE
11	AR	33304	(NOT SHOWN) CRATE 32 X 32 X 12 5/8 PLY HINGED BB6000 & BB6100 BEARINGS
12	4	38168	SCREW MODIFIED 3/4-10 X 1.3
13	4	39179	SCREW 1/2-13 X 2 HHHCS GRADE 8
14	1	66767	LABEL LARGE BORING BAR CRUSH HAZARD

22091 - ASSY BRG END MOUNT 4 ARM 3.5 DIA 38 DIA - REV A

FOR REFERENCE ONLY

FIGURE 16. 4-ARM END MOUNT BEARING ASSEMBLY (P/N 22091)



PARTS LIST			
ITEM	QTY	P/N:	DESCRIPTION
1	4	10436	WASHER THRUST .500 ID X .937 OD X .060
2	2	10437	BRG THRUST .500 ID X .937 OD X .0781
3	8	10588	SCREW DRIVE #2 x 1/4 HOLE SIZE .089
4	8	10672	SCREW 3/8-16 X 3/4 SHCS
5	2	11740	O-RING 3/32 X 3/4 ID X 15/16 OD
6	2	22143	NUT LEADSCREW BRG ADJUSTING Ø3/4
7	2	22191	CAP END BORING BAR 3-1/2 DIA
8	1	22403	KEY DRIVE
9	2	22814	RING HOIST 3/4-10 X 1-1/2 5000 LB
10	2	22815	SPACER BOLT EYE 1/2 THK.
11	2	29152	PLATE MASS CE
12	1	CHART 1	LEADSCREW 3/4 5P ACME
13	1	CHART 2	BAR BORING 3-1/2 DIA

CHART 1	
P/N	DESCRIPTION
25216	LEADSCREW 3/4 5P ACME 48 IN BORING BAR
46242	LEADSCREW 3/4 5P ACME 53.5 IN BORING BAR
22132	LEADSCREW 3/4 5P ACME 60 IN BORING BAR
22133	LEADSCREW 3/4 5P ACME 72 IN BORING BAR
22134	LEADSCREW 3/4 5P ACME 84 IN BORING BAR
22135	LEADSCREW 3/4 5P ACME 96 IN BORING BAR
37899	LEADSCREW 3/4 5P ACME 104 IN BORING BAR
22136	LEADSCREW 3/4 5P ACME 108 IN BORING BAR
22137	LEADSCREW 3/4 5P ACME 120 IN BORING BAR
22138	LEADSCREW 3/4 5P ACME 132 IN BORING BAR
22139	LEADSCREW 3/4 5P ACME 144 IN BORING BAR
22794	LEADSCREW 3/4 5P ACME 156 IN BORING BAR
22796	LEADSCREW 3/4 5P ACME 168 IN BORING BAR
22798	LEADSCREW 3/4 5P ACME 180 IN BORING BAR
22799	LEADSCREW 3/4 5P ACME 192 IN BORING BAR
48454	LEADSCREW 3/4 5P ACME 197 IN BORING BAR
30253	LEADSCREW 3/4 5P ACME 204 IN BORING BAR
71528	LEADSCREW 3/4 5P ACME 216 IN BORING BAR
36488	LEADSCREW 3/4 5P ACME 240 IN BORING BAR

CHART 2	
P/N	DESCRIPTION
25212	BAR BORING 3-1/2 DIA X 48
46241	BAR BORING 3-1/2 DIA X 53.5
22121	BAR BORING 3-1/2 DIA X 60
22124	BAR BORING 3-1/2 DIA X 72
22125	BAR BORING 3-1/2 DIA X 84
22126	BAR BORING 3-1/2 DIA X 96
37897	BAR BORING 3-1/2 DIA X 104
22127	BAR BORING 3-1/2 DIA X 108
22128	BAR BORING 3-1/2 DIA X 120
22129	BAR BORING 3-1/2 DIA X 132
22130	BAR BORING 3-1/2 DIA X 144
22790	BAR BORING 3-1/2 DIA X 156
22791	BAR BORING 3-1/2 DIA X 168
22792	BAR BORING 3-1/2 DIA X 180
22793	BAR BORING 3-1/2 DIA X 192
48284	BAR BORING 3 1/2 DIA X 197
30250	BAR BORING 3-1/2 DIA X 204
71485	BAR BORING 3-1/2 DIA X 216
36487	BAR BORING 3-1/2 DIA X 240

71618 - CHART ASSY BORING BAR 3-1/2 DIA BB6000 - REV A

FOR REFERENCE ONLY

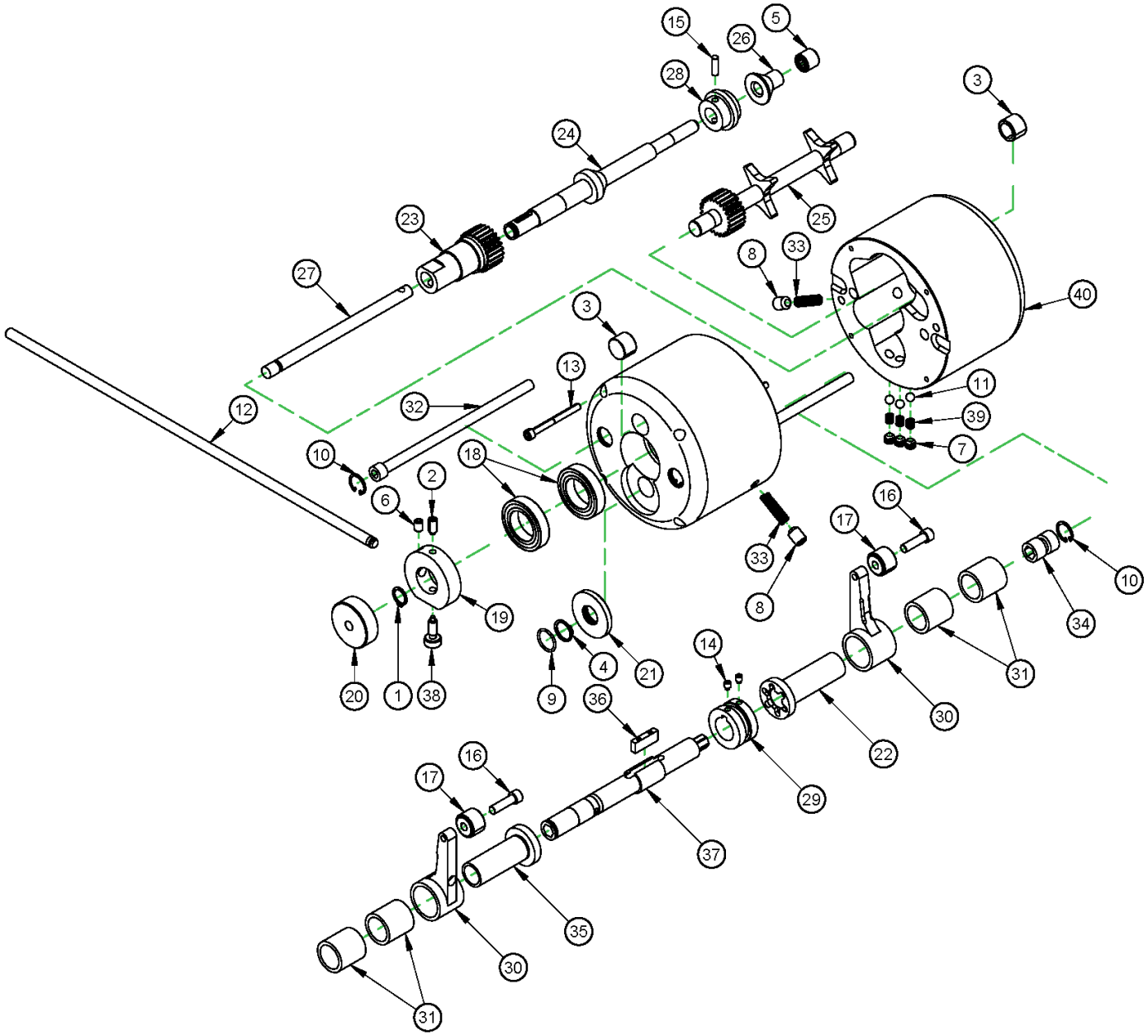
FIGURE 17. BORING BAR CHART ASSEMBLY (P/N 71618)

AVAILABLE CONFIGURATIONS	
Part Number	Description
22107	ASSY BAR BORING 3-1/2 DIA X 60 LG BB6000
22108	ASSY BAR BORING 3-1/2 DIA X 72 LG BB6000
22109	ASSY BAR BORING 3-1/2 DIA X 84 LG BB6000
22110	ASSY BAR BORING 3-1/2 DIA X 96 LG BB6000
22111	ASSY BAR BORING 3-1/2 DIA X 108 LG BB6000
22112	ASSY BAR BORING 3-1/2 DIA X 120 LG BB6000
22113	ASSY BAR BORING 3-1/2 DIA X 132 LG BB6000
22114	ASSY BAR BORING 3-1/2 DIA X 144 LG BB6000
22770	ASSY BAR BORING 3-1/2 DIA X 168 LG BB6000
22777	ASSY BAR BORING 3-1/2 DIA X 156 LG BB6000
22788	ASSY BAR BORING 3-1/2 DIA X 180 LG BB6000
22789	ASSY BAR BORING 3-1/2 DIA X 192 LG BB6000
24875	ASSY BAR BORING 3-1/2 DIA X 197 LG BB6100
25221	ASSY BAR BORING 3-1/2 DIA X 48 LG BB6000
30248	ASSY BAR BORING 3-1/2 DIA X 204 LG BB6000
36485	ASSY BAR BORING 3-1/2 DIA X 240 LG BB6000
37752	ASSY BAR BORING 3-1/2 DIA X 104 LG BB6000
46239	ASSY BAR BORING 3-1/2 DIA X 53.5 LG BB6000
71483	ASSY BAR BORING 3-1/2 DIA X 216 LG BB6000

71618 - CHART ASSY BORING BAR 3-1/2 DIA BB6000 - REV A

FOR REFERENCE ONLY

FIGURE 18. BORING BAR CHART ASSEMBLY PARTS LIST (P/N 71618)



23299 - FEED AXIAL UNIT ASSY MECHANICAL BB6000 - REV A

FOR REFERENCE ONLY

FIGURE 19. MECHANICAL AXIAL FEED UNIT ASSEMBLY (P/N 23299)

PARTS LIST			
ITEM	QTY	P/N:	DESCRIPTION
1	1	10829	RING SNAP 1/2 OD
2	1	10848	PLUNGER DETENT SPRING STUBBY 1/4-20 X .531
3	2	11011	BRG NEEDLE 1/2 ID X 11/16 OD X .500 CLOSED
4	1	11019	RING SNAP 5/8 OD X .035 THICK
5	1	11021	BRG NEEDLE 3/8 ID X 9/16 OD X .500 OPEN
6	1	11325	SCREW 1/4-20 X 3/8 SSSCP
7	3	11671	SCREW 5/16-18 X 1/4 SSSFP
8	2	11722	SCREW 3/8-16 X 1/2 SSSCP
9	1	12583	RING O 1/16 X 5/8 ID X 3/4 OD
10	3	13530	RING SNAP 5/8 ID
11	3	14203	BALL 1/4 DIA STEEL
12	1	14303	ROD-STOP
13	4	14779	SCREW 10-32 X 2 SHCS
14	2	15395	SCREW 10-32 X 1/4 SSSHDP
15	1	16953	PIN DOWEL 3/16 DIA X 5/8
16	2	17131	SCREW 1/4-20 X 7/8 SHCS
17	2	18203	BRG CAM FOLLOWER .750 OD X .500 WIDE OPEN (VMI)
18	2	21295	BRG BALL .9843 ID X 1.6535 OD X .3543 W/SEALS
19	1	22307	HUB TORQUE
20	1	22406	KNOB FEED ADJUST
21	1	22409	DIAL FEED
22	1	23258	BUSHING FEED DIRECTION
23	1	23260	GEAR CAM DRIVE
24	1	23261	SHAFT FEED ADJUSTING
25	1	23262	CAMSHAFT AXIAL FEED
26	1	23263	CONE FEED ADJUST
27	1	23264	ROD FEED DIRECTION
28	1	23265	SLIDE FEED DIRECTION MASTER
29	1	23266	SLIDE FEED DIRECTION SLAVE
30	2	23267	ARM RATCHET
31	4	23268	BRG ROLLER CLUTCH .79 X 1.02 OD X 1.024 (VMI)
32	2	23319	SCREW 5/16-18 X 6-1/2 SHCS
33	2	23536	SPRING .30 OD X .045 WIRE X 1.50 LONG
34	1	23659	FUSE AXIAL FEED 3-1/2 BAR
35	1	24940	BUSHING FEED DIRECTION
36	1	25205	KEY MAIN DRIVE 3/16 X 3/8
37	1	25206	SHAFT OUTPUT BB6000 BB6100
38	1	25448	PLUNGER HAND RETRACTABLE 1/4-20
39	3	26544	SPRING .24 OD X .022 WIRE X .5
40	1	41557	BOX AXIAL FEED MECHAINICAL BB6000

23299 - FEED AXIAL UNIT ASSY MECHANICAL BB6000 - REV A

FOR REFERENCE ONLY

FIGURE 20. MECHANICAL AXIAL FEED UNIT ASSEMBLY PARTS LIST (P/N 23299)

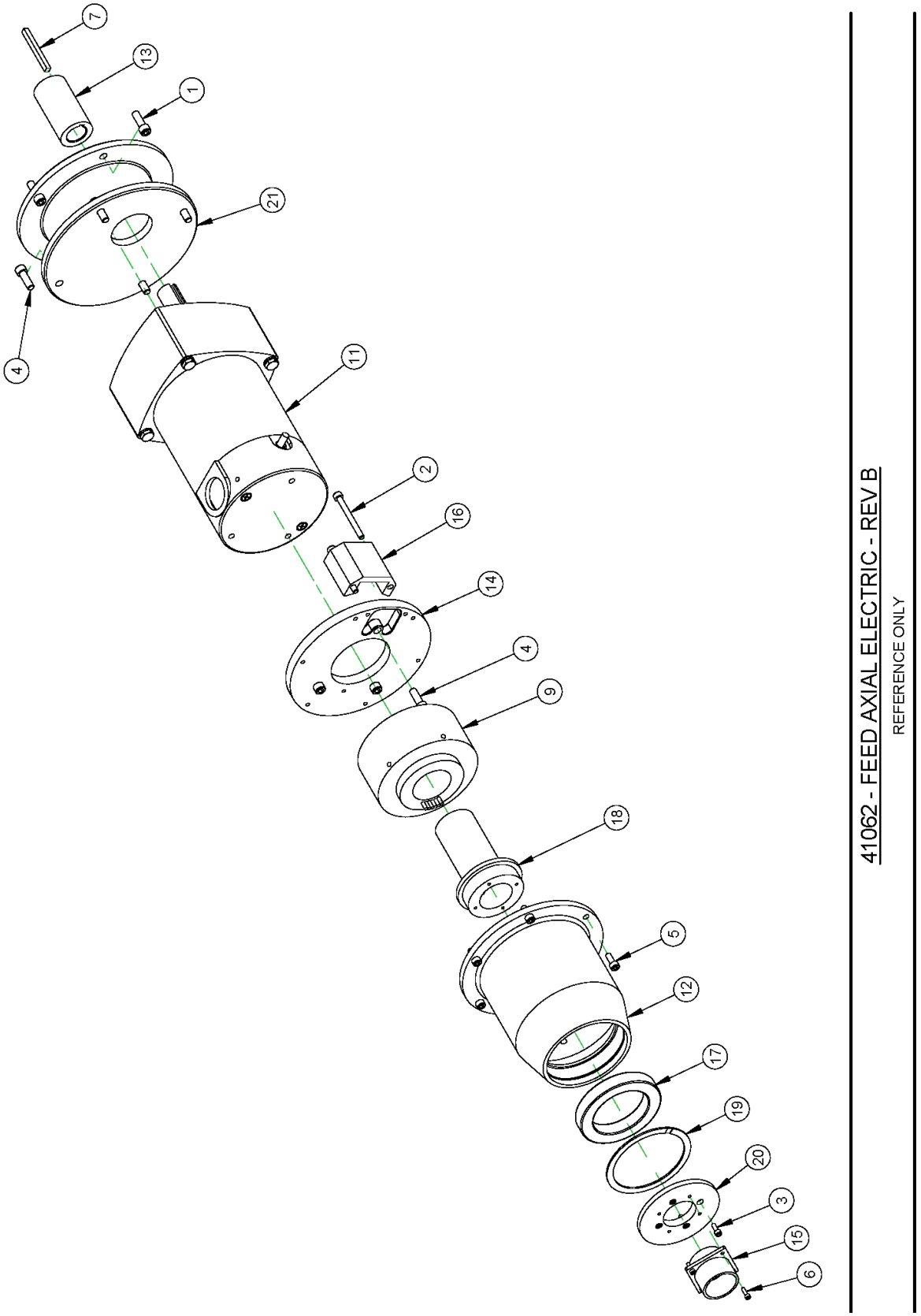


FIGURE 21. ELECTRIC AXIAL FEED ASSEMBLY (P/N 41062)

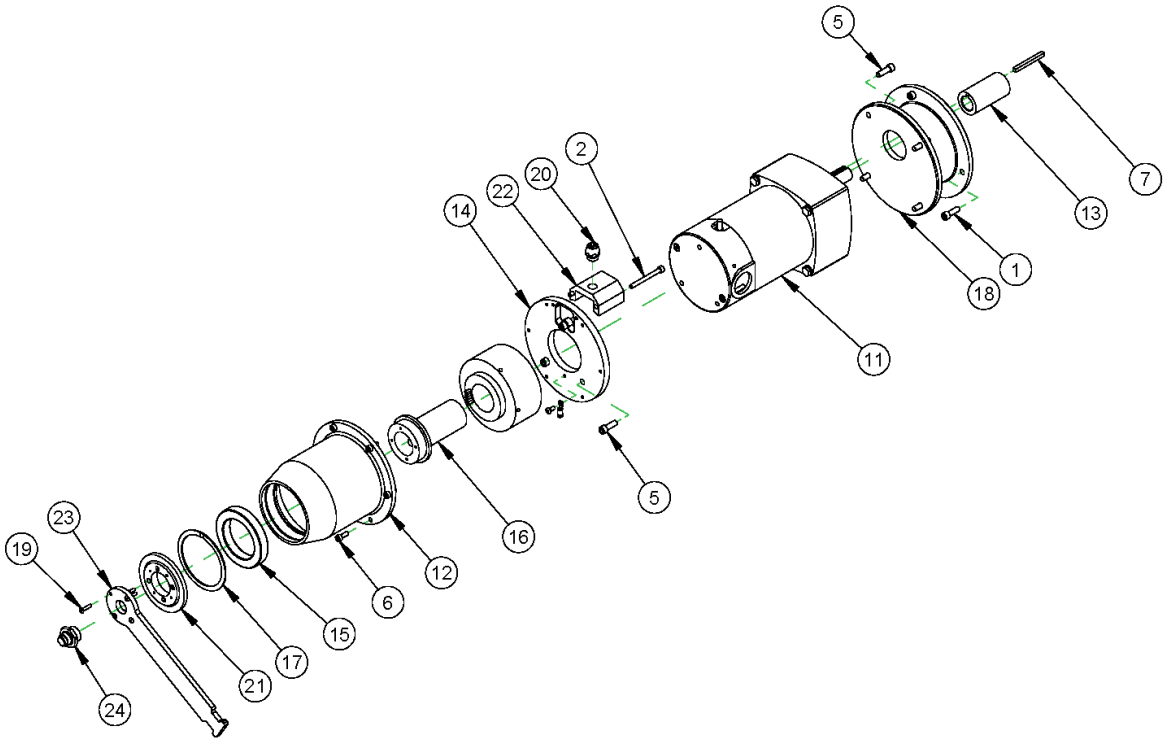
PARTS LIST

ITEM	QTY	P/N:	DESCRIPTION
1	4	10160	SCREW 1/4-20 X 3/4 SHCS
2	2	10229	SCREW 10-24 X 2 SHCS
3	4	10838	SCREW 6-32 X 3/8 SHCS
4	7	12647	SCREW 1/4-28 X .75 SHCS
5	6	12743	SCREW 10-24 X 1/2 SHCS
6	4	19829	SCREW 4-40 X 3/8 SHCS
7	1	20969	KEY 3/16 SQ X 2 SQ BOTH ENDS
8	3	29435	(NOT SHOWN) TUBE SHRINK .375 DIA BLACK
9	1	32371	RING SLIP
10	3	36363	(NOT SHOWN) TERMINAL SPLICE 16-10AWG CLOSED END
11	1	39012	MOTOR MODIFIED AXIAL FEED
12	1	39018	BRACKET SLIP RING MOUNT
13	1	39030	COUPLING MOTOR SHAFT
14	1	39051	ADAPTER SLIP RING TO BODINE MOTOR
15	1	39058	CONNECTOR FLANGED RECEPT 4 POLE 22-10P
16	1	39064	COVER ELECTRIC MOTOR CABLE
17	1	39124	BEARING BALL 2.1654 ID X 3.1496 OD X .5118
18	1	39126	ADAPTER SLIPRING CONNECTOR
19	1	39131	RING SNAP 3.149 ID (80mm) SPIRAL MED DUTY
20	1	39676	RETAINER BEARING
21	1	41063	PLATE ADAPTER AXIAL FEED MOTOR

41062 - FEED AXIAL ELECTRIC - REV B

REFERENCE ONLY

FIGURE 22. ELECTRIC AXIAL FEED ASSEMBLY PARTS LIST (P/N 41062)

