

ROTTLER

F69A CNC MACHINING CENTER

OPTIONAL EQUIPMENT PARTS MANUAL



RamSpeed.com.au

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ORDERING PROCEDURE

Contact your regional Rottler sales rep for assistance in ordering optional equipment, replacement parts, or tooling.

If you are unable to contact your regional Rottler sales rep, call the factory at 253-872-7050 and ask to speak to the parts sales specialist.

Have the following information handy to expedite the ordering process:

1. Your name, business name, and contact number
2. Customer number
3. If you don't have a customer number, your billing address
4. Shipping address if different from billing address
5. Machine model and serial number
6. Part number and description of what you want to order
7. Preferred method of shipment

You may also contact us via e-mail with the above information. Send e-mail requests to:
parts@rottermfg.com

In some cases you may be requested to send a photo of the part you are ordering if it is a replacement part, or doesn't appear in the database.

If you are unsure which part you need to order, contact our service department and ask to speak to one of our service consultants. They will assist you in determining which part you require.

THERE IS A MINIMUM ORDER OF \$25.00

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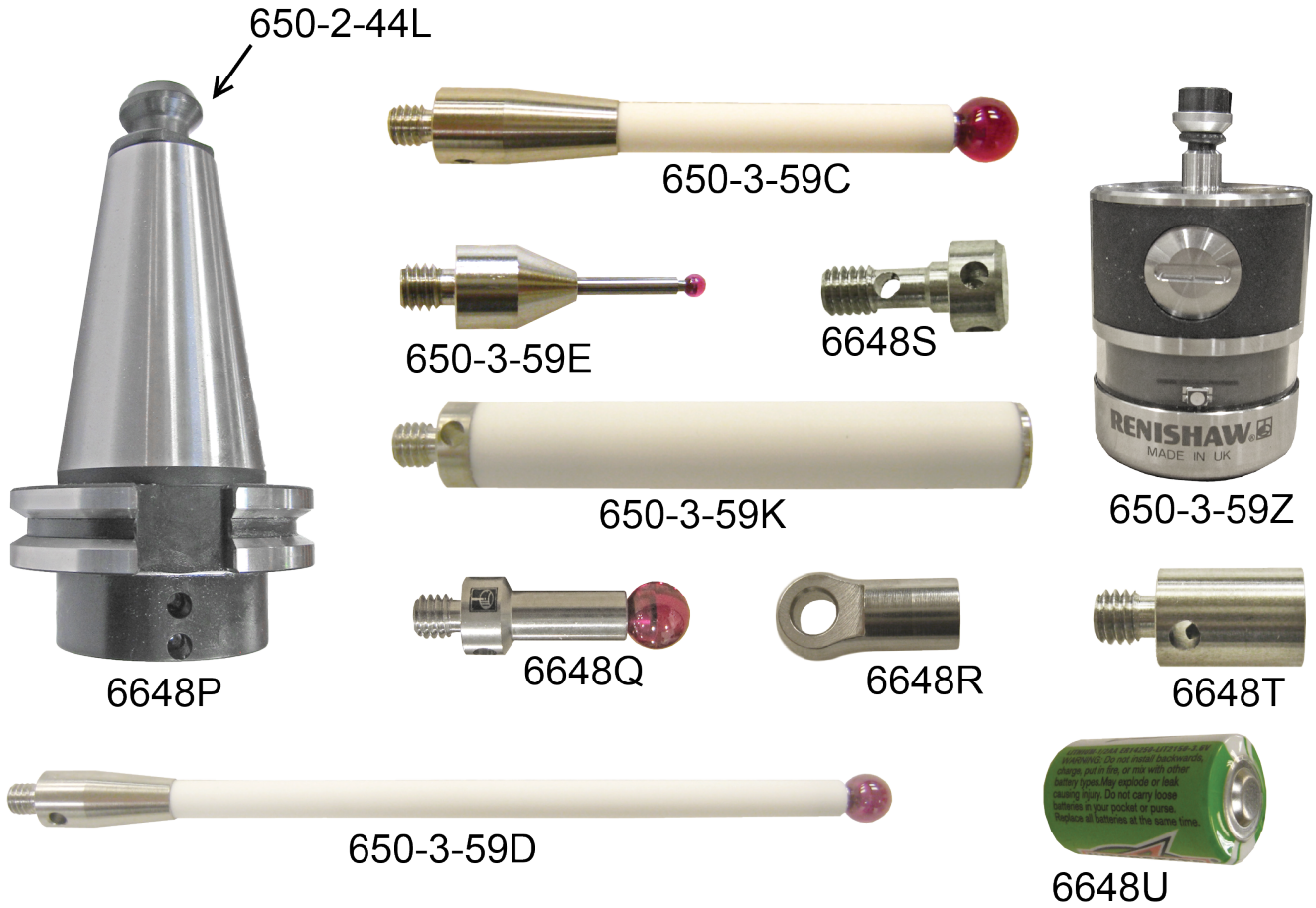
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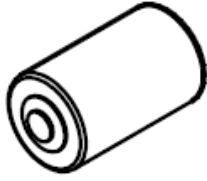
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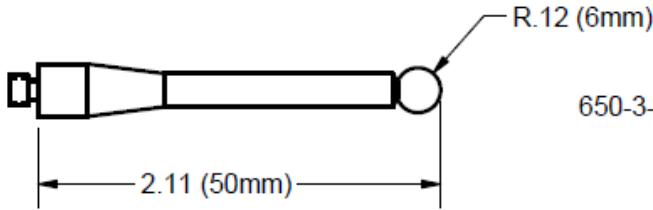
AUTOMATIC CENTERING