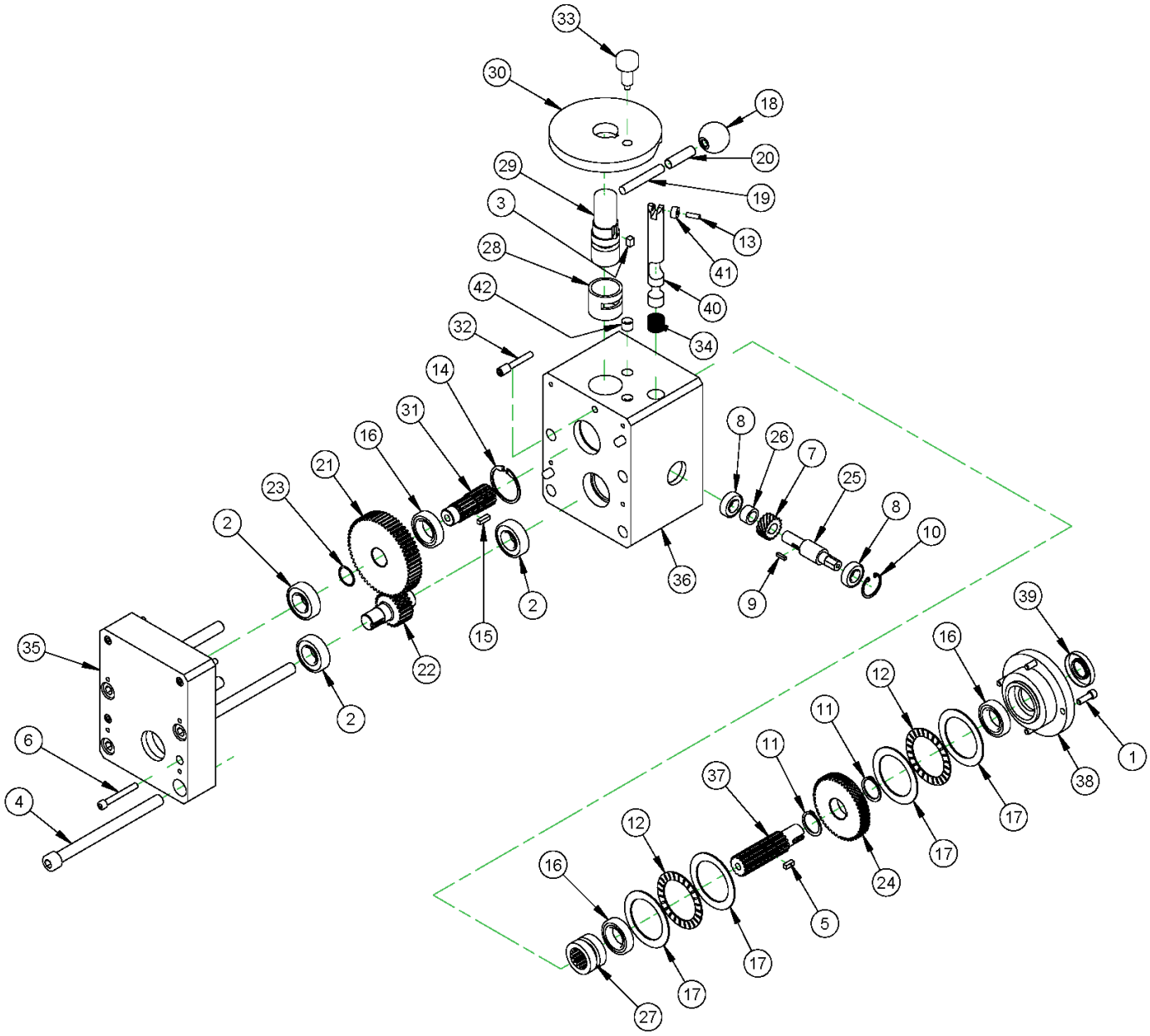


PARTS LIST			
ITEM	QTY	P/N:	DESCRIPTION
1	4	10160	SCREW 1/4-20 X 3/4 SHCS
2	2	10229	SCREW 10-24 X 2 SHCS
3	4	10838	SCREW 6-32 X 3/8 SHCS
4	1	11359	SCREW 8-32 X 3/8 BHSCS
5	7	12647	SCREW 1/4-28 X .75 SHCS
6	6	12743	SCREW 10-24 X 1/2 SHCS
7	1	20969	KEY 3/16 SQ X 2 SQ BOTH ENDS
8	12	22800	(NOT SHOWN) TUBE SHRINK .125 DIA BLACK
9	1	28546	TERMINAL RING 16-14AWG X #8 VINYL INSLTD BLUE
10	1	32371	RING SLIP
11	1	39012	MOTOR MODIFIED AXIAL FEED
12	1	39018	BRACKET SLIP RING MOUNT
13	1	39030	COUPLING MOTOR SHAFT
14	1	39051	ADAPTER SLIP RING TO BODINE MOTOR
15	1	39124	BEARING BALL 2.1654 ID X 3.1496 OD X .5118
16	1	39126	ADAPTER SLIPRING CONNECTOR
17	1	39131	RING SNAP 3.149 ID (80mm) SPIRAL MED DUTY
18	1	41063	PLATE ADAPTER AXIAL FEED MOTOR
19	4	62944	SCREW 6-32 X 5/8 BHSCS
20	1	86666	RECEPTACLE EUROFAST FEMALE 4 PIN FRONT MOUNT 1/4 NPT THD 0.5M LEADS
21	1	86687	RETAINER BEARING
22	1	86688	COVER ELECTRIC MOTOR CABLE
23	1	86690	ARM ROTATION RESTRAINT
24	1	89741	RECEPTACLE TURCK VERSAFAST 6 CONDUCTOR 0.5M LEADS FRONT PANEL MOUNT M20X X1.5 THREAD

86681 - FEED AXIAL ELECTRIC - REV A

FOR REFERENCE ONLY

FIGURE 23. ELECTRIC AXIAL FEED ASSEMBLY (P/N 86681)



41064 - ASSY MECHANICAL FEED FOR ELECTRIC AXIAL FEED - REV B

FOR REFERENCE ONLY

FIGURE 24. MECHANICAL FEED ASSEMBLY FOR ELECTRIC AXIAL FEED (P/N 41064)

PARTS LIST			
ITEM	QTY	P/N:	DESCRIPTION
1	4	10160	SCREW 1/4-20 X 3/4 SHCS
2	3	10807	BRG BALL .7874 ID X 1.6535 OD X .4724 W/SEALS
3	1	10854	KEY 1/4 SQ X .37 SQ BOTH ENDS
4	4	11695	SCREW 1/2-13 X 6-1/2 SHCS
5	1	12361	KEY 3/16 SQ X .50 SQ BOTH ENDS
6	4	12444	SCREW 1/4-20 X 2 SHCS
7	1	12881	GEAR HELICAL 16DP 16T 14.5PA 45HA RH .5 STL H
8	2	14034	BRB BALL .5000 ID X 1.125 OD X .3125
9	1	14788	KEY 1/8 SQ X .50 SQ BOTH ENDS
10	1	14980	RING SNAP 1-1/8 ID
11	2	15729	RING SNAP 63/64 OD (25mm)
12	2	16177	BRB THRUST 2.000 ID X 2.750 OD X .0781
13	1	16953	PIN DOWEL 3/16 DIA X 5/8
14	1	17857	RING SNAP INT. 42MM X .062
15	1	18146	KEY 3/16 SQ X .62 SQ BOTH ENDS
16	3	21295	BRG BALL .9843 ID X 1.6535 OD X .3543 W/SEALS
17	4	30021	WASHER THRUST 2.000 ID X 2.750 OD X .060
18	1	33526	KNOB BALL 1-3/8 DIA 3/8-16 THD
19	1	35507	STUD HANDLE
20	1	35508	FERRULE HANDLE
21	1	39017	GEAR SPUR 16DP 60T 2-PA .745 X .875LG STEEL
22	1	39029	GEAR SPUR SHAFT INFO
23	1	39074	RING SNAP 7/8 OD SPIRAL MED DUTY
24	1	40371	GEAR HELICAL STEEL MODIFIED
25	1	40380	PINION SHAFT
26	1	40382	SPACER
27	1	40383	SPLINE COUPLING
28	1	40384	BUSHING OILITE 1-1/4 (1.254) ID X 1-1/2 (1.504) OD X 1-1/4
29	1	40394	ROD SHIFT
30	1	40395	SHIFT PLATE
31	1	40397	SHAFT DRIVE INVOLUTE SPLINE 1 INCH 15T 16/32
32	1	40398	LOCK SCREW
33	1	40402	PLUNGER SPRING 1/12-13 X .88 KNURLED KNOB BRASS
34	1	40472	SPRING COMP .734 OD .050 WIRE X 1.31 LG
35	1	41065	COVER GEARBOX HOUSING MECH RAPID
36	1	41066	BOX GEAR MAIN HOUSING MECH RAPID
37	1	42593	SHAFT SPLINE OUTPUT 3/4 OD KEYED
38	1	42598	CAP SEAL AND GEAR COVER
39	1	42602	SEAL .750 ID X 1.625 OD X .25 WIDE CRW1
40	1	42631	ROD PUSH STOP RAPID FEED LOCKOUT
41	1	42642	BUSHING DRILL 3/16 ID X 1/2 OD X 1/4
42	2	42647	BUSHING DRILL 17/64 ID X 1/2 OD X 3/8

41064 - ASSY MECHANICAL FEED FOR ELECTRIC AXIAL FEED - REV B

FOR REFERENCE ONLY

FIGURE 25. MECHANICAL FEED ASSEMBLY PARTS LIST FOR ELECTRIC AXIAL FEED (P/N 41064)

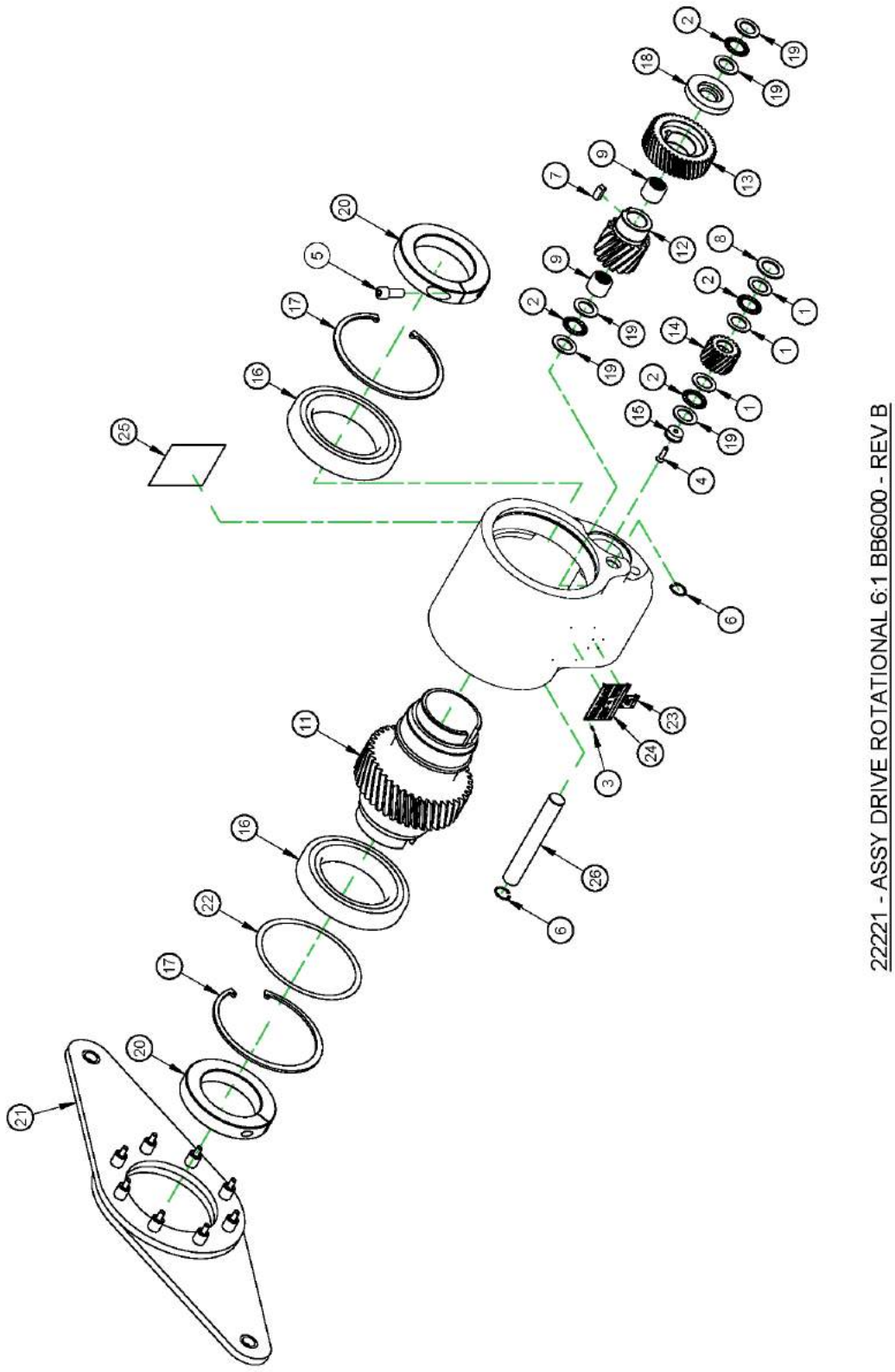


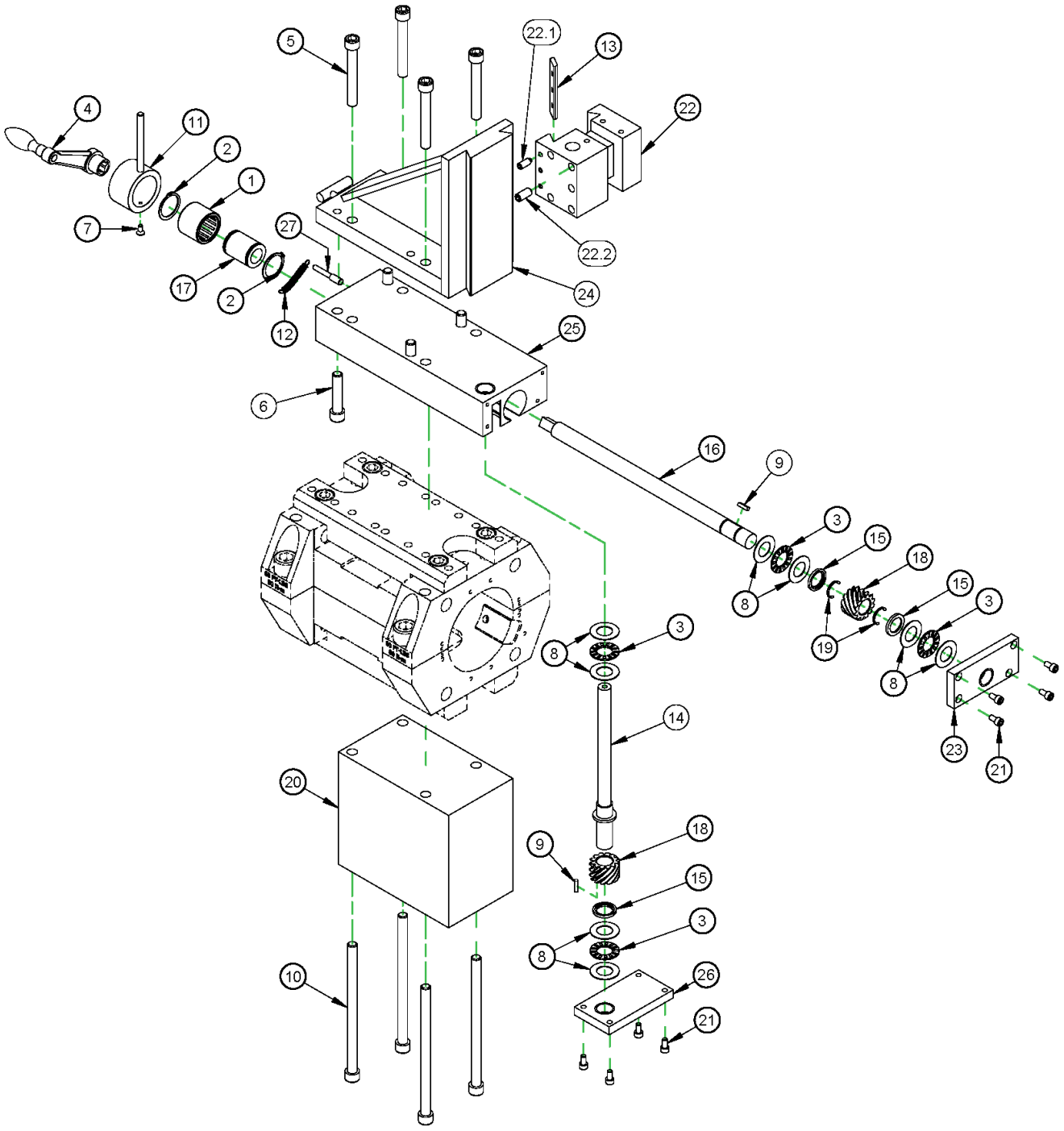
FIGURE 26. ROTATIONAL DRIVE ASSEMBLY (P/N 22221)

PARTS LIST			
ITEM	QTY	P/N:	DESCRIPTION
1	3	10144	WASHER THRUST 1 ID X 1.562 OD X .060
2	4	10145	BRG THRUST 1 ID X 1.562 OD X .0781
3	8	10588	SCREW DRIVE #2 x 1/4 HOLE SIZE .089
4	1	10888	SCREW 1/4-20 X 1 FHSCS
5	2	12646	SCREW 1/2-13 X 1-1/4 SHCS
6	2	13693	RING SNAP 1 DI
7	1	15047	KEY 3/8 SQ X .87 SQ BOTH ENDS
8	1	17786	WASHER THRUST 1.125 X 1.75 X .095
9	2	17953	BRG NEEDLE 1 ID X 1-5/16 OD X 1.000 OPEN
11	1	22224	DRIVE HUB 40 TOOTH GEAR
12	1	22225	GEAR HELICAL 6 DP 15 T 20 PA 23 HA LH 216 STEEL
13	1	22226	GEAR HELICAL 10 DP 42 T 20 PA 23 HA LH 1.362STL
14	1	22227	GEAR HELICAL 10 DP 19 T 20 PA 23 HA RH 1.4 STLA
15	1	22228	RETAINER PINION
16	2	22385	BEARING BALL 4.7244 ID X 7.0866 OD X 1.102 2 SEAL
17	2	22386	RING SNAP 7 ID
18	1	22392	RETAINER THRUST BEARING
19	5	22402	WASHER THRUST 1.000 ID X 1.562 OD X .095
20	2	22571	CLAMP COLLAR SPLIT HINGED 4 ID
21	1	22604	ARM TORQUE ASSY
22	1	25814	SHIM SET 7.00 OD X 6.25 ID X .010 & .005
23	1	29152	PLATE MASS CE
24	1	29154	PLATE SERIAL YEAR MODEL CE 2.0 X 3.0
25	1	34735	LABEL WARNING 3-1/2 X 4
26	1	68605	STEEL 1 DIA X 7 CLASS N THOMSON SHAFT
10	1	22222	HOUSING RDU BB6000

22221 - ASSY DRIVE ROTATIONAL 6:1 BB6000 - REV B

FOR REFERENCE ONLY

FIGURE 27. ROTATIONAL DRIVE ASSEMBLY PARTS LIST (P/N 22221)



75682 - CHART FACING HEAD 4 THRU 8 INCH TRAVEL BB6 BB7 - REV A

FOR REFERENCE ONLY

FIGURE 28. FACING HEAD CHART ASSEMBLY (P/N 75682)

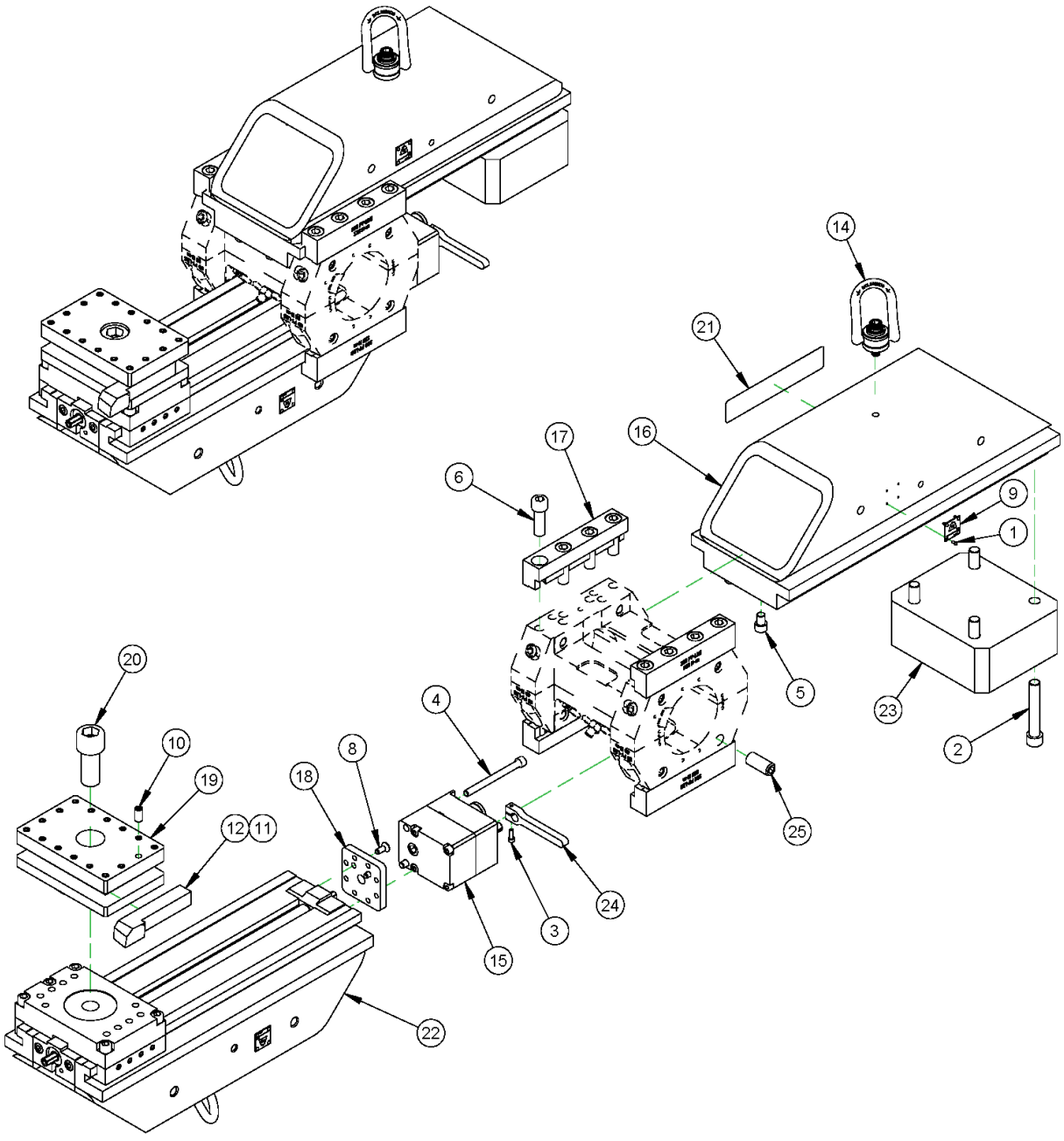
AVAILABLE CONFIGURATIONS	
P/N	DESCRIPTION
22680	ASSY FACING HEAD 4 INCH TRAVEL BB6 BB7
49753	ASSY FACING HEAD 6 INCH TRAVEL BB6 BB7
49754	ASSY FACING HEAD 8 INCH TRAVEL BB6 BB7

PARTS LIST			
ITEM	QTY	P/N:	DESCRIPTION
1	1	10532	BRG ROLLER CLUTCH 1 ID X 1-5/16 OD X 1.063
2	2	10534	RING SNAP 1 OD
3	4	10538	BRG THRUST .625 ID X 1.125 OD X .0781
4	1	11020	HANDLE CRANK STRAIGHT 10MM SQUARE
5	4	11053	SCREW 3/8-16 X 2-3/4 SHCS
6	4	11211	SCREW 3/8-16 X 1-3/4 SHCS
7	1	11259	SCREW 8-32 X 3/8 FHSCS
8	8	11823	WASHER THRUST .625 ID X 1.125 OD X .030
9	2	14788	KEY 1/8 SQ X .50 SQ BOTH ENDS
10	4	15613	SCREW 3/8-16 X 6 SHCS
11	1	18399	HOUSING CLUTCH AXIAL
12	1	18432	SPRING EXTENSION .24 OD X .026 WIRE X 1.250
13	1	19099	GIB CARRIER TOOL BB8000 FACING HEAD
14	1	19104	LEADSCREW ASSY FACING HEAD 4 INCH STROKE
		41098	LEADSCREW ASSY FACING HEAD 6 INCH STROKE
		43366	LEADSCREW ASSY FACING HEAD 8 INCH STROKE
15	3	19105	SPACER
16	1	19110	SHAFT DRIVE
17	1	19112	COLLAR FEED CLUTCH
18	2	19122	GEAR HELICAL 12DP 12T 14.5PA 45HA RH .75 STLH
19	2	19130	RING SNAP 5/8 OD LOW PROFILE
20	1	19223	COUNTERWEIGHT FACING ASSY
21	8	19232	SCREW 10-24 X 3/8 SHCS
22	1	22685	CARRIER TOOL
22.1	3	10189	SCREW 1/4-20 X 5/8 SSSHDPPL
22.2	5	11684	SCREW 5/16-18 X 3/4 SSSCP
23	1	22686	PLATE END DRIVE SHAFT
24	1	22687	SLIDE FACING HEAD 4 INCH TRAVEL BB6000
		41097	SLIDE FACING HEAD 6 INCH TRAVEL BB6000
		43364	SLIDE FACING HEAD 8 INCH TRAVEL BB6000
25	1	22688	BASE PLATE FACING HEAD
26	1	22689	PLATE END LEADSCREW
27	1	28953	PIN DOWEL MODIFIED

75682 - CHART FACING HEAD 4 THRU 8 INCH TRAVEL BB6 BB7 - REV A

FOR REFERENCE ONLY

FIGURE 29. FACING HEAD CHART ASSEMBLY PARTS LIST (P/N 75682)



AVAILABLE CONFIGURATIONS	
PART No.	DESCRIPTION
54385	BORING/FACING SLIDE ARM SET 18" BB6100 (SHOWN)
54386	BORING/FACING SLIDE ARM SET 23" BB6100

81561 - CHART BORING/FACING SLIDE ARM SET BB6100 - REV A

FOR REFERENCE ONLY

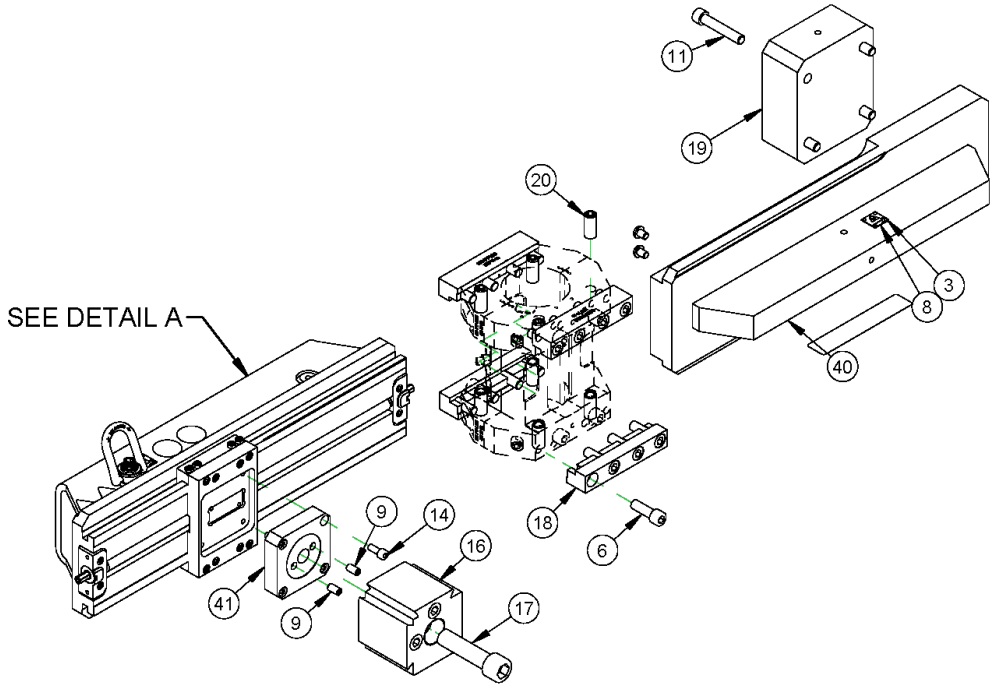
FIGURE 30. BORING/FACING SLIDE ARM SET ASSEMBLY (P/N 81561)

PARTS LIST			
ITEM	QTY	P/N:	DESCRIPTION
1	4	10588	SCREW DRIVE #2 x 1/4 HOLE SIZE .089
2	4	11696	SCREW 1/2-13 X 3 SHCS
3	1	11845	SCREW 8-32 x 1/2 SHCS
4	2	11873	SCREW 5/16-18 X 3-1/2 SHCS
5	2	16403	SCREW 3/8-16 X 1/2 SHCS
6	16	16559	SCREW 1/2-20 X 1-1/2 SHCS
7	1	19700	(NOT SHOWN) CONTAINER SHIPPING FLAT ROOF 20 X 8.75 X 10.5
8	2	22496	SCREW 1/4-20 X 5/8 FHSCS
9	1	29152	PLATE MASS CE
10	16	29378	SCREW 3/8-16 X 3/4 SSSFP
11	1	40463	HOLDER INSERT 80 DEG NEGATIVE L/H 3/4 SHANK
12	1	40787	HOLDER INSERT 80 DEG NEG R/H
13	10	41407	(NOT SHOWN) INSERT CARBIDE 80 DEG 1/2 IC 1/64 NOSE RADIUS KC5010
14	1	41471	HOIST RING 3/8-16 X .56 1.3 ID 2.18 OD 3.79 OAL 1000 LBS SWIVEL
15	1	45691	ASSY FEEDBOX REVERSE CLUTCH INPUT
16	1	53893	COUNTERWEIGHT ARM 18 INCH BB6100 & BB7100
		54255	COUNTERWEIGHT ARM 23 INCH BB6100 & BB7100
17	4	54219	CLAMP SLIDE ARM BB6100
18	1	54867	PLATE ADAPTER FEEDBOX
19	1	54910	TOOL POST ROTATING 3/4IN TOOLING 4IN SQUARE BB6100
20	1	54924	SCREW 7/8-14 X 2 SHCS
21	1	54939	LABEL COUNTERWEIGHT ARM 18"
		54940	LABEL COUNTERWEIGHT ARM 23"
22	1	54955	ASSEMBLY 18IN SLIDE ARM
		54956	ASSEMBLY 23IN SLIDE ARM
23	1	54997	COUNTERWEIGHT BB6100
24	1	55094	TRIP ARM STEEL 3 INCH
25	8	55564	SCREW ASSY 5/8-18 X 1-1/2 SSSFP WITH NYLON BALL TIP

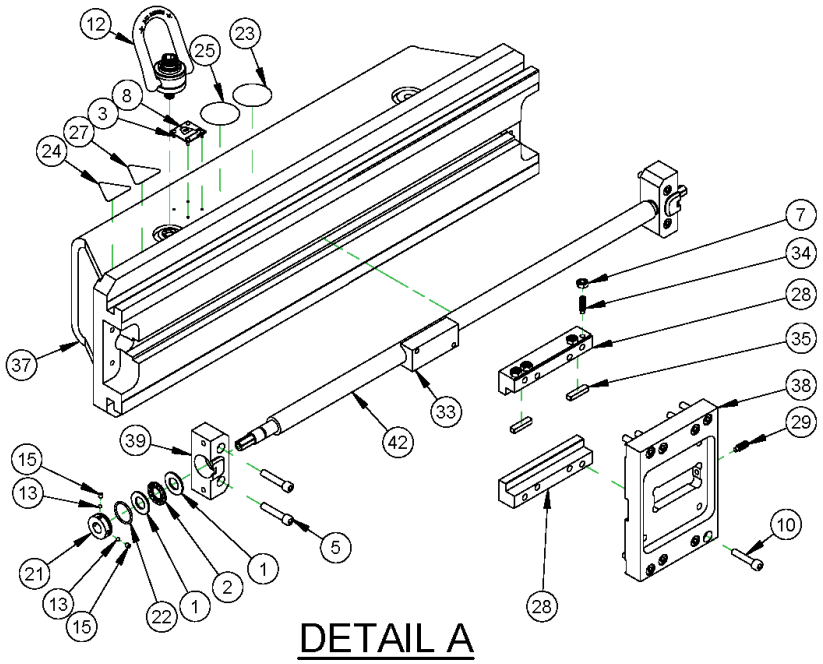
81561 - CHART BORING/FACING SLIDE ARM SET BB6100 - REV A

FOR REFERENCE ONLY

FIGURE 31. BORING/FACING SLIDE ARM SET ASSEMBLY PARTS LIST (P/N 81561)



AVAILABLE CONFIGURATIONS						
PART NO	DESCRIPTION	ITEM 37	ITEM 40	ITEM 42	ITEM 43	ITEM 44
86646	BORING/FACING ARM SET 23 IN	86585	86652	86731	86795	86796



DETAIL A

86638 - CHART ASSY BORING/FACING TOOL ARM - REV -

FOR REFERENCE ONLY

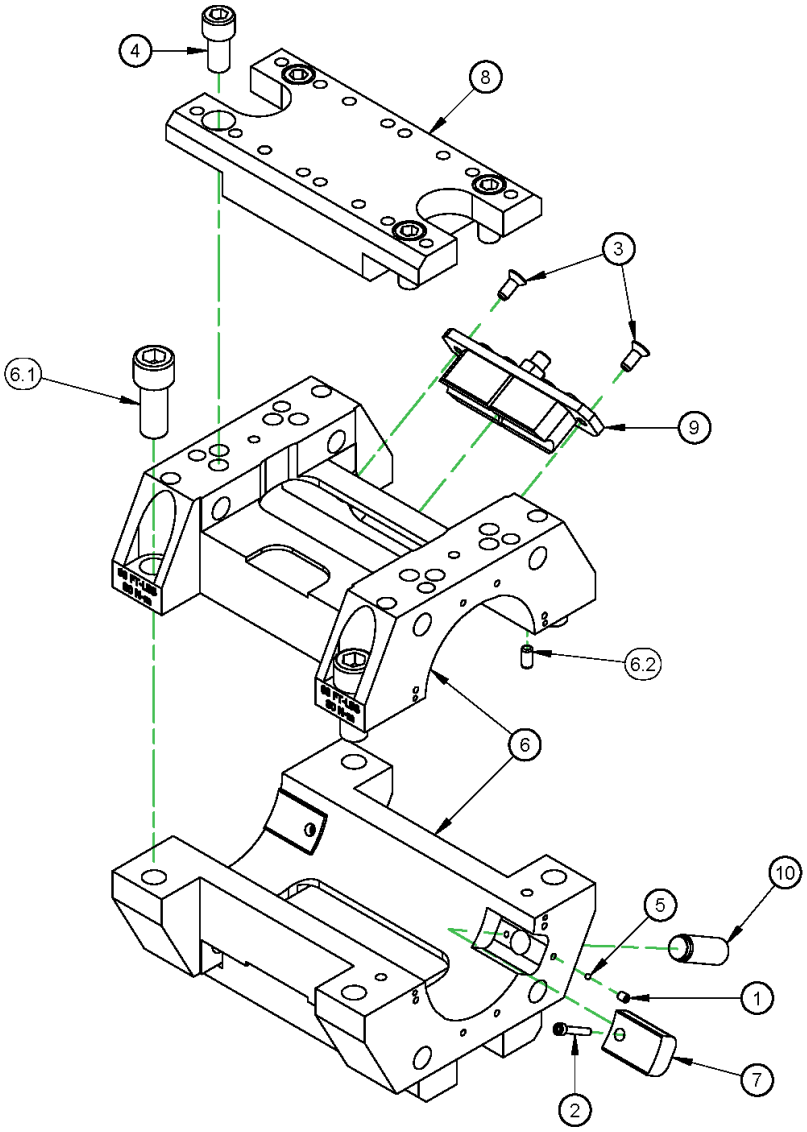
FIGURE 32. BORING/FACING TOOL ARM CHART ASSEMBLY (P/N 86638)

PARTS LIST			
ITEM	QTY	P/N:	DESCRIPTION
1	4	10436	WASHER THRUST .500 ID X .937 OD X .060
2	2	10437	BRG THRUST .500 ID X .937 OD X .0781
3	8	10588	SCREW DRIVE #2 x 1/4 HOLE SIZE .089
4	2	10650	SCREW 3/8-16 X 1/2 BHSCS
5	4	10671	SCREW 1/4-20 X 1-1/4 SHCS
6	16	16559	SCREW 1/2-20 X 1-1/2 SHCS
7	4	20772	NUT M6 X 1.0 STDN ZINC PLATED
8	2	29152	PLATE MASS CE
9	2	29378	SCREW 3/8-16 X 3/4 SSSFP
10	8	35505	SCREW M6 X 1.0 X 30 SHCS
11	4	40282	SCREW 1/2-13 X 2-3/4
12	1	41471	HOIST RING 3/8-16 X .56 1.3 ID 2.18 OD 3.79 OAL 1000 LBS SWIVEL
13	4	43489	BALL NYLON 1/8 DIA
14	4	50458	SCREW M8 X 1.25 X 20mm SHCS
15	4	53365	SCREW M4 X 0.7 X 4 mm SSSFP
16	1	53451	QUICK CHANGE TOOL POST MODIFIED
17	1	53455	SCREW 7/8 -14 X 3-1/2 SHCS
18	4	54219	CLAMP SLIDE ARM BB6100
19	1	54997	COUNTERWEIGHT BB6100
20	8	55564	SCREW ASSY 5/8-18 X 1-1/2 SSSFP WITH NYLON BALL TIP
21	2	57214	BRG RETAINING NUT AXIAL FEED LEADSCREW
22	2	57320	RING O 1/16 X 13/16 ID X 15/16 OD
23	1	59035	LABEL WARNING - WEAR EYE PROTECTION
24	1	59042	LABEL WARNING - HAND CRUSH/MOVING PARTS
25	1	59044	LABEL WARNING - CONSULT OPERATOR'S MANUAL 1.5 DIA
26	1	70227	LABEL CLIMAX LOGO 2 X 8
27	1	79324	LABEL WARNING - HAND ENTANGLEMENT/ROTATING GEARS 1.13 TALL TRIANGLE YELLOW
28	1	79796	KEEPER SET
29	1	79994	SCREW M6 X 1.0 X 16 SSSHDP
30	A/R	80423	(NOT SHOWN) SHIM .55 X 4.20 .001 THICK
31	A/R	80424	(NOT SHOWN) SHIM .55 X 4.20 .002 THICK
32	A/R	80425	(NOT SHOWN) SHIM .55 X 4.20 .005 THICK
33	1	80534	HALFNUT 3/4-10 ACME LH
34	4	80886	SCREW M6 X 1.0 X 18MM SSSDP
35	2	82201	GIB CLAMP TOOL HEAD
36	A/R	85727	(NOT SHOWN) SHIM .55 X 4.20 .0015 THICK
37	1	CHART	ARM TOOL FACING/BORING
38	1	86586	PLATE RADIAL SLIDE
39	2	86588	BLOCK BEARING SLIDE ARM
40	1	CHART	ARM CWT FACING/BORING
41	1	86659	SPACER TOOL POST 3.5 IN BAR
42	1	CHART	LEADSCREW SLIDE ARM
43	1	CHART	LABEL TOOL ARM ASSY
44	1	CHART	LABEL COUNTERWEIGHT ARM

86638 - CHART ASSY BORING/FACING TOOL ARM - REV -

FOR REFERENCE ONLY

FIGURE 33. BORING/FACING TOOL ARM CHART ASSEMBLY PARTS LIST (P/N 86638)

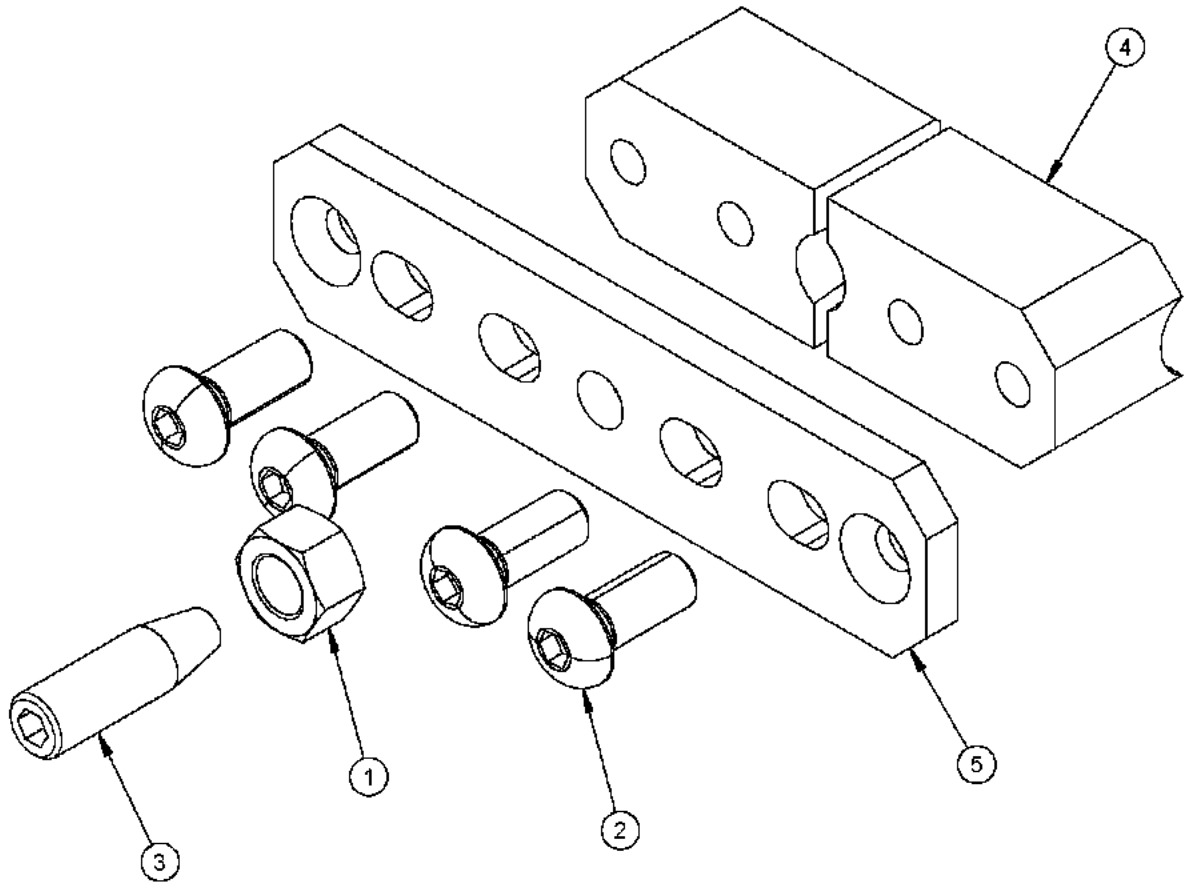


PARTS LIST			
ITEM	QTY	P/N:	DESCRIPTION
1	2	11672	SCREW 10-32 X 1/4 SSSCP
2	2	12880	SCREW 8-32 X 1 SHCS
3	2	22496	SCREW 1/4-20 X 5/8 FHSCS
4	8	24955	SCREW 1/2-20 X 1 SHCS
5	2	43489	BALL NYLON 1/8 DIA
6	1	53845	TOOL CARRIER BB6100
6.1	4	12571	SCREW 5/8-18-X 1-1/2 SHCS
6.2	2	20166	PIN DOWEL 1/4 DIA X 1/2
7	2	54217	SHOE ADJUSTABLE TOOL CARRIER BB6100
8	2	54220	STACK UP MOUNTING BLOCK BB6100
9	1	54223	ADJUSTABLE NUT AXIAL LEAD SCREW 3/4-5 ACME
10	2	55307	SCREW 5/8-18 X 1.55 SSSFP MODIFIED

54224 - TOOL CARRIER ASSY BB6100 - REV A

FOR REFERENCE ONLY

FIGURE 34. TOOL CARRIER ASSEMBLY (P/N 54224)

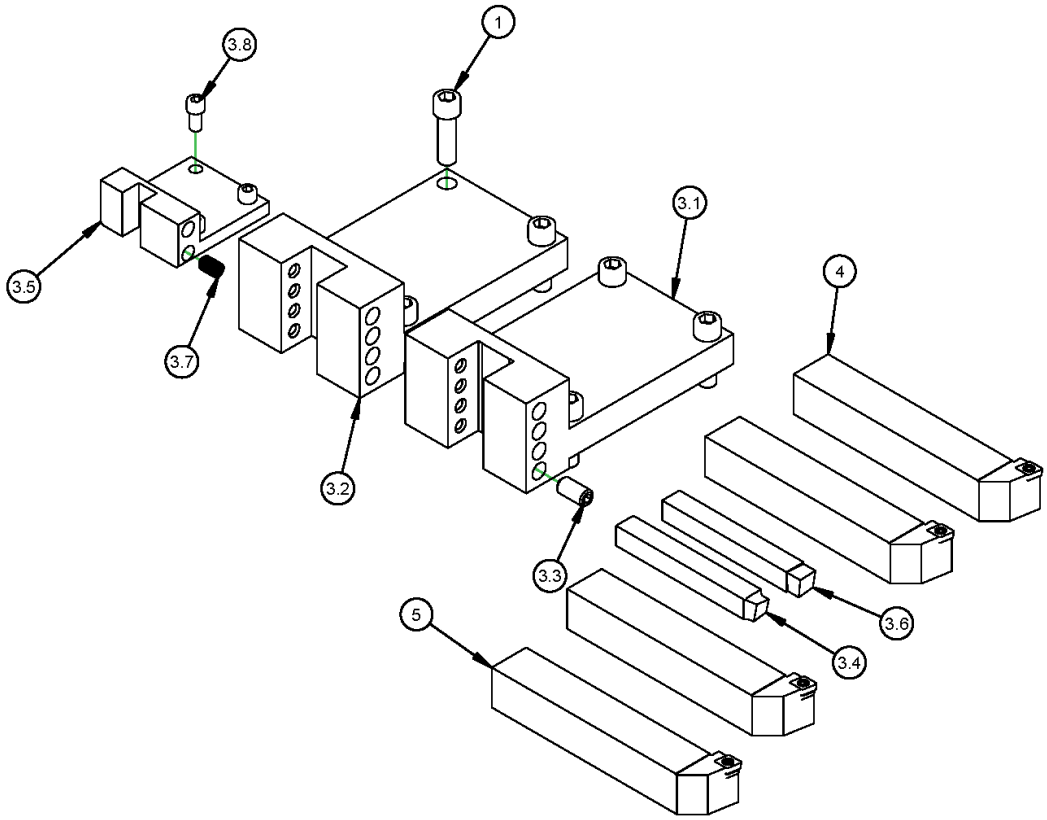


PARTS LIST			
ITEM	QTY	P/N:	DESCRIPTION
1	1	10536	NUT 3/8-24 STDN
2	4	14771	SCREW 5/16-18 X 3/4 BHSCS
3	1	54137	SCREW MODIFIED 3/8-24 SSS 10 DEG TAPER
4	1	54221	SET NUT AXIAL LEAD SCREW 3/4-5 ACME BB6100
5	1	54222	ADJUSTABLE HALFNUT BACK PLATE BB6100

54223 - ADJUSTABLE NUT AXIAL LEAD SCREW 3/4-5 ACME - REV A

FOR REFERENCE ONLY

FIGURE 35. ADJUSTABLE AXIAL NUT LEAD SCREW ASSEMBLY (P/N 54223)