650-3-59Y Renishaw Wireless Probing System Replacement Parts

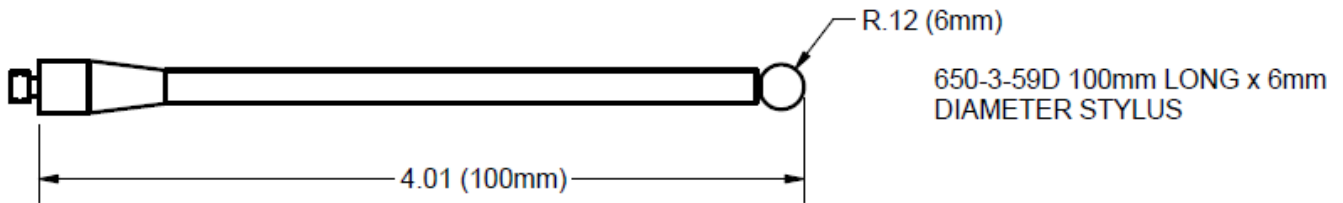




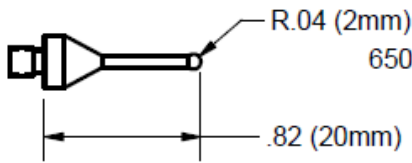
6648U SPARE BATTERY FOR RENISHAW PROBE (2 REQUIRED)



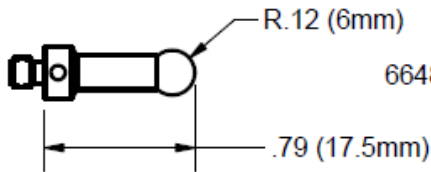
650-3-59C 50mm LONG x 6mm DIAMETER STYLUS



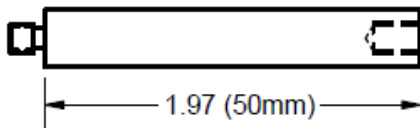
650-3-59D 100mm LONG x 6mm DIAMETER STYLUS



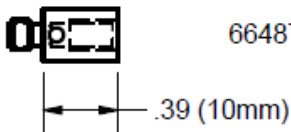
650-2-59E 20mm LONG x 2mm DIAMETER STYLUS