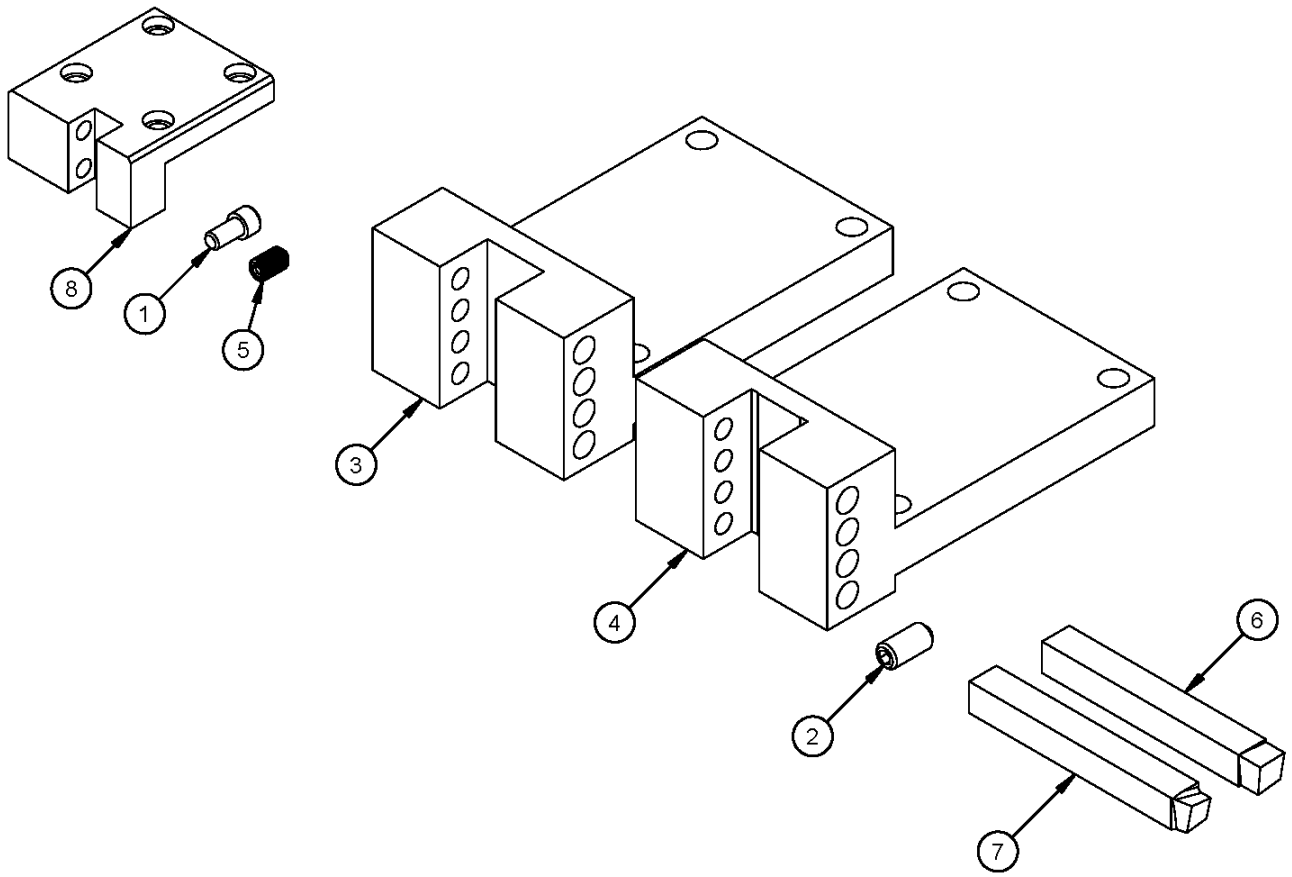
ITEM	QTY	PART No.	DESCRIPTION
6	10	79484	(NOT SHOWN) INSERT CARBIDE 80 DEG 3/8 IC 1/32 NOSE RADIUS CCGT-3252
5	2	79480	HOLDER INSERT CARBIDE 1 SQ SHANK SCREW ON RIGHT HAND
4	2	79479	HOLDER INSERT CARBIDE 1 SQ SHANK SCREW ON LEFT HAND
3.8	4	10800	SCREW 1/4-20 X 1/2 SHCS
3.7	2	25150	SCREW 5/16-24 X 1/2 SSSFP
3.6	1	31859	BIT TOOL HSS 1/2 X 4.0 LH FINISHING SINGLE
3.5	1	54328	1/2" TOOL HOLDER FOR BB6100 & BB7100 BORING SET
3.4	1	31868	BIT TOOL HSS 1/2 X 4.0 LH ROUGHING SINGLE
3.3	16	11734	SCREW 3/8-16 X 3/4 SSSCP
3.2	1	23090	HOLDER TOOL 1 IN. SQUARE LEAD
3.1	1	23091	HOLDER TOOL 1 IN. SQUARE FOLLOW
3	1	60382	BORING HEAD SET SUPPLEMENTAL SOLID TOOLING HOLDERS
2	1	39694	(NOT SHOWN) WRENCH TORX FT-15
1	8	10453	SCREW 3/8-16 X 1 1/4 SHCS

PARTS LIST

81246 - BORING HEAD SOLID TOOLING LEADING AND TRAILING FOR LARGE BB - REV B

FOR REFERENCE ONLY

FIGURE 36. BORING HEAD SOLID TOOLING (P/N 81246)

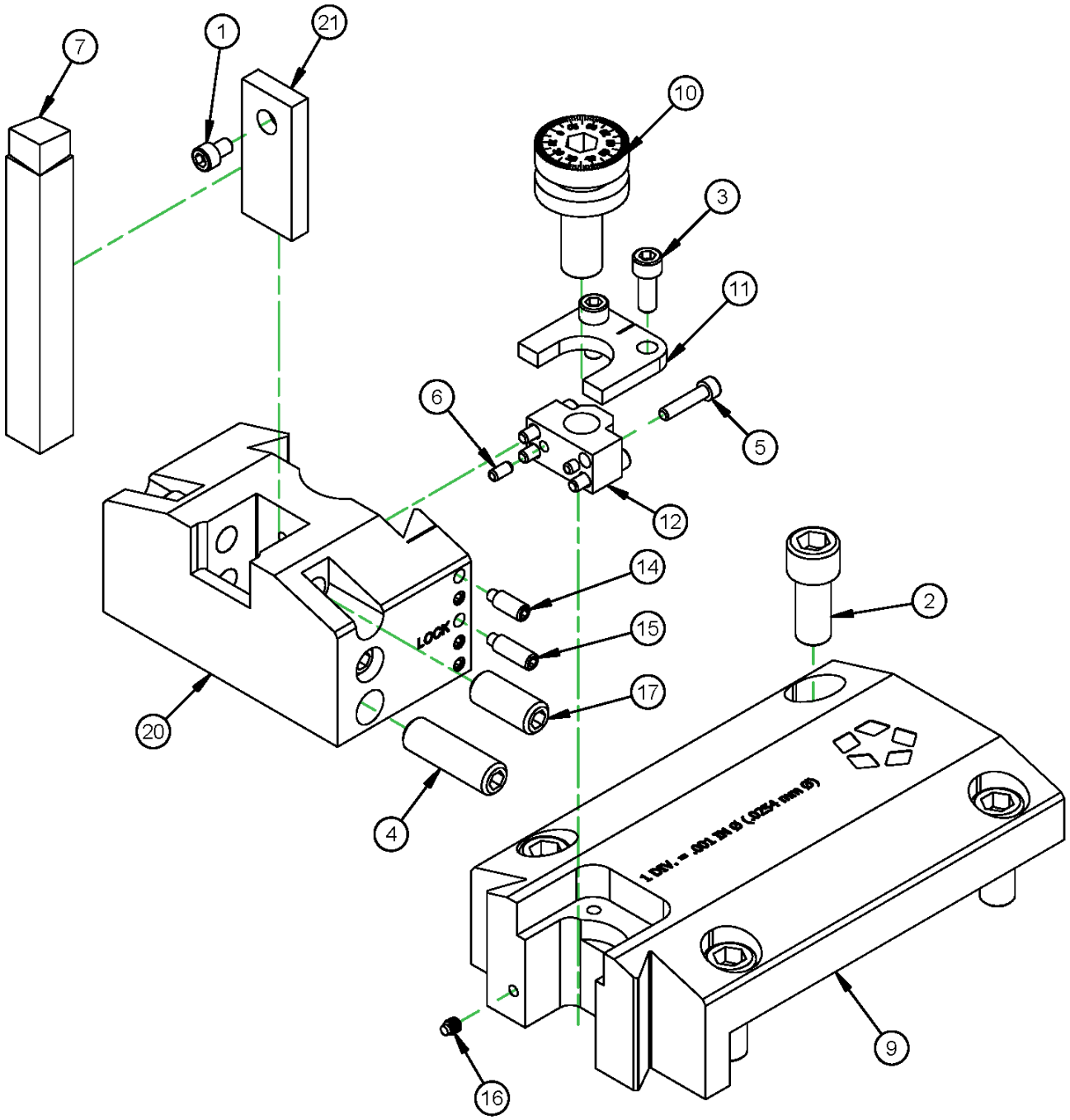


PARTS LIST			
ITEM	QTY	PART No.	DESCRIPTION
1	4	10800	SCREW 1/4-20 X 1/2 SHCS
2	16	11734	SCREW 3/8-16 X 3/4 SSSCP
3	1	23090	HOLDER TOOL 1 IN. SQUARE LEAD
4	1	23091	HOLDER TOOL 1 IN. SQUARE FOLLOW
5	2	25150	SCREW 5/16-24 X 1/2 SSSFP
6	1	31859	BIT TOOL HSS 1/2 X 4.0 LH FINISHING SINGLE
7	1	31868	BIT TOOL HSS 1/2 X 4.0 LH ROUGHING SINGLE
8	1	54328	1/2" TOOL HOLDER FOR BB6100 & BB7100 BORING SET

BORING HEAD SET SUPPLEMENTAL SOLID TOOLING HOLDERS

60382

FIGURE 37. BORING HEAD SET SUPPLEMENTAL SOLID TOOLING HOLDERS (P/N 60382)



79325 - BORING HEAD MICRO ADJUST LARGE BB

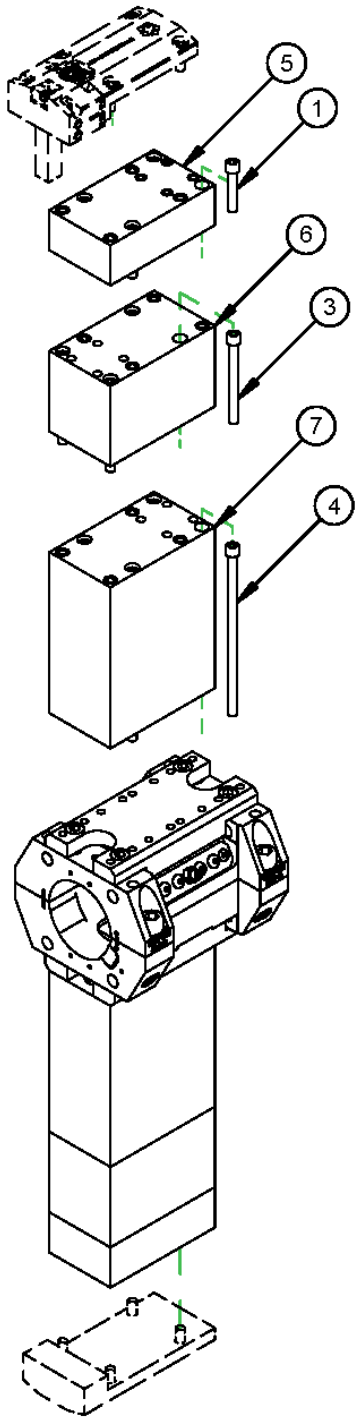
FIGURE 38. MICRO ADJUST BORING HEAD ASSEMBLY (P/N 79325)

AVAILABLE CONFIGURATIONS	
P/N:	DESCRIPTION
79468	BORING HEAD MICRO ADJUST 1/2 INCH TOOLING LARGE BB
79020	BORING HEAD MICRO ADJUST 3/4 INCH TOOLING (1/2 INCH READY) LARGE BB
79021	BORING HEAD MICRO ADJUST 1 INCH TOOLING LARGE BB

PARTS LIST			
ITEM	QTY	P/N:	DESCRIPTION
1	1	10226	SCREW 8-32 X 1/4 SHCS (79020)
2	8	11756	SCREW 3/8-16 X 7/8
3	2	12743	SCREW 10-24 X 1/2 SHCS
4	4	13484	SCREW 3/8-16 X 1-1/2 SSSFP (79468)
		79424	SCREW 3/8-16 X 1-1/4 SSSFP (79020, 79021)
5	4	15210	SCREW 6-32 X 5/8 SHCS
6	2	15414	PIN DOWEL 1/8 DIA X 1/4
7	1	31859	BIT TOOL HSS 1/2 X 4.0 LH FINISHING SINGLE TC (79468)
		31868	BIT TOOL HSS 1/2 X 4.0 LH ROUGHING SINGLE (79468)
8	1	39694	(NOT SHOWN) WRENCH TORX FT-15 (79020, 79021)
9	1	78776	BORING HEAD CARRIAGE HOLDER
10	1	78807	BORING HEAD MICRO ADJUST DIAL SCREW MOD
11	1	78809	DIAL SCREW PLATE
12	1	79019	NUT DIAL SCREW 7/16-20 UNF
13	1	79242	(NOT SHOWN) COUNTERWEIGHT BORING HEAD
14	4	79418	SCREW 10-32 X 1/2 SSSFDP
15	1	79419	SCREW 10-32 X 5/8 SSSFDP
16	1	79420	SCREW 8-32 X 3/16 SSSFDP
17	2	79422	SCREW 3/8-16 X 7/8 SSSFP
18	10	79484	(NOT SHOWN) INSERT CARBIDE 80 DEG 3/8 IC 1/64 NOSE RADIUS CCGT-3251 KC5010 (79020, 79021)
19	1	79485	(NOT SHOWN) HOLDER INSERT CARBIDE 3/4 SQ SHANK SCREW ON LEFT HAND
		79486	(79020)
		79479	(NOT SHOWN) HOLDER INSERT CARBIDE 3/4 SQ SHANK SCREW ON RIGHT HAND
		79480	(79020)
			(NOT SHOWN) HOLDER INSERT CARBIDE 1 SQ SHANK SCREW ON LEFT HAND (79021)
			(NOT SHOWN) HOLDER INSERT CARBIDE 1 SQ SHANK SCREW ON RIGHT HAND (79021)
20	1	79500	CARRIAGE BORING HEAD TOOL 1/2 INCH TOOLING
		78777	CARRIAGE BORING HEAD TOOL 3/4 INCH TOOLING
		79022	CARRIAGE BORING HEAD TOOL 1 INCH TOOLING
21	1	79556	SHIM FOR 1/2 TOOLING IN 3/4 CARRIAGE (79020)
22	1	80816	(NOT SHOWN) VIBRA-TITE VC3 THREADLOCKER
23	1	81073	(NOT SHOWN) DRIVE HEX KEY 3/32 T HANDLE SHORT LENGTH

79325 - BORING HEAD MICRO ADJUST LARGE BB

FIGURE 39. MICRO ADJUST BORING HEAD ASSEMBLY PARTS LIST (P/N 79325)



81249 - BORING DIAMETER RANGE 8.8-40.8 STACK UP BLOCKS BB6100

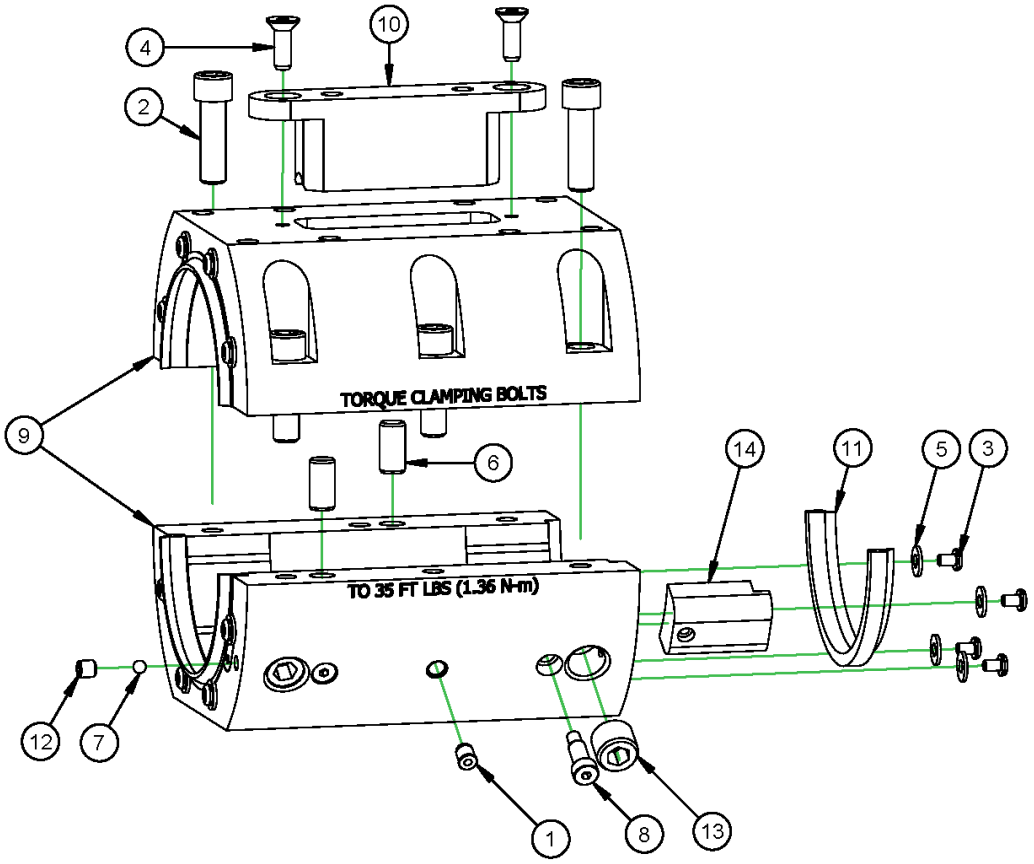
FIGURE 40. BORING DIAMETER RANGE STACK-UP BLOCKS ASSEMBLY (P/N 81249)

AVAILABLE CONFIGURATIONS	
P/N:	DESCRIPTION
81248	BORING DIAMETER RANGE 8.8-24.8 STACK UP BLOCKS BB6100
81249	BORING DIAMETER RANGE 8.8-40.8 STACK UP BLOCKS BB6100

PARTS LIST			
ITEM	QTY	P/N:	DESCRIPTION
1	4	10557	SCREW 3/8-16 X 2 SHCS
3	4	15743	SCREW 3/8-16 X 4 SHCS
4	4	20884	SCREW 3/8-16 X 8 SHCS
5	2	79010	SPACER 2.0 IN FOR BORING SET BB6100 & BB7100
6	2	79011	SPACER 4.0 IN FOR BORING SET BB6100 & BB7100
7	2	79012	SPACER 8.0 IN FOR BORING SET BB6100 & BB7100

81249 - BORING DIAMETER RANGE 8.8-40.8 STACK UP BLOCKS BB6100

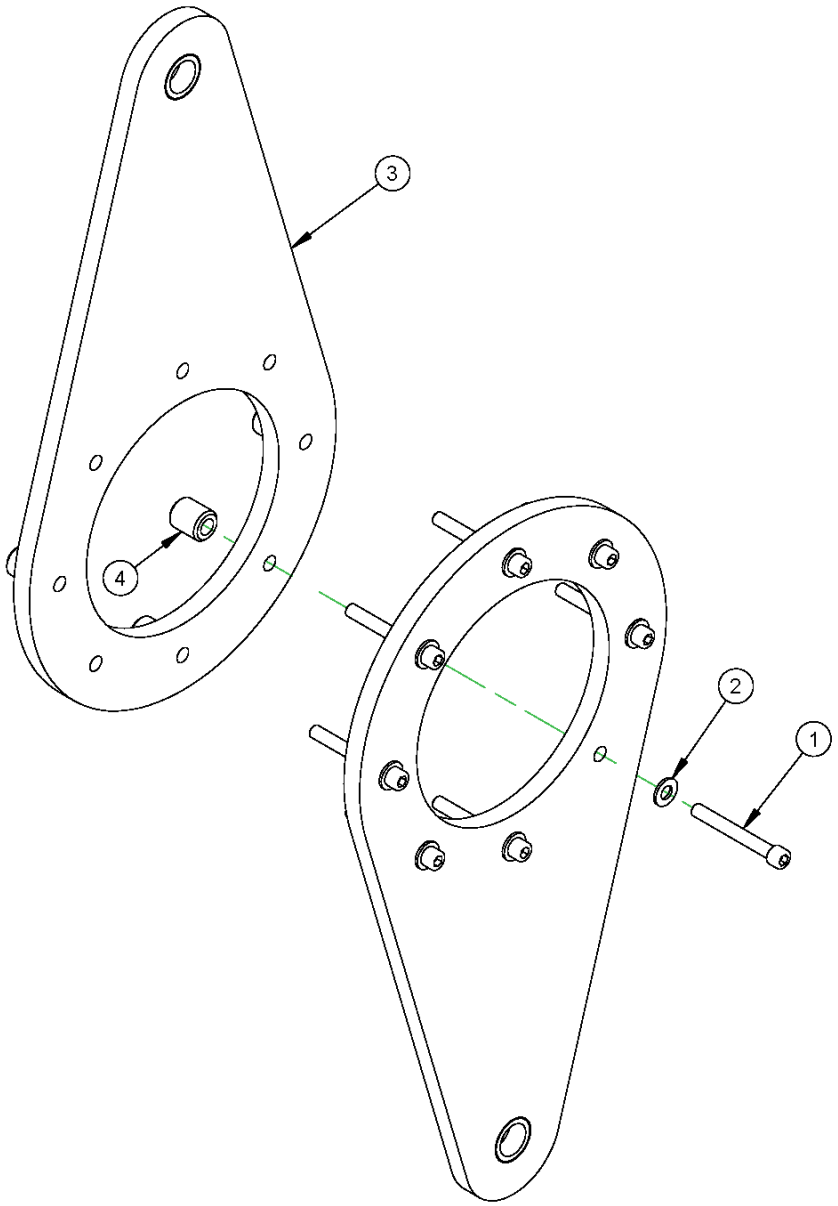
FIGURE 41. BORING DIAMETER RANGE STACK-UP BLOCKS ASSEMBLY PARTS LIST (P/N 81249)



PARTS LIST			
ITEM	QTY	PART No.	DESCRIPTION
1	1	10139	OILER BALL VALVE DRIVE IN
2	6	10453	SCREW 3/8-16 X 1 1/4 SHCS (INCLUDED W/ITEM 9)
3	16	10839	SCREW 8-32 X 1/4 BHSCS
4	2	10843	SREW 1/4-20 X 3/4FHSCS
5	16	11872	WASHER #8 FLTW SAE
6	2	16407	DOWEL PIN 3/8 DIA X 3/4 (INCLUDED W/ITEM 9)
7	2	16594	BALL NYLON 3/16 DIA
8	2	20877	SCREW 1/4 DIA X 1/2 X 10-24 SHLDCS
9	1	22204	ASSY CARRIER TOOL 3.5 DIA 2 PIECE
10	1	22205	NUT AXIAL LEADSCREW 3/4-5 ACME
11	4	22384	WIPER ROD 3.5 ID MOLYTHANE
12	2	30954	SCREW 1/4-28 X 1/4 SSSFP
13	2	47041	SCREW SET 5/8-18 X 1/2 SSSFP
14	2	58430	SHOE ADJUSTABLE TOOL CARRIER BB6000

22377

FIGURE 42. TOOL CARRIER ASSEMBLY (P/N 22377)

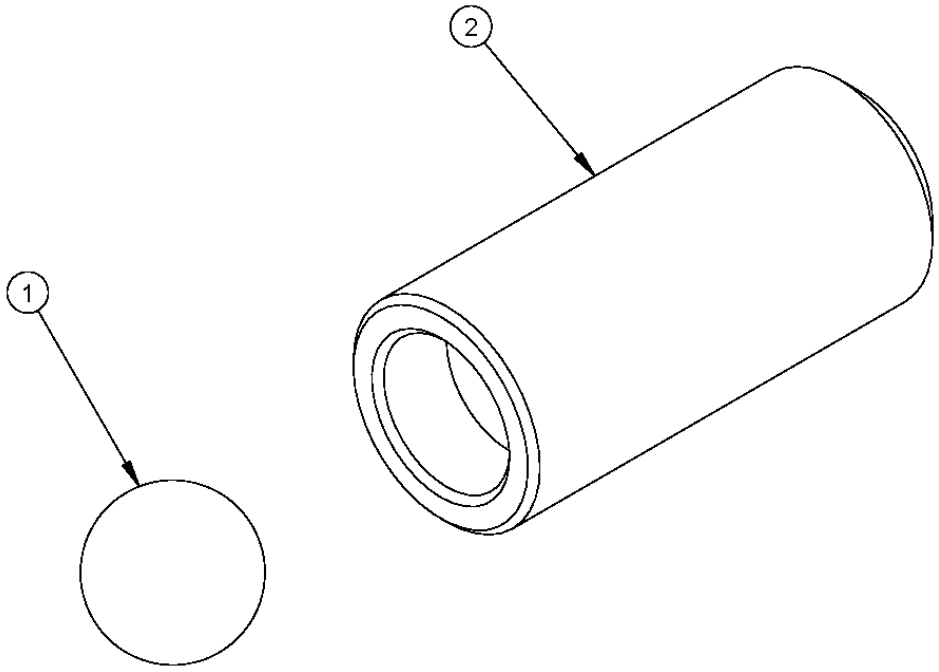


PARTS LIST			
ITEM	QTY	P/N:	DESCRIPTION
1	8	11296	SCREW 5/16-18 X 2-1/2 SHCS
2	8	13489	WASHER 5/16 FLTW SAE
3	2	22577	ARM TORQUE
4	8	22580	SPACER

22604 - ARM TORQUE ASSY - REV A

FOR REFERENCE ONLY

FIGURE 43. TORQUE ARM ASSEMBLY (P/N 22604)



PARTS LIST			
ITEM	QTY	P/N:	DESCRIPTION
1	1	16502	BALL NYLON 7/16 DIA
2	1	55562	SCREW 5/8-18 X 1-1/2 SSSFP MODIFED FOR NYLON BALL TIP

55564 - SCREW ASSY 5/8-18 X 1-1/2 SSSFP WITH NYLON BALL TIP - REV A

FOR REFERENCE ONLY

FIGURE 44. SCREW ASSEMBLY (P/N 55564)

TABLE 6. HYDRAULIC MOTORS

PART	DESCRIPTION
43438	Hydraulic, 3.6 CIR 60 SERIES QD
43439	Hydraulic, 5.6 CIR 60 SERIES QD
43440	Hydraulic, 7.3 CIR 60 SERIES QD
43441	Hydraulic, 8.9 CIR 60 SERIES QD
43442	Hydraulic, 11.3 CIR 60 SERIES QD
43443	Hydraulic, 14.3 CIR 60 SERIES QD
43444	Hydraulic, 17.9 CIR
84278	Hydraulic, 3.6 CIR ISO 16028 QD
84279	Hydraulic, 5.6 CIR ISO 16028 QD
84280	Hydraulic, 7.3 CIR ISO 16028 QD
84281	Hydraulic, 8.9 CIR ISO 16028 QD
84282	Hydraulic, 11.3 CIR ISO 16028 QD
84283	Hydraulic, 14.3 CIR ISO 16028 QD
84284	Hydraulic, 17.9 CIR ISO 16028 QD

8 SCHEMATICS

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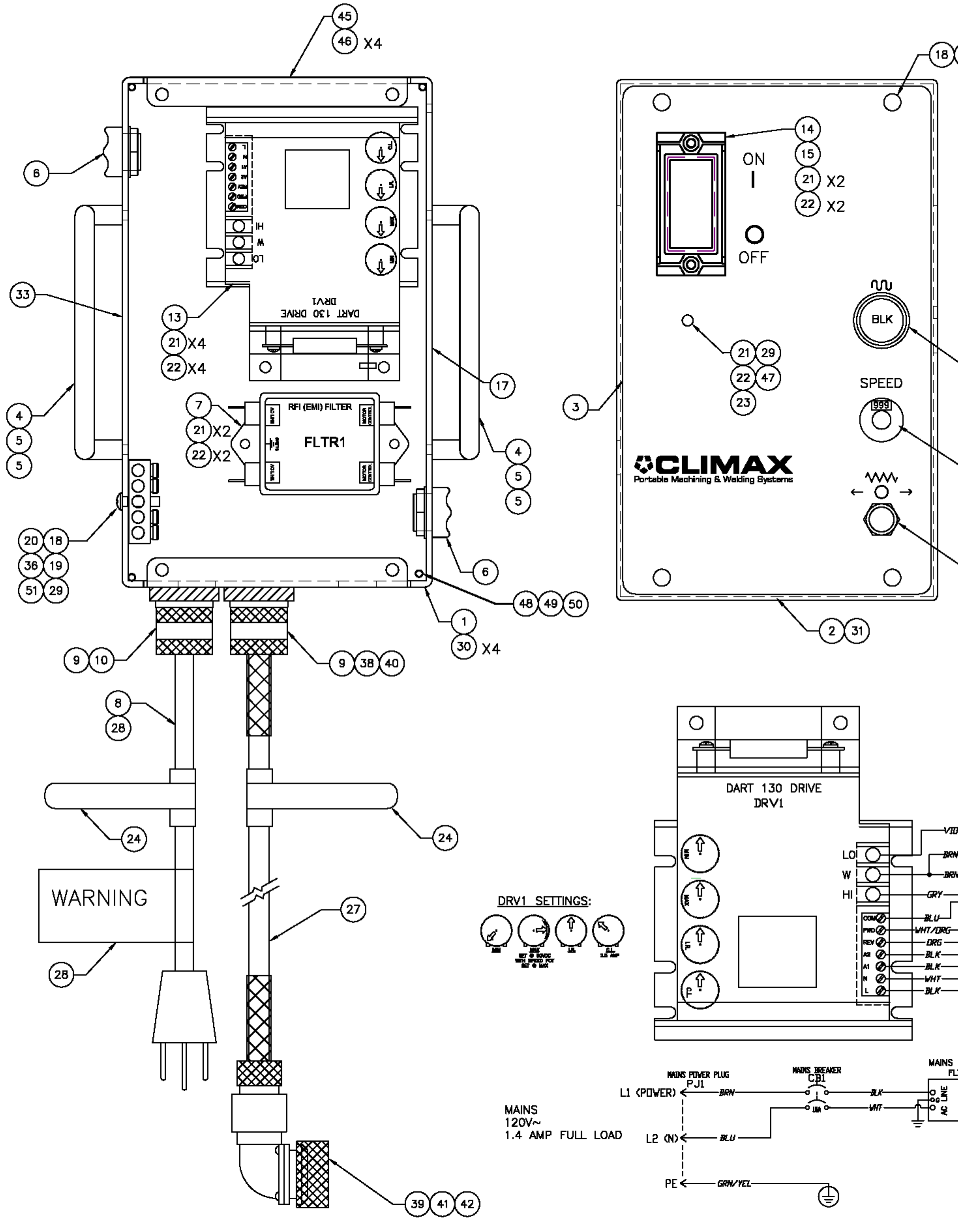


NOTES:

1) USE SILICONE BASE HEAT SINK COMPOUND SUCH AS (CLIMAX 31739) TECH SPRAY #1977–DP BETWEEN THE CHASSIS OF THE DART DRIVE AND THE ENCLOSURE SURFACE

2) USE IDEAL NOALOX ANTIOXIDIZING COMPOUND OR EQUIVALENT UNDER TERMINAL RINGS OF ALL GROUND WIRES. ENSURE THAT THE CONTACT SURFACE IS FREE OF PAINT, OXIDATION OR OTHER FOREIGN MATERIALS PRIOR TO NOALOX APPLICATION AND INSTALLATION

3) TIGHTEN LOCK NUTS AND SEALING NUTS ON SWITCHES AND POTENTIOMETERS TO 60–70 IN–LBS.

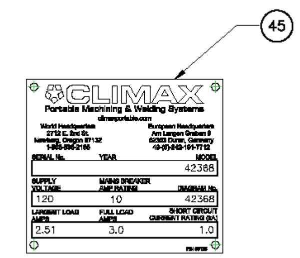
4) TIGHTEN SET SCREWS ON POTENTIOMETERS KNOBS TO 5–7 IN–LBS

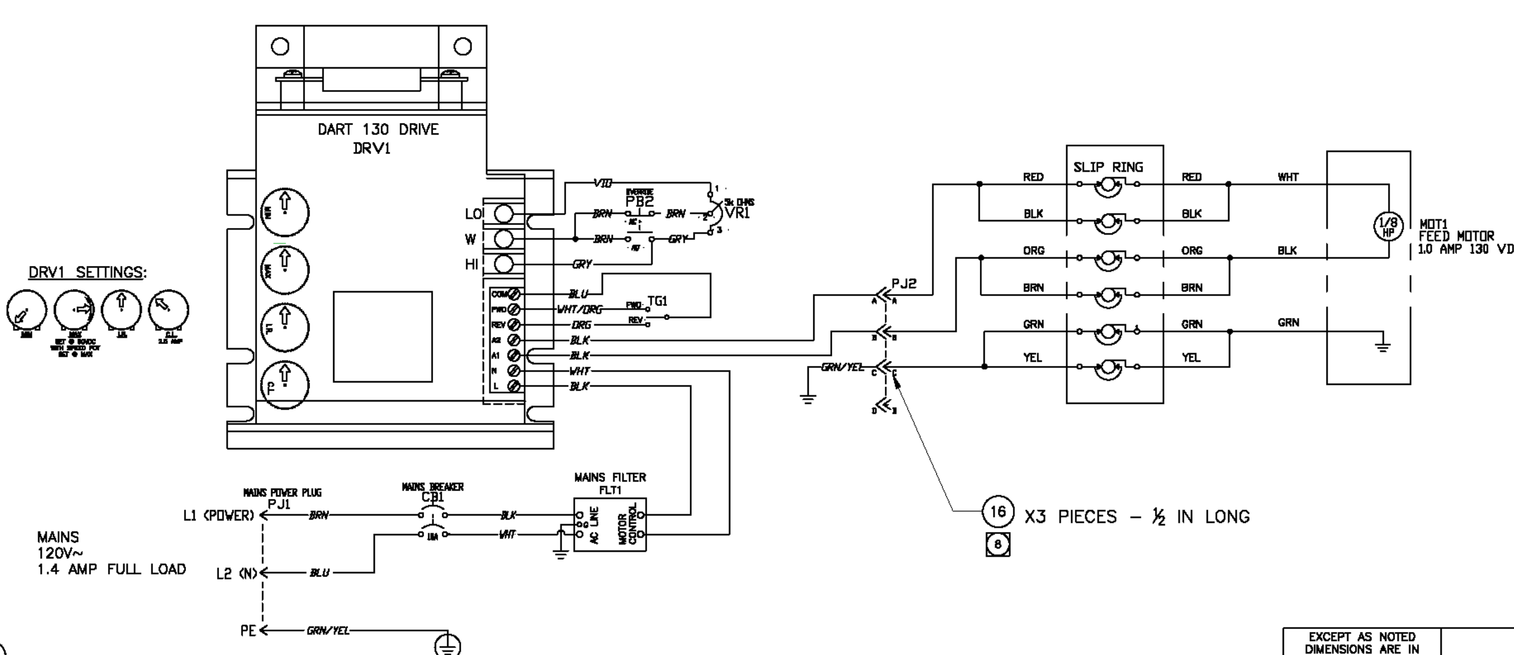
5) PROVIDE SUFFICIENT LENGTH ON ALL WIRES TO ALLOW ENCLOSURE COVER TO OPEN 180° TO THE LEFT

6) CUT AND REMOVE 12 INCHES OF THE OUTER COVER ON ALL CORD SETS AND INSTALL SO THAT OUTER COVER EXTENDS 1/4 INCH INSIDE THE ENCLOSURE.

7) INSTALL PIN TERMINALS ON ALL GROUND CONDUCTORS AT THE GROUND BUSS

8) INSTALL ½ INCH LONG HEAT SHRINK OVER EACH OF THE WIRES AFTER THEY ARE SOLDERED INTO THE CONNECTOR





* NOT SHOWN

FIND NO.	QTY.	PART NO.	DESCRIPTION	MANUFACTURER PART NO.
60	12	36429	WIRE 16 AWG BROWN TYPE MTW	[illegible]
59	12	36430	WIRE 16 AWG VIOLET TYPE MTW	[illegible]
58	12	36428	WIRE 16 AWG GRAY TYPE MTW	[illegible]
57	12	27572	WIRE 16 AWG BLACK TYPE MTW	[illegible]
56	12	27575	WIRE 16 AWG WHITE TYPE MTW	[illegible]
55	12	27829	WIRE 16 AWG BLUE TYPE MTW	[illegible]
54	12	36437	WIRE 16 AWG ORANGE TYPE MTW	[illegible]
53	12	36438	WIRE 16 AWG WHITE/ORANGE TYPE MTW	[illegible]
52	12	27571	WIRE 16 AWG GREEN/YELLOW TYPE MTW	[illegible]
51	2	37572	LABEL PE GROUND TERMINAL (KB)	[illegible]
50	4	59449	SCREW 6–32 X 3/4 SHCS (KB)	[illegible]
49	4	67161	NUT 6–32 NYLON INSERT ZINC PLATED	[illegible]
48	4	55771	BUMPER 1/2 OD X 1/4 TALL X 1/8 CENTER HOLE (KB)	[illegible]
47	1	35923	WASHER #6FLTW NYLON	[illegible]
46	4	10588	DRIVE SCREW #2 X 1/4	[illegible]
45	1	39125	NAMEPLATE ELECTRICAL PANELS	AS PER DWG
44	1	41046	POTENTIOMETER OPERATOR 15 TURN 1/4 SHAFT 7/8 OD	[illegible]
43	1	42720	POTENTIOMETER 5K OHM 10 TURN 1/4 SHAFT 3/8 BUSH	[illegible]
42	1	40365	ADAPTER SIZE 22MS CONNECTOR TO 3/4 NPT	[illegible]
41	1	39063	CONNECTOR ANGLED PLUG 4 POLE SIZE 22	[illegible]
40	1	24115	SEALING RING OIL TIGHT 1/2 NPT	[illegible]
39	1	40366	CORD GRIP W/WIRE MESH .375–.50 X 3/4 NPT	[illegible]
38	1	40640	CORD GRIP W/WIRE MESH .375–.5 X 1/2 NPT	[illegible]
* 37	13	27377	TERMINAL SPADE FM .25 16–14 AWG	[illegible]
36	1	38443	GROUND BUSS 4 POLE COOPER	[illegible]
* 35	4	32304	TERMINAL PIN 14–16–AWG	[illegible]
34	1	38039	PUSHBUTTON OPERATOR UNIVERSAL COLOR MOM 22MM	[illegible]
* 33	1	37576	LABEL ELECTRICAL WARNING	PER PRINT
32	1	38048	MOUNTING COLLAR W/O CONTACTS 22 MM	[illegible]
31	36	35655	SEAL NEOPRENE SPONGE 3/8 X 5/32 ADHESIVE BACK	[illegible]
30	•	•	•	•
* 29	2	28546	TERMINAL RING PIDG 14–16 AWG 8/M4 STUD	[illegible]
* 28	1	34734	LABEL OPERATOR WARNING 3 1/2 X 11	[illegible]
27	252	39931	CABLE SHIELDED POWER 16–3	[illegible]
26	1	10336	TOGGLE SWITCH 1 POLE 3 WAY	[illegible]
25	1	32927	SEAL TOGGLE SWITCH 15/32–32 HEXNUT	[illegible]
24	2	37749	WIRE TIE VELCRO 11 IN LONG	[illegible]
23	2	20757	WASHER #8 INTERNAL STAR WASHER	[illegible]
22	9	28617	NUT 8–32 LOCKING STAR WASHER	[illegible]
21	9	11852	SCREW 8–32 X 1/2 BHSCS	[illegible]
20	5	35366	SCREW 10–32 X 3/4 BINDING HEAD SLOTTED MS	[illegible]
19	1	28060	NUT 10–32 LOCKING STAR WASHER	[illegible]
18	5	29458	WASHER #10 FLTW NYLON	[illegible]
* 17	1	32585	LABEL VOLTAGE 120 VOLTS	[illegible]
* 16	1.5	70901	TUBING HEAT SHRINK 0.19 ID 2:1 SHRINK RATIO	[illegible]
15	1	41887	CIRCUIT BREAKER COLLAR W/COVER FOR TA45 BREAKERS	[illegible]
14	1	42187	CIRCUIT BREAKER ROCKER HANDLE 10 AMP 2POLE 240VAC	[illegible]
13	1	71365	DC DRIVE 120VAC/90VDC 5.5A REVERSING	[illegible]
12	1	38051	CONTACT BLOCK 1 NC	[illegible]
11	1	38050	CONTACT BLOCK 1 NO	[illegible]
10	1	37739	CORD GRIP NONMETALLIC .17–.47 DIA X 1/2 NPT	[illegible]
9	2	12574	CONDUIT NUT 1/2 NPT	[illegible]
8	1	37315	CORDSET 120 VAC 16A 7 FT LONG	[illegible]
7	1	34144	FILTER RFI/EMI 24AMP 115/230V 50/60HZ	[illegible]
6	2	37565	VENT 3/4" ELECTRICAL ENCLOSURE	[illegible]
5	4	34481	SCREW M5 X 0.8 X 12 BHCS ZINC FINISH	[illegible]
4	2	32953	HANDLE 5 INCH U SHAPED OFFSET CHROME	[illegible]
3	1	40897	LEGEND PLATE PM5000/PM6000 CONTROLLER	PER PRINT
2	1	40895	COVER PENDANT ENCLOSURE	PER PRINT
1	1	40896	PENDANT ENCLOSURE	PER PRINT

PARTS LIST

EXCEPT AS NOTED DIMENSIONS ARE IN INCHES PER ASME Y14.5
.X ± .030
.XX ± .010
.XXX ± .005
ANGLES ± .5°

MATERIAL

COSMETIC CLASS EXCEPT AS NOTED

CLIMAX Portable Machine Tools, Inc.
Newberg, Or. USA 97132

CONTROLLER ASSY BB8000
ELECTRIC FEED 120VAC 50/60 HZ

SIZE	CAGE CODE	DWG NO.	REVISION
D	15509	42368	E

SCALE NTS — SHEET 1 OF 1

FIGURE 45. ELECTRIC FEED CONTROLLER ASSEMBLY (P/N 42368)

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9 SDS

Safety Data Sheet

According to OSHA HCS 2012 (29 CFR 1910.1200), Health Canada HPR (SOR/2015-17), and Mexico NOM-018-STPS-2015

SECTION 1: Identification

Product Identifier	**Hydraulic AW**
Other means of identification	Phillips 66® Hydraulic AW 32 Phillips 66® Hydraulic AW 46 Phillips 66® Hydraulic AW 68 Phillips 66® Hydraulic AW 100
Code	**LBPH778830**
Issue date	12-Mar-2019
Relevant identified uses	Hydraulic Fluid
Uses advised against	All others
24 Hour Emergency Phone Number	CHEMTREC: 1-800-424-9300 CHEMTREC Mexico 01-800-681-9531 CHEMTREC Global +1 703 527 3887

Manufacturer/Supplier
Phillips 66 Lubricants
A Division of Phillips 66 Company
P.O. Box 421959
Houston, Texas 77242-1959

SDS Information
URL: www.phillips66.com/SDS
Phone: 800-762-0942
Email: SDS@P66.com

Customer Service
U.S.: 800-368-7128 or International: 1-832-765-2500

Technical Information
1-877-445-9198

SECTION 2: Hazard identification

Classified Hazards

No classified hazards

Hazards Not Otherwise Classified (HNOC)

PHNOC: None known

HHNOC: None known

Label elements

No classified hazards

SECTION 3: Composition/information on ingredients

Chemical Name	CASRN	Concentration
Distillates, petroleum, hydrotreated heavy paraffinic	64742-54-7	<100
Distillates, petroleum, solvent-dewaxed heavy paraffinic	64742-65-0	<95
Distillates, petroleum, solvent-refined heavy paraffinic	64741-88-4	<75
Distillates, petroleum, solvent-dewaxed light paraffinic	64742-56-9	<30

[1] All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

SECTION 4: First aid measures

Eye Contact: If irritation or redness develops from exposure, flush eyes with clean water. If symptoms persist, seek medical attention.

Skin Contact: Remove contaminated shoes and clothing and cleanse affected area(s) thoroughly by washing with mild soap and water or a waterless hand cleaner. If irritation or redness develops and persists, seek medical attention. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician. (see Note to Physician)

Inhalation: First aid is not normally required. If breathing difficulties develop, move victim away from source of exposure and into fresh air in a position comfortable for breathing. Seek immediate medical attention.

Ingestion: First aid is not normally required; however, if swallowed and symptoms develop, seek medical attention.

Most important symptoms and effects, both acute and delayed: Inhalation of oil mists or vapors generated at elevated temperatures may cause respiratory irritation. Accidental ingestion can result in minor irritation of the digestive tract, nausea and diarrhea. Prolonged or repeated contact may dry skin and cause irritation.

Notes to Physician: Acute aspirations of large amounts of oil-laden material may produce a serious aspiration pneumonia. Patients who aspirate these oils should be followed for the development of long-term sequelae. Inhalation exposure to oil mists below current workplace exposure limits is unlikely to cause pulmonary abnormalities.

When using high-pressure equipment, injection of product under the skin can occur. In this case, the casualty should be sent immediately to the hospital. Do not wait for symptoms to develop. High-pressure hydrocarbon injection injuries may produce substantial necrosis of underlying tissue despite an innocuous appearing external wound. These injuries often require extensive emergency surgical debridement and all injuries should be evaluated by a specialist in order to assess the extent of injury. Early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

SECTION 5: Firefighting measures

NFPA 704: National Fire Protection Association

Health: 0 **Flammability:** 1 **Instability:** 0

0 = minimal hazard
1 = slight hazard
2 = moderate hazard
3 = severe hazard
4 = extreme hazard

Extinguishing Media: Dry chemical, carbon dioxide, foam, or water spray is recommended. Water or foam may cause frothing of materials heated above 212°F / 100°C. Carbon dioxide can displace oxygen. Use caution when applying carbon dioxide in confined spaces. Simultaneous use of foam and water on the same surface is to be avoided as water destroys the foam.

Specific hazards arising from the chemical

Unusual Fire & Explosion Hazards: This material may burn, but will not ignite readily. If container is not properly cooled, it can rupture in the heat of a fire.

Hazardous Combustion Products: Combustion may yield smoke, carbon monoxide, and other products of incomplete combustion. Oxides of sulfur, nitrogen or phosphorus may also be formed.

Special protective actions for fire-fighters: For fires beyond the initial stage, emergency responders in the immediate hazard area should wear protective clothing. When the potential chemical hazard is unknown, in enclosed or confined spaces, a self contained breathing apparatus should be worn. In addition, wear other appropriate protective equipment as conditions warrant (see Section 8). Isolate the hazard area and deny entry to unnecessary and unprotected personnel. Stop spill/release if it can be done safely. Move undamaged containers from immediate hazard area if it can be done safely. Water spray may be useful in minimizing or dispersing vapors and to protect personnel. Cool equipment exposed to fire with water, if it can be done safely. Avoid spreading burning liquid with water used for cooling purposes.

See Section 9 for Flammable Properties including Flash Point and Flammable (Explosive) Limits

SECTION 6: Accidental release measures

Personal precautions, protective equipment and emergency procedures: This material may burn, but will not ignite readily. Keep all sources of ignition away from spill/release. Stay upwind and away from spill/release. Avoid direct contact with material. For large spillages, notify persons down wind of the spill/release, isolate immediate hazard area and keep unauthorized personnel out. Wear appropriate protective equipment, including respiratory protection, as conditions warrant (see Section 8). See Sections 2 and 7 for additional information on hazards and precautionary measures.

Environmental Precautions: Stop and contain spill/release if it can be done safely. Prevent spilled material from entering sewers, storm drains, other unauthorized drainage systems, and natural waterways. Use water sparingly to minimize environmental contamination and reduce disposal requirements. If spill occurs on water notify appropriate authorities and advise shipping of any hazard. Spills into or upon navigable waters, the contiguous zone, or adjoining shorelines that cause a sheen or discoloration on the surface of the water, may require notification of the National Response Center (phone number 800-424-8802).

Methods and material for containment and cleaning up: Notify relevant authorities in accordance with all applicable regulations. Immediate cleanup of any spill is recommended. Dike far ahead of spill for later recovery or disposal. Absorb spill with inert material such as sand or vermiculite, and place in suitable container for disposal. If spilled on water remove with appropriate methods (e.g. skimming, booms or absorbents). In case of soil contamination, remove contaminated soil for remediation or disposal, in accordance with local regulations.

Recommended measures are based on the most likely spillage scenarios for this material; however local conditions and regulations may influence or limit the choice of appropriate actions to be taken. See Section 13 for information on appropriate disposal.

SECTION 7: Handling and storage

Precautions for safe handling: Keep away from flames and hot surfaces. Wash thoroughly after handling. Use good personal hygiene practices and wear appropriate personal protective equipment (see section 8). Spills will produce very slippery surfaces. High pressure injection of hydrocarbon fuels, hydraulic oils or greases under the skin may have serious consequences even though no symptoms or injury may be apparent. This can happen accidentally when using high pressure equipment such as high pressure grease guns, fuel injection apparatus or from pinhole leaks in tubing of high pressure hydraulic oil equipment.

Do not enter confined spaces such as tanks or pits without following proper entry procedures such as ASTM D-4276 and 29CFR 1910.146. Do not wear contaminated clothing or shoes.

Conditions for safe storage: Use and store this material in cool, dry, well-ventilated area away from heat and all sources of ignition. Keep container(s) tightly closed and properly labeled. Store only in approved containers. Keep away from any incompatible material (see Section 10). Protect container(s) against physical damage.