6648Q 17.5mm LONG x 6mm DIAMETER STYLUS



650-3-59K 50mm LONG EXTENSION FOR 50mm AND 100mm STYLI



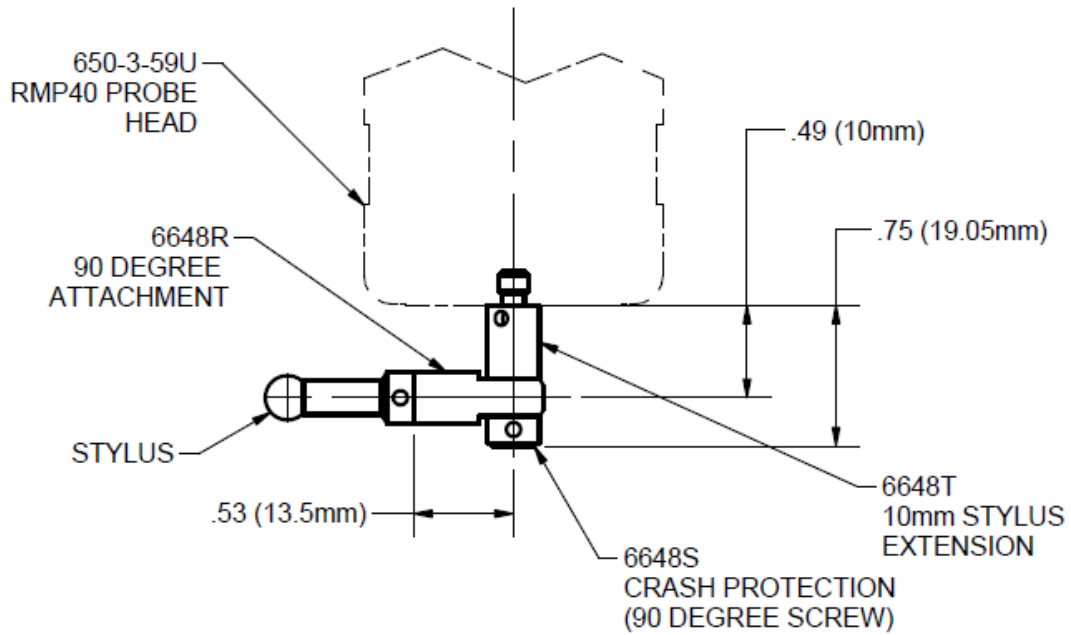
6648T 10mm LONG STYLUS EXTENSION



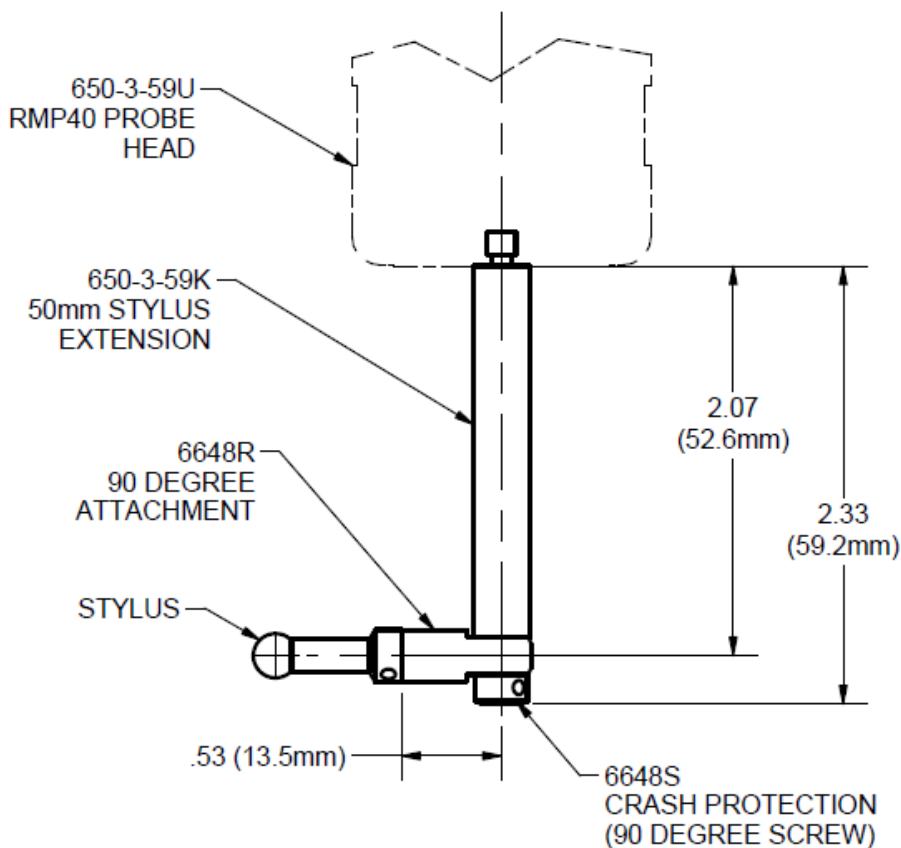
6648R 90 DEGREE STYLUS ATTACHMENT