"Empty" containers retain residue and may be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, or other sources of ignition. They may explode and cause injury or death. "Empty" drums should be completely drained, properly bunged, and promptly shipped to the supplier or a drum reconditioner. All containers should be disposed of in an environmentally safe manner and in accordance with governmental regulations. Before working on or in tanks which contain or have contained this material, refer to OSHA regulations, ANSI Z49.1, and other references pertaining to cleaning, repairing, welding, or other contemplated operations.

SECTION 8: Exposure controls/personal protection

Occupational exposure limits
The following constituents are the only constituents of the product which have a PEL, TLV or other recommended exposure limit. At this time, the other constituents have no known exposure limits.

Chemical Name	ACGIH	OSHA	Mexico	Phillips 66
Distillates, petroleum, solvent-dewaxed heavy paraffinic	TWA: 5mg/m^3 STEL: 10 mg/m^3 as Oil Mist, if Generated	---	---	---
Distillates, petroleum, solvent-refined heavy paraffinic	TWA: 5mg/m^3 STEL: 10 mg/m^3 as Oil Mist, if Generated	---	---	---
Distillates, petroleum, hydrotreated heavy paraffinic	TWA: 5mg/m^3 STEL: 10 mg/m^3 as Oil Mist, if Generated	---	---	---
Distillates, petroleum, solvent-dewaxed light paraffinic	TWA: 5mg/m^3 STEL: 10 mg/m^3 as Oil Mist, if Generated	---	---	---

Note: State, local or other agencies or advisory groups may have established more stringent limits. Consult an industrial hygienist or similar professional, or your local agencies, for further information.

CLIMAX P/N 39547

Biological occupational exposure limits
Note: None

Engineering controls: If current ventilation practices are not adequate to maintain airborne concentrations below the established exposure limits, additional engineering controls may be required.

Eye/Face Protection: The use of eye protection that meets or exceeds ANSI Z.87.1 is recommended to protect against potential eye contact, irritation, or injury. Depending on conditions of use, a face shield may be necessary.

Skin/Hand Protection: The use of gloves impervious to the specific material handled is advised to prevent skin contact. Users should check with manufacturers to confirm the breakthrough performance of their products. Suggested protective materials: Nitrile rubber

Respiratory Protection: Where there is potential for airborne exposure above the exposure limit a NIOSH certified air purifying respirator equipped with R or P95 filters may be used.

A respiratory protection program that meets or is equivalent to OSHA 29 CFR 1910.134 and ANSI Z88.2 should be followed whenever workplace conditions warrant a respirator's use. Air purifying respirators provide limited protection and cannot be used in atmospheres that exceed the maximum use concentration (as directed by regulation or the manufacturer's instructions), in oxygen deficient (less than 19.5 percent oxygen) situations, or under conditions that are immediately dangerous to life and health (IDLH).

Suggestions provided in this section for exposure control and specific types of protective equipment are based on readily available information. Users should consult with the specific manufacturer to confirm the performance of their protective equipment. Specific situations may require consultation with industrial hygiene, safety, or engineering professionals.

SECTION 9: Physical and chemical properties

Note: Unless otherwise stated, values are determined at 20°C (68°F) and 760 mm Hg (1 atm). Data represent typical values and are not intended to be specifications.

Appearance: Amber, Transparent
Physical Form: Liquid
Odor: Petroleum
Odor Threshold: No data
pH: Not applicable
Vapor Density (air=1): >1
Upper Explosive Limits (vol % in air): No data
Lower Explosive Limits (vol % in air): No data
Evaporation Rate (nBuAc=1): No data
Particle Size: Not applicable
Percent Volatile: Negligible
Flammability (solid, gas): Not applicable
Solubility in Water: Insoluble

Flash Point: > 420 °F / > 216 °C
Test Method: Cleveland Open Cup (COC), ASTM D92
Initial Boiling Point/Range: No data
Vapor Pressure: <1 mm Hg
Partition Coefficient (n-octanol/water) (Kow): No data
Melting/Freezing Point: < 15.8 °F / < -9 °C
Auto-ignition Temperature: No data
Decomposition Temperature: No data
Specific Gravity (water=1): 0.866 - 0.886 @ 60ºF (15.6ºC)
Bulk Density: 7.2 - 7.4 lbs/gal
Viscosity: 5.3 - 10.1 cSt @ 100°C; 32 - 100 cSt @ 40°C
Pour Point: 0 to 14 °F / -17.8 to -10 °C

SECTION 10: Stability and reactivity

Reactivity: Not chemically reactive.

Chemical stability: Stable under normal ambient and anticipated conditions of use.

Possibility of hazardous reactions: Hazardous reactions not anticipated.

Conditions to avoid: Extended exposure to high temperatures can cause decomposition. Avoid all possible sources of ignition.

Incompatible materials: Avoid contact with strong oxidizing agents and strong reducing agents.

Hazardous decomposition products: Not anticipated under normal conditions of use.

SECTION 11: Toxicological information

Information on Toxicological Effects

Substance / Mixture

Acute Toxicity	Hazard	Additional Information	LC50/LD50 Data
Inhalation	Unlikely to be harmful		>5 mg/L (mist, estimated)
Dermal	Unlikely to be harmful		> 2 g/kg (estimated)
Oral	Unlikely to be harmful		> 5 g/kg (estimated)

Likely Routes of Exposure: Inhalation, eye contact, skin contact

Aspiration Hazard: Not expected to be an aspiration hazard

Skin Corrosion/Irritation: Causes mild skin irritation. Repeated exposure may cause skin dryness or cracking.

Serious Eye Damage/Irritation: Causes mild eye irritation.

Skin Sensitization: No information available on the mixture, however none of the components have been classified for skin sensitization (or are below the concentration threshold for classification).

Respiratory Sensitization: No information available.

Specific Target Organ Toxicity (Single Exposure): No information available on the mixture, however none of the components have been classified for target organ toxicity (or are below the concentration threshold for classification).

Specific Target Organ Toxicity (Repeated Exposure): No information available on the mixture, however none of the components have been classified for target organ toxicity (or are below the concentration threshold for classification).

Carcinogenicity: No information available on the mixture, however none of the components have been classified for carcinogenicity (or are below the concentration threshold for classification).

Germ Cell Mutagenicity: No information available on the mixture, however none of the components have been classified for germ cell mutagenicity (or are below the concentration threshold for classification).

Reproductive Toxicity: No information available on the mixture, however none of the components have been classified for reproductive toxicity (or are below the concentration threshold for classification).

Information on Toxicological Effects of Components

Lubricant Base Oil (Petroleum)

Carcinogenicity: The petroleum base oils contained in this product have been highly refined by a variety of processes including severe hydrocracking/hydroprocessing to reduce aromatics and improve performance characteristics. All of the oils meet the IP-346 criteria of less than 3 percent PAH's and are not considered carcinogens by NTP, IARC, or OSHA.

SECTION 12: Ecological information

GHS Classification:
No classified hazards

Toxicity: All acute aquatic toxicity studies on samples of lubricant base oils show acute toxicity values greater than 100 mg/L for invertebrates, algae and fish. These tests were carried out on water accommodated fractions and the results are consistent with the predicted aquatic toxicity of these substances based on their hydrocarbon compositions.

Persistence and Degradability: The hydrocarbons in this material are not readily biodegradable, but since they can be degraded by microorganisms, they are regarded as inherently biodegradable.

Bioaccumulative Potential: Log Kow values measured for the hydrocarbon components of this material are greater than 5.3, and therefore regarded as having the potential to bioaccumulate. In practice, metabolic processes may reduce bioconcentration.

Mobility in Soil: Volatilization to air is not expected to be a significant fate process due to the low vapor pressure of this material. In water, base oils will float and spread over the surface at a rate dependent upon viscosity. There will be significant removal of hydrocarbons from the water by sediment adsorption. In soil and sediment, hydrocarbon components will show low mobility with adsorption to sediments being the predominant physical process. The main fate process is expected to be slow biodegradation of the hydrocarbon constituents in soil and sediment.

Other adverse effects: None anticipated.

SECTION 13: Disposal considerations

The generator of a waste is always responsible for making proper hazardous waste determinations and needs to consider state and local requirements in addition to federal regulations. This material, if discarded as produced, would not be a federally regulated RCRA "listed" hazardous waste and is not believed to exhibit characteristics of hazardous waste. See Sections 7 and 8 for information on handling, storage and personal protection and Section 9 for physical/chemical properties. It is possible that the material as produced contains constituents which are not required to be listed in the SDS but could affect the hazardous waste determination. Additionally, use which results in chemical or physical change of this material could subject it to regulation as a hazardous waste.This material under most intended uses would become "Used Oil" due to contamination by physical or chemical impurities. Whenever possible, Recycle used oil in accordance with applicable federal and state or local regulations. Container contents should be completely used and containers should be emptied prior to discard.

SECTION 14: Transport information

UN Number: Not regulated
UN proper shipping name: None
Transport hazard class(es): None
Packing Group: None
Environmental Hazards: This product does not meet the DOT/UN/IMDG/IMO criteria of a marine pollutant
Special precautions for user: If shipped by land in a packaging having a capacity of 3,500 gallons or more, the provisions of 49 CFR, Part 130 apply. (Contains oil)
Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code: Not applicable

SECTION 15: Regulatory information

CERCLA/SARA - Section 302 Extremely Hazardous Substances and TPQs (in pounds)
This material does not contain any chemicals subject to the reporting requirements of SARA 302 and 40 CFR 372.

CERCLA/SARA - Section 311/312 (Title III Hazard Categories)
Should this product meet EPCRA 311/312 Tier reporting criteria at 40 CFR 370, refer to Section 2 of this SDS for appropriate classifications.

CERCLA/SARA - Section 313 and 40 CFR 372
This material does not contain any chemicals subject to the reporting requirements of SARA 313 and 40 CFR 372.

EPA (CERCLA) Reportable Quantity (in pounds)
This material does not contain any chemicals with CERCLA Reportable Quantities.

California Proposition 65
This material does not contain any chemicals which are known to the State of California to cause cancer, birth defects or other reproductive harm at concentrations that trigger the warning requirements of California Proposition 65.

International Inventories
All components are either listed on the US TSCA Inventory, or are not regulated under TSCA.
All components are either on the DSL, or are exempt from DSL listing requirements.

SECTION 16: Other information

Issue date	Previous Issue Date:	SDS Number	Status:
12-Mar-2019	30-Apr-2018	LBPH778830	FINAL

Revised Sections or Basis for Revision:
Composition (Section 3)

Mexican NOM-018-STPS-2015:
The information within is considered correct but is not exhaustive and will be used for guidance only, which is based on the current

knowledge of the substance or mixture and is applicable to the appropriate safety precautions for the product.

Guide to Abbreviations:
ACGIH = American Conference of Governmental Industrial Hygienists; CASRN = Chemical Abstracts Service Registry Number; CEILING = Ceiling Limit (15 minutes); CERCLA = The Comprehensive Environmental Response, Compensation, and Liability Act; EPA = Environmental Protection Agency; GHS = Globally Harmonized System; HPR = Hazardous Products Regulations; IARC = International Agency for Research on Cancer; INSHT = National Institute for Health and Safety at Work; IOPC = International Oil Pollution Compensation; LEL = Lower Explosive Limit; NE = Not Established; NFPA = National Fire Protection Association; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration; PEL = Permissible Exposure Limit (OSHA); SARA = Superfund Amendments and Reauthorization Act; STEL = Short Term Exposure Limit (15 minutes); TLV = Threshold Limit Value (ACGIH); TWA = Time Weighted Average (8 hours); UEL = Upper Explosive Limit; WHMIS = Worker Hazardous Materials Information System (Canada)

Disclaimer of Expressed and implied Warranties:
The information presented in this Safety Data Sheet is based on data believed to be accurate as of the date this Safety Data Sheet was prepared. HOWEVER, NO WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY OTHER WARRANTY IS EXPRESSED OR IS TO BE IMPLIED REGARDING THE ACCURACY OR COMPLETENESS OF THE INFORMATION PROVIDED ABOVE, THE RESULTS TO BE OBTAINED FROM THE USE OF THIS INFORMATION OR THE PRODUCT, THE SAFETY OF THIS PRODUCT, OR THE HAZARDS RELATED TO ITS USE. No responsibility is assumed for any damage or injury resulting from abnormal use or from any failure to adhere to recommended practices. The information provided above, and the product, are furnished on the condition that the person receiving them shall make their own determination as to the suitability of the product for their particular purpose and on the condition that they assume the risk of their use. In addition, no authorization is given nor implied to practice any patented invention without a license.

CLIMAX P/N 39547

Safety Data Sheet

According to OSHA HCS 2012 (29 CFR 1910.1200), Health Canada HPR (SOR/2015-17), and Mexico NOM-018-STPS-2015

SECTION 1: Identification

Product Identifier	**Koolkut® SPECTRUM**
Other means of identification	Phillips 66 Koolkut® SPECTRUM
Code	**LBPH778731**
Relevant identified uses	Metalworking Fluid
Uses advised against	All others
24 Hour Emergency Phone Number	CHEMTREC: 1-800-424-9300 CHEMTREC México 01-800-681-9531

Manufacturer/Supplier
Phillips 66 Lubricants
P.O. Box 4428
Houston, TX 77210

SDS Information
URL: www.phillips66.com/SDS
Phone: 800-762-0942
Email: SDS@P66.com

Customer Service
U.S.: 800-368-7128 or International: 1-832-765-2500

Technical Information
1-877-445-9198

SECTION 2: Hazard identification

Classified Hazards

No classified hazards

Hazards Not Otherwise Classified (HNOC)

PHNOC: None known

HHNOC: None known

Label elements

No classified hazards

SECTION 3: Composition/information on ingredients

Chemical Name	CASRN	Concentration
Distillates, petroleum, solvent-dewaxed heavy paraffinic	64742-65-0	50-70
Distillates, petroleum, solvent-refined light paraffinic	64741-89-5	30-50

[1] All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

SECTION 4: First aid measures

Eye Contact: If irritation or redness develops from exposure, flush eyes with clean water. If symptoms persist, seek medical attention.

Skin Contact: Remove contaminated shoes and clothing and cleanse affected area(s) thoroughly by washing with mild soap and water or a waterless hand cleaner. If irritation or redness develops and persists, seek medical attention.

Inhalation: First aid is not normally required. If breathing difficulties develop, move victim away from source of exposure and into fresh air in a position comfortable for breathing. Seek immediate medical attention.

Ingestion: First aid is not normally required; however, if swallowed and symptoms develop, seek medical attention.

Most important symptoms and effects, both acute and delayed: Inhalation of oil mists or vapors generated at elevated temperatures may cause respiratory irritation. Accidental ingestion can result in minor irritation of the digestive tract, nausea and diarrhea. Prolonged or repeated contact may dry skin and cause irritation.

Notes to Physician: Acute aspirations of large amounts of oil-laden material may produce a serious aspiration pneumonia. Patients who aspirate these oils should be followed for the development of long-term sequelae. Inhalation exposure to oil mists below current workplace exposure limits is unlikely to cause pulmonary abnormalities.

SECTION 5: Firefighting measures

NFPA 704: National Fire Protection Association

Health: 0 **Flammability:** 1 **Instability:** 0

0 = minimal hazard
1 = slight hazard
2 = moderate hazard
3 = severe hazard
4 = extreme hazard

Extinguishing Media: Dry chemical, carbon dioxide, foam, or water spray is recommended. Water or foam may cause frothing of materials heated above 212°F / 100°C. Carbon dioxide can displace oxygen. Use caution when applying carbon dioxide in confined spaces. Simultaneous use of foam and water on the same surface is to be avoided as water destroys the foam.

Specific hazards arising from the chemical

Unusual Fire & Explosion Hazards: This material may burn, but will not ignite readily. If container is not properly cooled, it can rupture in the heat of a fire.

Hazardous Combustion Products: Combustion may yield smoke, carbon monoxide, and other products of incomplete combustion. Oxides of sulfur, nitrogen or phosphorus may also be formed.

Special protective actions for fire-fighters: For fires beyond the initial stage, emergency responders in the immediate hazard area should wear protective clothing. When the potential chemical hazard is unknown, in enclosed or confined spaces, a self contained breathing apparatus should be worn. In addition, wear other appropriate protective equipment as conditions warrant (see Section 8). Isolate the hazard area and deny entry to unnecessary and unprotected personnel. Stop spill/release if it can be done safely. Move undamaged containers from immediate hazard area if it can be done safely. Water spray may be useful in minimizing or dispersing vapors and to protect personnel. Cool equipment exposed to fire with water, if it can be done safely. Avoid spreading burning liquid with water used for cooling purposes.

See Section 9 for Flammable Properties including Flash Point and Flammable (Explosive) Limits

SECTION 6: Accidental release measures

Personal precautions, protective equipment and emergency procedures: This material may burn, but will not ignite readily. Keep all sources of ignition away from spill/release. Stay upwind and away from spill/release. Avoid direct contact with material. For large spillages, notify persons down wind of the spill/release, isolate immediate hazard area and keep unauthorized personnel out. Wear appropriate protective equipment, including respiratory protection, as conditions warrant (see Section 8). See Sections 2 and 7 for additional information on hazards and precautionary measures.

Environmental Precautions: Stop and contain spill/release if it can be done safely. Prevent spilled material from entering sewers, storm drains, other unauthorized drainage systems, and natural waterways. Use water sparingly to minimize environmental contamination and reduce disposal requirements. If spill occurs on water notify appropriate authorities and advise shipping of any hazard. Spills into or upon navigable waters, the contiguous zone, or adjoining shorelines that cause a sheen or discoloration on the surface of the water, may require notification of the National Response Center (phone number 800-424-8802).

Methods and material for containment and cleaning up: Notify relevant authorities in accordance with all applicable regulations. Immediate cleanup of any spill is recommended. Dike far ahead of spill for later recovery or disposal. Absorb spill with inert material such as sand or vermiculite, and place in suitable container for disposal. If spilled on water remove with appropriate methods (e.g. skimming, booms or absorbents). In case of soil contamination, remove contaminated soil for remediation or disposal, in accordance with local regulations.

Recommended measures are based on the most likely spillage scenarios for this material; however local conditions and regulations may influence or limit the choice of appropriate actions to be taken. See Section 13 for information on appropriate disposal.

SECTION 7: Handling and storage

Precautions for safe handling: Keep away from flames and hot surfaces. Wash thoroughly after handling. Use good personal hygiene practices and wear appropriate personal protective equipment (see section 8). Spills will produce very slippery surfaces. Do not enter confined spaces such as tanks or pits without following proper entry procedures such as ASTM D-4276 and 29CFR 1910.146. Do not wear contaminated clothing or shoes.

Conditions for safe storage: Keep container(s) tightly closed and properly labeled. Use and store this material in cool, dry, well-ventilated area away from heat and all sources of ignition. Store only in approved containers. Keep away from any incompatible material (see Section 10). Protect container(s) against physical damage.

"Empty" containers retain residue and may be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, or other sources of ignition. They may explode and cause injury or death. "Empty" drums should be completely drained, properly bunged, and promptly shipped to the supplier or a drum reconditioner. All containers should be disposed of in an environmentally safe manner and in accordance with governmental regulations. Before working on or in tanks which contain or have contained this material, refer to OSHA regulations, ANSI Z49.1, and other references pertaining to cleaning, repairing, welding, or other contemplated operations.

SECTION 8: Exposure controls/personal protection

Occupational exposure limits
The following constituents are the only constituents of the product which have a PEL, TLV or other recommended exposure limit. At this time, the other constituents have no known exposure limits.

Chemical Name	ACGIH	OSHA	Mexico	Phillips 66
Distillates, petroleum, solvent-dewaxed heavy paraffinic	TWA: 5mg/m^3 STEL: 10 mg/m^3 as Oil Mist, if Generated	---	---	---
Distillates, petroleum, solvent-refined light paraffinic	TWA: 5mg/m^3 STEL: 10 mg/m^3 as Oil Mist, if Generated	---	---	---

Note: State, local or other agencies or advisory groups may have established more stringent limits. Consult an industrial hygienist or similar professional, or your local agencies, for further information.

Biological occupational exposure limits
Note: This product, as supplied, does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies

Engineering controls: If current ventilation practices are not adequate to maintain airborne concentrations below the established exposure limits, additional engineering controls may be required.

Eye/Face Protection: The use of eye/face protection is not normally required; however, good industrial hygiene practice suggests the use of eye protection that meets or exceeds ANSI Z.87.1 whenever working with chemicals.

Skin/Hand Protection: The use of skin protection is not normally required; however, good industrial hygiene practice suggests the use of gloves or other appropriate skin protection whenever working with chemicals. Suggested protective materials: Nitrile rubber

Respiratory Protection: Where there is potential for airborne exposure above the exposure limit a NIOSH certified air purifying respirator equipped with R or P95 filters may be used.

A respiratory protection program that meets or is equivalent to OSHA 29 CFR 1910.134 and ANSI Z88.2 should be followed whenever workplace conditions warrant a respirator's use. Air purifying respirators provide limited protection and cannot be used in atmospheres that exceed the maximum use concentration (as directed by regulation or the manufacturer's instructions), in oxygen deficient (less than 19.5 percent oxygen) situations, or under conditions that are immediately dangerous to life and health (IDLH).

Suggestions provided in this section for exposure control and specific types of protective equipment are based on readily available information. Users should consult with the specific manufacturer to confirm the performance of their protective equipment. Specific situations may require consultation with industrial hygiene, safety, or engineering professionals.

SECTION 9: Physical and chemical properties

Note: Unless otherwise stated, values are determined at 20°C (68°F) and 760 mm Hg (1 atm). Data represent typical values and are not intended to be specifications.

Appearance: Amber, Transparent
Physical Form: Liquid
Odor: Petroleum
Odor Threshold: No data
pH: Not applicable
Vapor Density (air=1): >1
Upper Explosive Limits (vol % in air): No data
Lower Explosive Limits (vol % in air): No data
Evaporation Rate (nBuAc=1): No data
Particle Size: Not applicable
Percent Volatile: No data
Flammability (solid, gas): Not applicable
Solubility in Water: Insoluble

Flash Point: > 410 °F / > 210 °C
Test Method: Cleveland Open Cup (COC), ASTM D92
Initial Boiling Point/Range: No data
Vapor Pressure: No data
Partition Coefficient (n-octanol/water) (Kow): No data
Melting/Freezing Point: No data
Auto-ignition Temperature: No data
Decomposition Temperature: No data
Specific Gravity (water=1): 0.89 @ 60°F (15.6°C)
Bulk Density: 7.4 lbs/gal
Viscosity: 5.4 cSt @ 100°C; 32 cSt @ 40°C
Pour Point: < -4 °F / < -20 °C

SECTION 10: Stability and reactivity

Reactivity: Not chemically reactive.

Chemical stability: Stable under normal ambient and anticipated conditions of use.

Possibility of hazardous reactions: Hazardous reactions not anticipated.

Conditions to avoid: Extended exposure to high temperatures can cause decomposition. Avoid all possible sources of ignition.

Incompatible materials: Avoid contact with strong oxidizing agents and strong reducing agents.

Hazardous decomposition products: Not anticipated under normal conditions of use.

SECTION 11: Toxicological information

Information on Toxicological Effects

Substance / Mixture

Acute Toxicity	Hazard	Additional Information	LC50/LD50 Data
Inhalation	Unlikely to be harmful		>5 mg/L (mist, estimated)
Dermal	Unlikely to be harmful		> 2 g/kg (estimated)
Oral	Unlikely to be harmful		> 5 g/kg (estimated)

Likely Routes of Exposure: Inhalation, eye contact, skin contact

Aspiration Hazard: Not expected to be an aspiration hazard

Skin Corrosion/Irritation: Not expected to be irritating. Repeated exposure may cause skin dryness or cracking.

Serious Eye Damage/Irritation: Not expected to be irritating.

Skin Sensitization: Not expected to be a skin sensitizer.

Respiratory Sensitization: No information available.

Specific Target Organ Toxicity (Single Exposure): No information available on the mixture, however none of the components have been classified for target organ toxicity (or are below the concentration threshold for classification).

Specific Target Organ Toxicity (Repeated Exposure): Not expected to cause organ effects from repeated exposure.

Carcinogenicity: No information available on the mixture, however none of the components have been classified for carcinogenicity (or are below the concentration threshold for classification).

Germ Cell Mutagenicity: Not expected to cause heritable genetic effects.

Reproductive Toxicity: No information available on the mixture, however none of the components have been classified for reproductive toxicity (or are below the concentration threshold for classification).

Information on Toxicological Effects of Components

Lubricant Base Oil (Petroleum)

Carcinogenicity: The petroleum base oils contained in this product have been highly refined by a variety of processes including severe hydrocracking/hydroprocessing to reduce aromatics and improve performance characteristics. All of the oils meet the IP-346 criteria of less than 3 percent PAH's and are not considered carcinogens by NTP, IARC, or OSHA.

SECTION 12: Ecological information

GHS Classification:
No classified hazards

Toxicity: All acute aquatic toxicity studies on samples of lubricant base oils show acute toxicity values greater than 100 mg/L for invertebrates, algae and fish. These tests were carried out on water accommodated fractions and the results are consistent with the predicted aquatic toxicity of these substances based on their hydrocarbon compositions.

Persistence and Degradability: The hydrocarbons in this material are not readily biodegradable, but since they can be degraded by microorganisms, they are regarded as inherently biodegradable.

Bioaccumulative Potential: Log Kow values measured for the hydrocarbon components of this material are greater than 5.3, and therefore regarded as having the potential to bioaccumulate. In practice, metabolic processes may reduce bioconcentration.

Mobility in Soil: Volatilization to air is not expected to be a significant fate process due to the low vapor pressure of this material. In water, base oils will float and spread over the surface at a rate dependent upon viscosity. There will be significant removal of hydrocarbons from the water by sediment adsorption. In soil and sediment, hydrocarbon components will show low mobility with adsorption to sediments being the predominant physical process. The main fate process is expected to be slow biodegradation of the hydrocarbon constituents in soil and sediment.

Other adverse effects: None anticipated.

SECTION 13: Disposal considerations

The generator of a waste is always responsible for making proper hazardous waste determinations and needs to consider state and local requirements in addition to federal regulations. This material, if discarded as produced, would not be a federally regulated RCRA "listed" hazardous waste and is not believed to exhibit characteristics of hazardous waste. See Sections 7 and 8 for information on handling, storage and personal protection and Section 9 for physical/chemical properties. It is possible that the material as produced contains constituents which are not required to be listed in the SDS but could affect the hazardous waste determination. Additionally, use which results in chemical or physical change of this material could subject it to regulation as a hazardous waste.This material under most intended uses would become "Used Oil" due to contamination by physical or chemical impurities. Whenever possible, Recycle used oil in accordance with applicable federal and state or local regulations. Container contents should be completely used and containers should be emptied prior to discard.

SECTION 14: Transport information

U.S. Department of Transportation (DOT)
UN Number: Not regulated
UN proper shipping name: None
Transport hazard class(es): None
Packing Group: None
Environmental Hazards: This product does not meet the DOT/UN/IMDG/IMO criteria of a marine pollutant
Special precautions for user: If shipped by land in a packaging having a capacity of 3,500 gallons or more, the provisions of 49 CFR, Part 130 apply. (Contains oil)
Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code: Not applicable

SECTION 15: Regulatory information

CERCLA/SARA - Section 302 Extremely Hazardous Substances and TPQs (in pounds)
This material does not contain any chemicals subject to the reporting requirements of SARA 302 and 40 CFR 372.

CERCLA/SARA - Section 311/312 (Title III Hazard Categories)
Should this product meet EPCRA 311/312 Tier reporting criteria at 40 CFR 370, refer to Section 2 of this SDS for appropriate classifications.

CERCLA/SARA - Section 313 and 40 CFR 372
This material does not contain any chemicals subject to the reporting requirements of SARA 313 and 40 CFR 372.

EPA (CERCLA) Reportable Quantity (in pounds)
This material does not contain any chemicals with CERCLA Reportable Quantities.

California Proposition 65
This material does not contain any chemicals which are known to the State of California to cause cancer, birth defects or other reproductive harm at concentrations that trigger the warning requirements of California Proposition 65.

International Inventories
All components are either listed on the US TSCA Inventory, or are not regulated under TSCA.
All components are either on the DSL, or are exempt from DSL listing requirements.

SECTION 16: Other information

Issue Date:	Previous Issue Date:	SDS Number	Status:
01-May-2018	16-Feb-2018	LBPH778731	FINAL

Revised Sections or Basis for Revision:
Exposure limits (Section 8)

Legend (pursuant to NOM-018-STPS-2015):
The information within is considered correct but is not exhaustive and will be used for guidance only, which is based on the current knowledge of the substance or mixture and is applicable to the appropriate safety precautions for the product.

Guide to Abbreviations:
ACGIH = American Conference of Governmental Industrial Hygienists; CASRN = Chemical Abstracts Service Registry Number; CEILING = Ceiling Limit (15 minutes); CERCLA = The Comprehensive Environmental Response, Compensation, and Liability Act; EPA = Environmental Protection Agency; GHS = Globally Harmonized System; HPR = Hazardous Products Regulations; IARC = International Agency for Research on Cancer; INSHT = National Institute for Health and Safety at Work; IOPC = International Oil Pollution Compensation; LEL = Lower Explosive Limit; NE = Not Established; NFPA = National Fire Protection Association; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration; PEL = Permissible Exposure Limit (OSHA); SARA = Superfund Amendments and Reauthorization Act; STEL = Short Term Exposure Limit (15 minutes); TLV = Threshold Limit Value (ACGIH); TWA = Time Weighted Average (8 hours); UEL = Upper Explosive Limit; WHMIS = Worker Hazardous Materials Information System (Canada)

Disclaimer of Expressed and implied Warranties:
The information presented in this Safety Data Sheet is based on data believed to be accurate as of the date this Safety Data Sheet was prepared. HOWEVER, NO WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY OTHER WARRANTY IS EXPRESSED OR IS TO BE IMPLIED REGARDING THE ACCURACY OR COMPLETENESS OF THE INFORMATION PROVIDED ABOVE, THE RESULTS TO BE OBTAINED FROM THE USE OF THIS INFORMATION OR THE PRODUCT, THE SAFETY OF THIS PRODUCT, OR THE HAZARDS RELATED TO ITS USE. No responsibility is assumed for any damage or injury resulting from abnormal use or from any failure to adhere to recommended practices. The information provided above, and the product, are furnished on the condition that the person receiving them shall make their own determination as to the suitability of the product for their particular purpose and on the condition that they assume the risk of their use. In addition, no authorization is given nor implied to practice any patented invention without a license.

SAFETY DATA SHEET

1. Identification

Product identifier	**LPS® 2 (Aerosol)**
Other means of identification	
Part Number	00216
Recommended use	An industrial lubricant designed to displace moisture from equipment, provide heavy-duty lubrication and rust prevention.
Recommended restrictions	None known.

Manufacturer/Importer/Supplier/Distributor information

Manufacturer

Manufacturer

Company name	ITW Pro Brands
Address	4647 Hugh Howell Rd. Tucker, GA 30084
Country	(U.S.A.)
	Tel: +1 770-243-8800
In Case of Emergency	1-800-424-9300 (inside U.S.) +001 703-527-3887 (outside U.S.)
Website	www.lpslabs.com
E-mail	lpssds@itwprobrands.com

2. Hazard(s) identification

Physical hazards	Flammable aerosols	Category 1
	Gases under pressure	Compressed gas
Health hazards	Not classified.	
Environmental hazards	Not classified.	
OSHA defined hazards	Not classified.	

Label elements

Signal word	Danger
Hazard statement	Extremely flammable aerosol. Contains gas under pressure; may explode if heated.
Precautionary statement	
Prevention	Keep away from heat/sparks/open flames/hot surfaces. - No smoking. Do not spray on an open flame or other ignition source. Pressurized container: Do not pierce or burn, even after use.
Response	Wash hands after handling.
Storage	Protect from sunlight. Store in a well-ventilated place. Do not expose to temperatures exceeding 50°C/122°F.
Disposal	Dispose of waste and residues in accordance with local authority requirements.
Hazard(s) not otherwise classified (HNOC)	Combustible.
Supplemental information	None known.

3. Composition/information on ingredients

Mixtures

Chemical name	Common name and synonyms	CAS number	%
Distillates Petroleum Hydrotreated Light		64742-47-8	70 - 80
Petroleum Oil		64742-52-5	10 - 20
Carbon Dioxide		124-38-9	1 - 5

4. First-aid measures

Inhalation Move to fresh air. Call a physician if symptoms develop or persist.

Skin contact No adverse effects due to skin contact are expected.

Eye contact No specific first aid measures noted

Ingestion Not likely, due to the form of the product.

Most important symptoms/effects, acute and delayed Direct contact with eyes may cause temporary irritation.

Indication of immediate medical attention and special treatment needed Provide general supportive measures and treat symptomatically.

General information Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. Fire-fighting measures

Suitable extinguishing media Water fog. Alcohol resistant foam. Dry chemical powder. Dry chemicals. Carbon dioxide (CO2).

Unsuitable extinguishing media Do not use water jet as an extinguisher, as this will spread the fire.

Specific hazards arising from the chemical Contents under pressure. Pressurized container may explode when exposed to heat or flame. During fire, gases hazardous to health may be formed.

Special protective equipment and precautions for firefighters Firefighters must use standard protective equipment including flame retardant coat, helmet with face shield, gloves, rubber boots, and in enclosed spaces, SCBA.

Fire fighting equipment/instructions In case of fire. Stop leak if safe to do so. Do not move cargo or vehicle if cargo has been exposed to heat. Move containers from fire area if you can do so without risk. Cool containers exposed to heat with water spray and remove container, if no risk is involved. Containers should be cooled with water to prevent vapor pressure build up. For massive fire in cargo area, use unmanned hose holder or monitor nozzles, if possible. If not, withdraw and let fire burn out.

Specific methods Use standard firefighting procedures and consider the hazards of other involved materials. Move containers from fire area if you can do so without risk. In the event of fire and/or explosion do not breathe fumes.

General fire hazards Extremely flammable aerosol. Contents under pressure. Pressurized container may explode when exposed to heat or flame. Combustible.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures Keep unnecessary personnel away. Keep people away from and upwind of spill/leak. Keep out of low areas. Many gases are heavier than air and will spread along ground and collect in low or confined areas (sewers, basements, tanks). Wear appropriate protective equipment and clothing during clean-up. Emergency personnel need self-contained breathing equipment. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Ventilate closed spaces before entering them. Local authorities should be advised if significant spillages cannot be contained. Use personal protection recommended in Section 8 of the SDS.

Methods and materials for containment and cleaning up Refer to attached safety data sheets and/or instructions for use. Stop leak if you can do so without risk. Use water spray to reduce vapors or divert vapor cloud drift. Isolate area until gas has dispersed. Eliminate all ignition sources (no smoking, flares, sparks, or flames in immediate area). Keep combustibles (wood, paper, oil, etc.) away from spilled material. For waste disposal, see section 13 of the SDS.

Environmental precautions Avoid discharge into drains, water courses or onto the ground.

7. Handling and storage

Precautions for safe handling Pressurized container: Do not pierce or burn, even after use. Do not use if spray button is missing or defective. Do not spray on a naked flame or any other incandescent material. Do not smoke while using or until sprayed surface is thoroughly dry. Do not cut, weld, solder, drill, grind, or expose containers to heat, flame, sparks, or other sources of ignition. All equipment used when handling the product must be grounded. Do not re-use empty containers. Avoid prolonged or repeated contact with skin. Avoid prolonged exposure. Use only in well-ventilated areas. Wear appropriate personal protective equipment. Observe good industrial hygiene practices.

Conditions for safe storage, including any incompatibilities

Level 3 Aerosol.

Pressurized container. Protect from sunlight and do not expose to temperatures exceeding 50°C/122 °F. Do not puncture, incinerate or crush. Do not handle or store near an open flame, heat or other sources of ignition. This material can accumulate static charge which may cause spark and become an ignition source. Store in a well-ventilated place. Stored containers should be periodically checked for general condition and leakage Store away from incompatible materials (see Section 10 of the SDS). Level 3 Aerosol.

8. Exposure controls/personal protection

Occupational exposure limits

The following constituents are the only constituents of the product which have a PEL, TLV or other recommended exposure limit. At this time, the other constituents have no known exposure limits.

U.S. - OSHA

Components	Type	Value	Form
Distillates Petroleum Hydrotreated Light (CAS 64742-47-8)	PEL	5 mg/m3	Oil mist
Petroleum Oil (CAS 64742-52-5)	PEL	5 mg/m3	Oil mist
White Mineral Oil (CAS 8042-47-5)	TWA	5 mg/m3	Oil mist.

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value
Carbon Dioxide (CAS 124-38-9)	PEL	9000 mg/m3
		5000 ppm

ACGIH

Components	Type	Value	Form
Distillates Petroleum Hydrotreated Light (CAS 64742-47-8)	TWA	5 mg/m3	Oil mist
Petroleum Oil (CAS 64742-52-5)	TWA	5 mg/m3	Oil mist
White Mineral Oil (CAS 8042-47-5)	TWA	5 mg/m3	Respirable fraction.

US. ACGIH Threshold Limit Values

Components	Type	Value
2-Methyl Butyl Acetate (CAS 624-41-9)	STEL	100 ppm
	TWA	50 ppm
Carbon Dioxide (CAS 124-38-9)	STEL	30000 ppm
	TWA	5000 ppm

U.S. - NIOSH

Components	Type	Value	Form
White Mineral Oil (CAS 8042-47-5)	TWA	5 mg/m3	Mist.

US. NIOSH: Pocket Guide to Chemical Hazards

Components	Type	Value
Carbon Dioxide (CAS 124-38-9)	STEL	54000 mg/m3
		30000 ppm
	TWA	9000 mg/m3
		5000 ppm

Biological limit values

No biological exposure limits noted for the ingredient(s).

Appropriate engineering controls

Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level.

Individual protection measures, such as personal protective equipment	
Eye/face protection	Wear safety glasses with side shields (or goggles).
Skin protection	
Hand protection	Wear appropriate chemical resistant gloves.
Other	Wear suitable protective clothing.
Respiratory protection	If permissible levels are exceeded use NIOSH mechanical filter / organic vapor cartridge or an air-supplied respirator.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
General hygiene considerations	When using do not smoke. Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

Appearance	
Physical state	Gas.
Form	Aerosol.
Color	Brown.
Odor	Slight petroleum odor. Cherry.
Odor threshold	Not established
pH	Not applicable
Melting point/freezing point	< -58 °F (< -50 °C)
Initial boiling point and boiling range	383 °F (195 °C) @ 101 kPa
Flash point	174.2 °F (79 0 °C) Tag Closed Cup (dispensed liquid)
Evaporation rate	< 0.1 BuAc
Flammability (solid, gas)	Flammable gas.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	0.6 %
Flammability limit - upper (%)	7 %
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available
Vapor pressure	< 0.05 mm Hg @ 20°C (dispensed liquid)
Vapor density	4.7 (air = 1)
Relative density	Not available.
Solubility(ies)	
Solubility (water)	< 3 %
Partition coefficient (n-octanol/water)	< 1
Auto-ignition temperature	> 442.4 °F (> 228 °C)
Decomposition temperature	Not established
Viscosity	< 7 cSt
Viscosity temperature	77 °F (25 °C)
Other information	
Explosive properties	Not explosive
Heat of combustion	> 30 kJ/g
Oxidizing properties	Not oxidizing
Percent volatile	92 - 95 %
Specific gravity	0.82 - 0.86 @ 20°C

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Material is stable under normal conditions.
Possibility of hazardous reactions	Hazardous polymerization does not occur.
Conditions to avoid	Heat. Avoid temperatures exceeding the flash point. Contact with incompatible materials.
Incompatible materials	Strong oxidizing agents.
Hazardous decomposition products	Carbon oxides.

11. Toxicological information

Information on likely routes of exposure

Inhalation	Prolonged inhalation may be harmful
Skin contact	No adverse effects due to skin contact are expected.
Eye contact	Direct contact with eyes may cause temporary irritation.
Ingestion	Expected to be a low ingestion hazard.
Symptoms related to the physical, chemical and toxicological characteristics	Direct contact with eyes may cause temporary irritation.

Information on toxicological effects

Acute toxicity Not expected to be acutely toxic.

Components	Species	Test Results
Distillates Petroleum Hydrotreated Light (CAS 64742-47-8)		
Acute		
Dermal		
LD50	Rabbit	> 2000 mg/kg
Inhalation		
Vapor		
LC50	Rat	> 4.5 mg/l, 4 Hours
Petroleum Oil (CAS 64742-52-5)		
Acute		
Dermal		
LD50	Rabbit	> 2000 mg/kg
Inhalation		
LC50	Rat	> 3.9 mg/l, 4 Hours
Oral		
LD50	Rat	> 2000 mg/kg
White Mineral Oil (CAS 8042-47-5)		
Acute		
Dermal		
LD50	Rabbit	> 2000 mg/kg, 24 Hours
Inhalation		
LC50	Rat	2.18 mg/l, 4 Hours

Skin corrosion/irritation	Prolonged skin contact may cause temporary irritation.
Serious eye damage/eye irritation	Direct contact with eyes may cause temporary irritation.
Respiratory or skin sensitization	
Respiratory sensitization	Not a respiratory sensitizer.
Skin sensitization	This product is not expected to cause skin sensitization.
Germ cell mutagenicity	No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.
Carcinogenicity	This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA.

IARC Monographs. Overall Evaluation of Carcinogenicity

Not listed.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not regulated.

US. National Toxicology Program (NTP) Report on Carcinogens

Not listed.

Reproductive toxicity	This product is not expected to cause reproductive or developmental effects.
Specific target organ toxicity - single exposure	Not classified.
Specific target organ toxicity - repeated exposure	Not classified.
Aspiration hazard	Not likely, due to the form of the product.
Chronic effects	Prolonged inhalation may be harmful.
Further information	None known.

12. Ecological information

Ecotoxicity The product is not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.

Components		Species	Test Results
Distillates Petroleum Hydrotreated Light (CAS 64742-47-8)			
Aquatic			
Fish	LC50	Rainbow trout,donaldson trout (Oncorhynchus mykiss)	2.9 mg/l, 96 hours

Persistence and degradability

Bioaccumulative potential

Partition coefficient n-octanol / water (log Kow)

LPS® 2 (Aerosol) < 1

Mobility in soil	No data available.
Other adverse effects	None known.

13. Disposal considerations

Disposal instructions	Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Contents under pressure. Do not puncture, incinerate or crush. Dispose of contents/container in accordance with local/regional/national/international regulations.
Local disposal regulations	Dispose in accordance with all applicable regulations.
Hazardous waste code	The waste code should be assigned in discussion between the user, the producer and the waste disposal company. D003 Waste Reactive material
Waste from residues / unused products	Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).
Contaminated packaging	Since emptied containers may retain product residue, follow label warnings even after container is emptied. Empty containers should be taken to an approved waste handling site for recycling or disposal. Do not re-use empty containers.

14. Transport information

DOT

UN number	UN1950
UN proper shipping name	Aerosols, flammable
Transport hazard class(es)	
Class	2.1
Subsidiary risk	-
Label(s)	2.1
Packing group	Not available.
Environmental hazards	
Marine pollutant	No
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
Packaging exceptions	306

Packaging non bulk	None
Packaging bulk	None

IATA

UN number	UN1950
UN proper shipping name	Aerosols, flammable
Transport hazard class(es)	
Class	2.1
Subsidiary risk	-
Label(s)	2.1
Packing group	Not available.
Environmental hazards	No.
ERG Code	10L
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
Other information	
Passenger and cargo aircraft	Allowed with restrictions.
Cargo aircraft only	Allowed with restrictions.

IMDG

UN number	UN1950
UN proper shipping name	AEROSOLS, flammable
Transport hazard class(es)	
Class	2.1
Subsidiary risk	-
Label(s)	2.1
Packing group	Not available.
Environmental hazards	
Marine pollutant	No
EmS	Not available.
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code: Not applicable.

DOT

IATA; IMDG

General information: Avoid transport on vehicles where the load space is not separated from the driver's compartment. Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency. Before transporting product containers: Ensure that containers are firmly secured. Ensure cylinder valve is closed and not leaking. Ensure valve outlet cap nut or plug (where provided) is correctly fitted. Ensure valve protection device (where provided) is correctly fitted. Ensure adequate ventilation. Ensure compliance with applicable regulations.

15. Regulatory information

US federal regulations This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

SARA 304 Emergency release notification

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not regulated

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories Immediate Hazard - No
Delayed Hazard - No
Fire Hazard - Yes
Pressure Hazard - Yes
Reactivity Hazard - No

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical Yes

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA) Not regulated.

US state regulations WARNING: This product contains a chemical known to the State of California to cause cancer.

US. California. Candidate Chemicals List. Safer Consumer Products Regulations (Cal. Code Regs, tit. 22, 69502.3, subd. (a))

Petroleum Oil (CAS 64742-52-5)

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	No
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	No
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	No
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date 11-01-2016

Revision date	09-20-2017
Version #	02
Disclaimer	ITW Pro Brands cannot anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use. The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.
Revision information	This document has undergone significant changes and should be reviewed in its entirety.

SAF-T-LOK
International Corporation

Material Safety Data Sheet

SAF-T-EZE MOLY GRADE ANTI-SEIZE

Issue Date: 10/19/17

SECTION I - PRODUCT AND COMPANY INFORMATION

Product Name:	MOLY GRADE ANTI-SEIZE
Product Type:	Lubricating Grease
Part Numbers:	**80855, 80837, 80822, 80878, 80853, 6V-4876**
Hazard Rating:	Health: 1 Fire: 1 Reactivity: 0
Company Identification:	SAF-T-LOK International Corporation 300 EISENHOWER LANE NORTH LOMBARD, IL 60148
Contact:	Chris Michaels
Telephone/ Fax:	(630) 495-2001
Emergency Phone (24 Hour):	(703) 527-3887
Chemtrec (24 Hour):	(800) 424-9300, (703) 527-3887
Preparer:	Ind. Hygiene Department
Internet:	www.saftlok.com
Product Class:	Mixture
DOT Hazard Class:	N/A
Shipping Name:	Unrestricted

SECTION II - INGREDIENT AND HAZARD INFORMATION

Components	CAS Number	Percent
Graphite	7782-42-5	20 - 30
Hydrotreated Heavy Napthenic Distillate	64742-52-5	40 - 50
Molybdenum Disulfide	1317-33-5	20 - 30

SECTION III - HAZARD IDENTIFICATION AND EMERGENCY OVERVIEW

EMERGENCY OVERVIEW

		HMIS	
Physical appearance:	Paste	Health:	1
Physical color:	Black	Flammability:	1
Odor:	Mild / Inoffensive	Reactivity:	0
		Personal Protection:	B

WARNING; MAY CAUSE: EYE IRRITATION
SKIN IRRITATION
RESPIRATORY TRACT IRRITATION
MAY IRRITATE EXISTING ALLERGIC SKIN CONDITIONS

Relative routes of entry: Skin, Inhalation, Eyes, Ingestion

Skin Contact: Usually no effect, however, as with any chemical, prolonged, excessive, or repeated exposure may cause mild to moderate skin irritation, exhibited by redness, drying and cracking of unprotected skin.
Eye Contact: May irritate with slight pain and redness.

Respiratory/ Inhalation: Usually none, however, as with any chemical product, some irritation may occur.

Ingestion: Amounts transferred to mouth by fingers, etc, during normal operation should not cause injury.

Medical conditions generally aggravated by exposure: None known, however any chemical product may enhance allergies already present in certain individuals.

This product does not require exceptional labeling due to the evaluation procedure of the "General Classification guideline for preparations of the EU".

SECTION IV – FIRST AID INSTRUCTIONS

Skin Contact: Remove contaminated clothing. Wash affected area with soap and rinse with plenty of water. Get medical attention if symptoms occur. Wash clothing before reuse.

Eye Contact: Flush with water for at least 15 minutes holding eyelid open. Get medical attention if symptoms persist.

Respiratory / Inhalation: Remove to fresh air, if symptoms develop get medical attention.

Ingestion: Do not induce vomiting. Obtain medical attention if symptoms develop.

SECTION V – FIRE FIGHTING INSTRUCTIONS

Flash Point:	360°F (C.O.C.)
Unusual Fire and Explosion Hazards:	None
Flammable Limits:	LEL: N/A, UEL: N/A
Extinguishing Media:	Carbon Dioxide, Foam, Dry Chemicals
Fire Fighting Procedures:	Air mask and procedures for fighting chemical fires. Do not inhale gases.

SECTION VI -ACCIDENTAL RELEASE MEASURES

Special Precautions:	None known. Follow general precautions shown below.
Environmental precautions:	Prevent material from entering floor drains, sewers, or any bodies of water.
Clean up methods:	Scoop up into waste container or soak up with absorbent material. Store in a closed container until disposal. Dispose of material according to regulations.

SECTION VII - HANDLING AND STORAGE

Handling:	No special precautions necessary if used properly Avoid contact with eyes, skin, and clothing. Avoid breathing vapors. Wash hands thoroughly at mealtime and end of shift.

Storage:	Isolated storage facility/ warehouse not required. Store in a cool, dry location (60-90°F) in a well-ventilated area in original container. Keep container tightly closed when not in use.
Personal Protection:	Wear personal protective equipment as outlined in Section VIII of this MSDS.

SECTION VIII – EXPOSURE CONTROLS AND PERSONAL PROTECTION

Respiratory Protection:	No respiratory protection required, but normal good ventilation is recommended. Forced ventilation may be required if concentrations exceed normal use exposure.
Skin Protection:	Not required, but if desired, use impermeable gloves (neoprene, butyl rubber, natural rubber), as necessary to avoid skin contact, as well as proper clothing or plastic apron. Wash hands before eating, drinking, or using restroom.
Eye Protection:	Not required if application method is proper. Avoid contact with eyes.
Eye Washes:	Eye wash stations should be located within 100 feet or 10 second walk of the work area.

SECTION IX - PHYSICAL AND CHEMICAL PROPERTIES

Physical state:	Paste
Color:	Black
Odor:	Mild/ Inoffensive
Boiling Point:	600°F (316°C)
Melting Point	Not determined
Flash Point	360°F
Self-inflammability	Is not self-igniting
Explosion danger	Not explosive
Specific Gravity:	1.4
Vapor Density (Air = 1):	N/D
Vapor Pressure (mm Hg.):	< 0.1 @70°F
pH:	Not determined
Evaporation Rate:	Not determined
Solubility in Water:	Insoluble
VOC (Organic solvents)	0.1%
Percent Solids:	50

SECTION X –STABILITY AND REACTIVITY

Stability:	Stable
Hazardous Polymerization:	Will not occur
Hazardous decomposition byproducts:	None if used and stored according to specifications
Conditions to avoid	Strong oxidizing agents

SECTION XI – TOXICOLOGICAL INFORMATION

No harmful effects have been determined if product is used and handled according to specifications.

This product is not subject to classification according to the calculation method of the General EC Classification Guidelines for Preparations.

Sensitization	None known
Eye Irritant	Not determined
Skin Irritant	Not determined
Carcinogen	No

SECTION XII – ECOLOGICAL DATA

Water Hazard:	Do not allow entry into drains or surface water Class 2 per German Regulation

SECTION XIII – DISPOSAL CONSIDERATIONS

Recommended method of disposal:	Small quantities can be disposed with normal household waste. Disposal must be made according to official regulations.
EPA Hazardous Waste Number;	Not an RCRA hazardous waste.

SECTION XIV – SHIPPING AND TRANSPORTATION INFORMATION

U.S. Department of Transportation Ground (49 CFR

Proper Shipping Name:	Unrestricted
Hazard Class or Division:	None
Identification Number:	None
Packing Group:	None

International Air Transportation (OCAO/IATA):

Proper Shipping Name:	Unrestricted
Hazard Class or Division:	None
Identification Number:	None
Packing Group:	None

Water Transportation (IMO/IMDG):

Proper Shipping Name:	Environmentaly hazardous substance, liquid, N.O. S.
Hazard Class or Division:	IMDG Class 9
Identification Number:	None
Packing Group:	None
Marine Pollutant:	Yes

ADR/RID-GGVS/E Class (cross border) Unrestricted

SECTION XV – REGULATORY INFORMATION

United States Regulatory Information
TSCA 8 (b) Inventory Status: All components are listed or are exempt from listing on the Toxic Substances Control Act Inventory

Canada Regulatory Information
CEPA DSL/NDSL Status: All components are listed on or are exempt from listing on the Domestic Substances List.

SECTION XVI – OTHER INFORMATION

Revision date: 10/19/17
By: Human Resource Department

DISCLAIMER: The information on this material safety data sheet represents our current data and best opinion as to the proper use in handling of this product under normal conditions. Any use of the product which is not in conformance with this data sheet or which involves using the product in combination with any other product or any other process is the responsibility of the user. SAF-T-LOK International Corporation specifically disclaims all warranties, express or implied, including warranties of merchantability and fitness for a particular purpose, arising from sale or use of SAF-T-LOK International Corporation products.

Safety Data Sheet

According to OSHA HCS 2012 (29 CFR 1910.1200), Health Canada HPR (SOR/2015-17), and Mexico NOM-018-STPS-2015

SECTION 1: Identification

Product Identifier	**Polytac® EP**
Other means of identification	Phillips 66® Polytac® EP #2
Code	**831644**
Issue date	30-Aug-2018
Relevant identified uses	Lubricating Grease
Uses advised against	All others
24 Hour Emergency Phone Number	CHEMTREC: 1-800-424-9300 CHEMTREC México 01-800-681-9531 CHEMTREC Global +1 703 527 3887

Manufacturer/Supplier
Phillips 66 Lubricants
P.O. Box 4428
Houston, TX 77210

SDS Information
URL: www.phillips66.com/SDS
Phone: 800-762-0942
Email: SDS@P66.com

Customer Service
U.S.: 800-368-7128 or International: 1-832-765-2500
Technical Information
1-877-445-9198

SECTION 2: Hazard identification

Classified Hazards

H412 -- Hazardous to the aquatic environment, chronic toxicity -- Category 3

Hazards Not Otherwise Classified (HNOC)

PHNOC: None known

HHNOC: None known

Label elements

Harmful to aquatic life with long lasting effects

Avoid release to the environment; Dispose of contents/container to an approved waste disposal plant

SECTION 3: Composition/information on ingredients

Chemical Name	CASRN	Concentration
Distillates, petroleum, hydrotreated heavy naphthenic	64742-52-5	<50
Lubricant Base Oil (Petroleum)	VARIOUS	<30
1H-Imidazole-1-ethanol, 4,5-dihydro-, 2-nortall-oil alkyl derivatives	61791-39-7	0.5
N-1-naphthylaniline	90-30-2	0.5

[1] All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

SECTION 4: First aid measures

Eye Contact: If irritation or redness develops from exposure, flush eyes with clean water. If symptoms persist, seek medical attention.

Skin Contact: Remove contaminated shoes and clothing and cleanse affected area(s) thoroughly by washing with mild soap and water or a waterless hand cleaner. If irritation or redness develops and persists, seek medical attention. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician. (see Note to Physician)

Inhalation: First aid is not normally required. If breathing difficulties develop, move victim away from source of exposure and into fresh air in a position comfortable for breathing. Seek immediate medical attention.

Ingestion: First aid is not normally required; however, if swallowed and symptoms develop, seek medical attention.

Most important symptoms and effects, both acute and delayed: Inhalation of oil mists or vapors generated at elevated temperatures may cause respiratory irritation. Accidental ingestion can result in minor irritation of the digestive tract, nausea and diarrhea. Prolonged or repeated contact may dry skin and cause irritation.

Notes to Physician: When using high-pressure equipment, injection of product under the skin can occur. In this case, the casualty should be sent immediately to the hospital. Do not wait for symptoms to develop. High-pressure hydrocarbon injection injuries may produce substantial necrosis of underlying tissue despite an innocuous appearing external wound. These injuries often require extensive emergency surgical debridement and all injuries should be evaluated by a specialist in order to assess the extent of injury. Early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

SECTION 5: Firefighting measures

NFPA 704: National Fire Protection Association

Health: 0 **Flammability:** 1 **Instability:** 0

0 = minimal hazard
1 = slight hazard
2 = moderate hazard
3 = severe hazard
4 = extreme hazard

Extinguishing Media: Dry chemical, carbon dioxide, foam, or water spray is recommended. Water or foam may cause frothing of materials heated above 212°F / 100°C. Carbon dioxide can displace oxygen. Use caution when applying carbon dioxide in confined spaces. Simultaneous use of foam and water on the same surface is to be avoided as water destroys the foam.

Specific hazards arising from the chemical

Unusual Fire & Explosion Hazards: This material may burn, but will not ignite readily. If container is not properly cooled, it can rupture in the heat of a fire.

Hazardous Combustion Products: Combustion may yield smoke, carbon monoxide, and other products of incomplete combustion. Oxides of sulfur, nitrogen or phosphorus may also be formed.

Special protective actions for fire-fighters: For fires beyond the initial stage, emergency responders in the immediate hazard area should wear protective clothing. When the potential chemical hazard is unknown, in enclosed or confined spaces, a self contained breathing apparatus should be worn. In addition, wear other appropriate protective equipment as conditions warrant (see Section 8). Isolate the hazard area and deny entry to unnecessary and unprotected personnel. Stop spill/release if it can be done safely. Move undamaged containers from immediate hazard area if it can be done safely. Water spray may be useful in minimizing or dispersing vapors and to protect personnel. Cool equipment exposed to fire with water, if it can be done safely. Avoid spreading burning liquid with water used for cooling purposes.

See Section 9 for Flammable Properties including Flash Point and Flammable (Explosive) Limits

SECTION 6: Accidental release measures

Personal precautions, protective equipment and emergency procedures: This material may burn, but will not ignite readily. Keep all sources of ignition away from spill/release. Stay upwind and away from spill/release. Avoid direct contact with material. For large spillages, notify persons down wind of the spill/release, isolate immediate hazard area and keep unauthorized personnel out. Wear appropriate protective equipment, including respiratory protection, as conditions warrant (see Section 8). See Sections 2 and 7 for additional information on hazards and precautionary measures.

Environmental Precautions: Stop and contain spill/release if it can be done safely. Prevent spilled material from entering sewers,

storm drains, other unauthorized drainage systems, and natural waterways. Use water sparingly to minimize environmental contamination and reduce disposal requirements. If spill occurs on water notify appropriate authorities and advise shipping of any hazard. Spills into or upon navigable waters, the contiguous zone, or adjoining shorelines that cause a sheen or discoloration on the surface of the water, may require notification of the National Response Center (phone number 800-424-8802).

Methods and material for containment and cleaning up: Notify relevant authorities in accordance with all applicable regulations. Immediate cleanup of any spill is recommended. Dike far ahead of spill for later recovery or disposal. Absorb spill with inert material such as sand or vermiculite, and place in suitable container for disposal. If spilled on water remove with appropriate methods (e.g. skimming, booms or absorbents). In case of soil contamination, remove contaminated soil for remediation or disposal, in accordance with local regulations.

Recommended measures are based on the most likely spillage scenarios for this material; however local conditions and regulations may influence or limit the choice of appropriate actions to be taken. See Section 13 for information on appropriate disposal.

SECTION 7: Handling and storage

Precautions for safe handling: Keep away from flames and hot surfaces. Wash thoroughly after handling. Use good personal hygiene practices and wear appropriate personal protective equipment (see section 8). Spills will produce very slippery surfaces. High pressure injection of hydrocarbon fuels, hydraulic oils or greases under the skin may have serious consequences even though no symptoms or injury may be apparent. This can happen accidentally when using high pressure equipment such as high pressure grease guns, fuel injection apparatus or from pinhole leaks in tubing of high pressure hydraulic oil equipment.

Do not enter confined spaces such as tanks or pits without following proper entry procedures such as ASTM D-4276 and 29CFR 1910.146. Do not wear contaminated clothing or shoes.

Conditions for safe storage: Keep container(s) tightly closed and properly labeled. Use and store this material in cool, dry, well-ventilated area away from heat and all sources of ignition. Store only in approved containers. Keep away from any incompatible material (see Section 10). Protect container(s) against physical damage.

"Empty" containers retain residue and may be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, or other sources of ignition. They may explode and cause injury or death. "Empty" drums should be completely drained, properly bunged, and promptly shipped to the supplier or a drum reconditioner. All containers should be disposed of in an environmentally safe manner and in accordance with governmental regulations. Before working on or in tanks which contain or have contained this material, refer to OSHA regulations, ANSI Z49.1, and other references pertaining to cleaning, repairing, welding, or other contemplated operations.

SECTION 8: Exposure controls/personal protection

Occupational exposure limits
The following constituents are the only constituents of the product which have a PEL, TLV or other recommended exposure limit. At this time, the other constituents have no known exposure limits.

Chemical Name	ACGIH	OSHA	Mexico	Phillips 66
Distillates, petroleum, hydrotreated heavy naphthenic	TWA: 5mg/m^3 STEL: 10 mg/m^3 as Oil Mist, if Generated	---	---	---
Lubricant Base Oil (Petroleum)	TWA: 5mg/m^3 STEL: 10 mg/m^3 as Oil Mist, if Generated	---	---	---

Note: State, local or other agencies or advisory groups may have established more stringent limits. Consult an industrial hygienist or similar professional, or your local agencies, for further information.

Biological occupational exposure limits
Note: None

Engineering controls: If current ventilation practices are not adequate to maintain airborne concentrations below the established exposure limits, additional engineering controls may be required.

Eye/Face Protection: The use of eye/face protection is not normally required; however, good industrial hygiene practice suggests the use of eye protection that meets or exceeds ANSI Z.87.1 whenever working with chemicals.

Skin/Hand Protection: The use of skin protection is not normally required; however, good industrial hygiene practice suggests the

use of gloves or other appropriate skin protection whenever working with chemicals. Suggested protective materials: Nitrile rubber

Respiratory Protection: Where there is potential for airborne exposure above the exposure limit a NIOSH certified air purifying respirator equipped with R or P95 filters may be used. A respiratory protection program that meets or is equivalent to OSHA 29 CFR 1910.134 and ANSI Z88.2 should be followed whenever workplace conditions warrant a respirator's use. Air purifying respirators provide limited protection and cannot be used in atmospheres that exceed the maximum use concentration (as directed by regulation or the manufacturer's instructions), in oxygen deficient (less than 19.5 percent oxygen) situations, or under conditions that are immediately dangerous to life and health (IDLH).

Suggestions provided in this section for exposure control and specific types of protective equipment are based on readily available information. Users should consult with the specific manufacturer to confirm the performance of their protective equipment. Specific situations may require consultation with industrial hygiene, safety, or engineering professionals.

SECTION 9: Physical and chemical properties

Note: Unless otherwise stated, values are determined at 20°C (68°F) and 760 mm Hg (1 atm). Data represent typical values and are not intended to be specifications.

Appearance: Green
Physical Form: Semi-Solid
Odor: Petroleum
Odor Threshold: No data
pH: Not applicable
Vapor Density (air=1): >1
Upper Explosive Limits (vol % in air): No data
Lower Explosive Limits (vol % in air): No data
Evaporation Rate (nBuAc=1): <1
Particle Size: Not applicable
Percent Volatile: No data
Flammability (solid, gas): Not applicable
Solubility in Water: Insoluble

Flash Point: No data
Test Method: Not applicable
Initial Boiling Point/Range: No data
Vapor Pressure: No data
Partition Coefficient (n-octanol/water) (Kow): No data
Melting/Freezing Point: No data
Auto-ignition Temperature: No data
Decomposition Temperature: No data
Specific Gravity (water=1): 0.9 @ 60ºF (15.6ºC)
Bulk Density: 7.5 lbs/gal
Viscosity: No data
Pour Point: No data

SECTION 10: Stability and reactivity

Reactivity: Not chemically reactive.

Chemical stability: Stable under normal ambient and anticipated conditions of use.

Possibility of hazardous reactions: Hazardous reactions not anticipated.

Conditions to avoid: Extended exposure to high temperatures can cause decomposition. Avoid all possible sources of ignition.

Incompatible materials: Avoid contact with strong oxidizing agents and strong reducing agents.

Hazardous decomposition products: Not anticipated under normal conditions of use.

SECTION 11: Toxicological information

Information on Toxicological Effects

Substance / Mixture

Acute Toxicity	Hazard	Additional Information	LC50/LD50 Data
Inhalation	Unlikely to be harmful		>5 mg/L (mist, estimated)
Dermal	Unlikely to be harmful		> 2 g/kg (estimated)
Oral	Unlikely to be harmful		> 5 g/kg (estimated)

Likely Routes of Exposure: Inhalation, eye contact, skin contact

Aspiration Hazard: Not expected to be an aspiration hazard

Skin Corrosion/Irritation: Not expected to be irritating. Repeated exposure may cause skin dryness or cracking.

Serious Eye Damage/Irritation: Not expected to be irritating.

Skin Sensitization: No information available on the mixture, however none of the components have been classified for skin sensitization (or are below the concentration threshold for classification).

Respiratory Sensitization: No information available.

Specific Target Organ Toxicity (Single Exposure): No information available on the mixture, however none of the components have been classified for target organ toxicity (or are below the concentration threshold for classification).

Specific Target Organ Toxicity (Repeated Exposure): No information available on the mixture, however none of the components have been classified for target organ toxicity (or are below the concentration threshold for classification).

Carcinogenicity: No information available on the mixture, however none of the components have been classified for carcinogenicity (or are below the concentration threshold for classification).

Germ Cell Mutagenicity: No information available on the mixture, however none of the components have been classified for germ cell mutagenicity (or are below the concentration threshold for classification).

Reproductive Toxicity: No information available on the mixture, however none of the components have been classified for reproductive toxicity (or are below the concentration threshold for classification).

Information on Toxicological Effects of Components

Lubricant Base Oil (Petroleum)

Carcinogenicity: The petroleum base oils contained in this product have been highly refined by a variety of processes including severe hydrocracking/hydroprocessing to reduce aromatics and improve performance characteristics. All of the oils meet the IP-346 criteria of less than 3 percent PAH's and are not considered carcinogens by NTP, IARC, or OSHA.

SECTION 12: Ecological information

GHS Classification:
H412 -- Hazardous to the aquatic environment, chronic toxicity -- Category 3
Harmful to aquatic life with long lasting effects.

Toxicity: Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment

Persistence and Degradability: The hydrocarbons in this material are not readily biodegradable, but since they can be degraded by microorganisms, they are regarded as inherently biodegradable.

Bioaccumulative Potential: Log Kow values measured for the hydrocarbon components of this material are greater than 5.3, and therefore regarded as having the potential to bioaccumulate. In practice, metabolic processes may reduce bioconcentration.

Mobility in Soil: Volatilization to air is not expected to be a significant fate process due to the low vapor pressure of this material. In water, base oils will float and spread over the surface at a rate dependent upon viscosity. There will be significant removal of hydrocarbons from the water by sediment adsorption. In soil and sediment, hydrocarbon components will show low mobility with adsorption to sediments being the predominant physical process. The main fate process is expected to be slow biodegradation of the hydrocarbon constituents in soil and sediment.

Other adverse effects: None anticipated.

SECTION 13: Disposal considerations

The generator of a waste is always responsible for making proper hazardous waste determinations and needs to consider state and local requirements in addition to federal regulations. This material, if discarded as produced, would not be a federally regulated RCRA "listed" hazardous waste and is not believed to exhibit characteristics of hazardous waste. See Sections 7 and 8 for information on handling, storage and personal protection and Section 9 for physical/chemical properties. It is possible that the material as produced contains constituents which are not required to be listed in the SDS but could affect the hazardous waste determination. Additionally, use which results in chemical or physical change of this material could subject it to regulation as a hazardous waste.This material under most intended uses would become "Used Oil" due to contamination by physical or chemical impurities. Whenever possible, Recycle used oil in accordance with applicable federal and state or local regulations. Container contents should be completely used and containers should be emptied prior to discard.

SECTION 14: Transport information

UN Number: Not regulated
UN proper shipping name: None
Transport hazard class(es): None
Packing Group: None
Environmental Hazards: This product does not meet the DOT/UN/IMDG/IMO criteria of a marine pollutant
Special precautions for user: If shipped by land in a packaging having a capacity of 3,500 gallons or more, the provisions of 49 CFR, Part 130 apply. (Contains oil)
Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code: Not applicable

SECTION 15: Regulatory information

CERCLA/SARA - Section 302 Extremely Hazardous Substances and TPQs (in pounds)
This material does not contain any chemicals subject to the reporting requirements of SARA 302 and 40 CFR 372.

CERCLA/SARA - Section 311/312 (Title III Hazard Categories)
Should this product meet EPCRA 311/312 Tier reporting criteria at 40 CFR 370, refer to Section 2 of this SDS for appropriate classifications.

CERCLA/SARA - Section 313 and 40 CFR 372
This material does not contain any chemicals subject to the reporting requirements of SARA 313 and 40 CFR 372.

EPA (CERCLA) Reportable Quantity (in pounds)
This material does not contain any chemicals with CERCLA Reportable Quantities.

California Proposition 65
This material does not contain any chemicals which are known to the State of California to cause cancer, birth defects or other reproductive harm at concentrations that trigger the warning requirements of California Proposition 65.

International Inventories
All components are either listed on the US TSCA Inventory, or are not regulated under TSCA.
All components are either on the DSL, or are exempt from DSL listing requirements.

SECTION 16: Other information

Issue date	Previous Issue Date:	SDS Number	Status:
30-Aug-2018	22-Aug-2018	831644	FINAL

Revised Sections or Basis for Revision:
Environmental hazards (Section 12)

Legend (pursuant to NOM-018-STPS-2015):
The information within is considered correct but is not exhaustive and will be used for guidance only, which is based on the current knowledge of the substance or mixture and is applicable to the appropriate safety precautions for the product. Legend (pursuant to NOM-018-STPS-2015):

Precautionary Statements:
P273 - Avoid release to the environment
P501 - Dispose of contents/ container to an approved waste disposal plant

Guide to Abbreviations:
ACGIH = American Conference of Governmental Industrial Hygienists; CASRN = Chemical Abstracts Service Registry Number; CEILING = Ceiling Limit (15 minutes); CERCLA = The Comprehensive Environmental Response, Compensation, and Liability Act; EPA = Environmental Protection Agency; GHS = Globally Harmonized System; HPR = Hazardous Products Regulations; IARC = International Agency for Research on Cancer; INSHT = National Institute for Health and Safety at Work; IOPC = International Oil Pollution Compensation; LEL = Lower Explosive Limit; NE = Not Established; NFPA = National Fire Protection Association; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration; PEL = Permissible Exposure Limit (OSHA); SARA = Superfund Amendments and Reauthorization Act; STEL = Short Term Exposure Limit (15 minutes); TLV = Threshold Limit Value (ACGIH); TWA = Time Weighted Average (8 hours); UEL = Upper Explosive Limit; WHMIS = Worker Hazardous Materials Information System (Canada)

Disclaimer of Expressed and implied Warranties:
The information presented in this Safety Data Sheet is based on data believed to be accurate as of the date this Safety Data Sheet was prepared. HOWEVER, NO WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY OTHER WARRANTY IS EXPRESSED OR IS TO BE IMPLIED REGARDING THE ACCURACY OR COMPLETENESS OF THE INFORMATION PROVIDED ABOVE, THE RESULTS TO BE OBTAINED FROM THE USE OF THIS INFORMATION OR THE PRODUCT, THE SAFETY OF THIS PRODUCT, OR THE HAZARDS RELATED TO ITS USE. No responsibility is assumed for any damage or injury resulting from abnormal use or from any failure to adhere to recommended practices. The information provided above, and the product, are furnished on the condition that the person receiving them shall make their own determination as to the suitability of the product for their particular purpose and on the condition that they assume the risk of their use. In addition, no authorization is given nor implied to practice any patented invention without a license.


CLIMAX
BORTECH
CALDER
H&S TOOL