Renishaw 90° Probe Mounting Combinations

90 DEGREE PROBE MOUNTING - SHORT COMBINATION

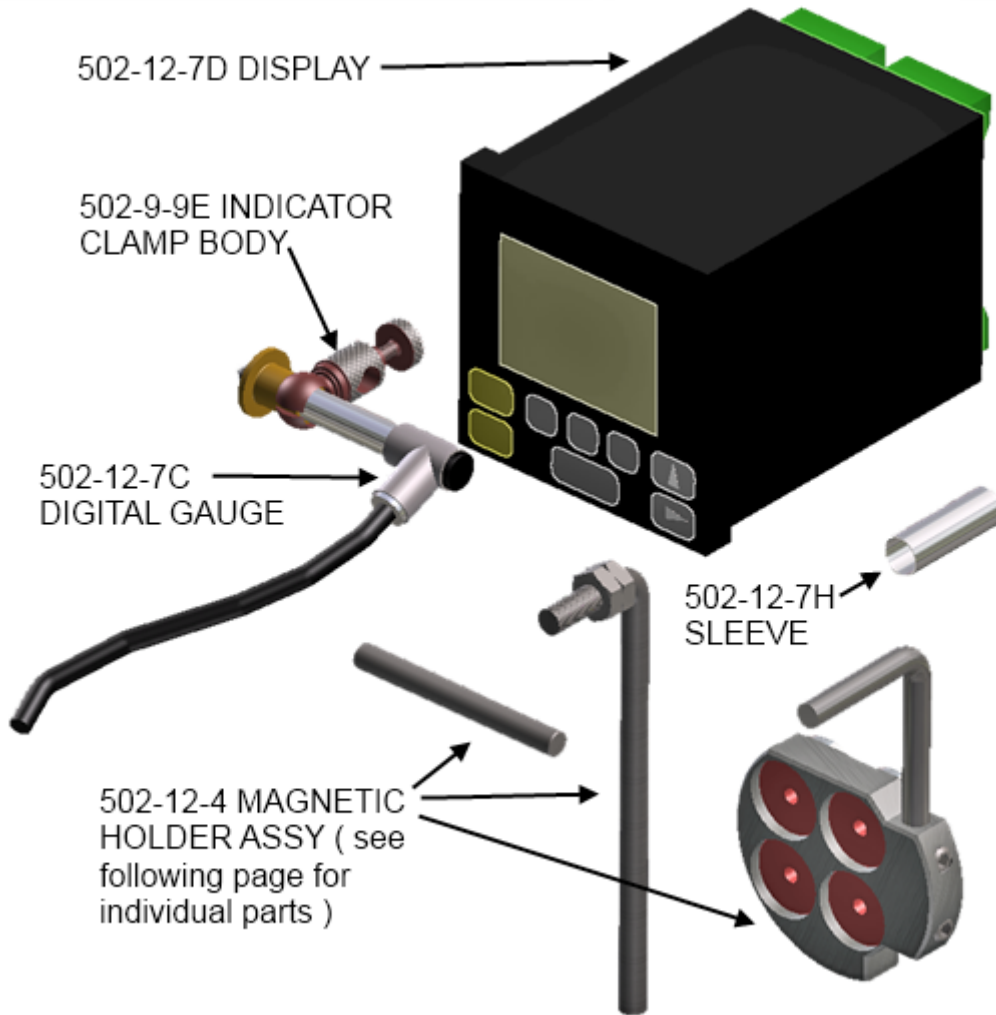


90 DEGREE PROBE MOUNTING - LONG COMBINATION



Manual Centering

502-12-7B Digital Runout Probe and Readout

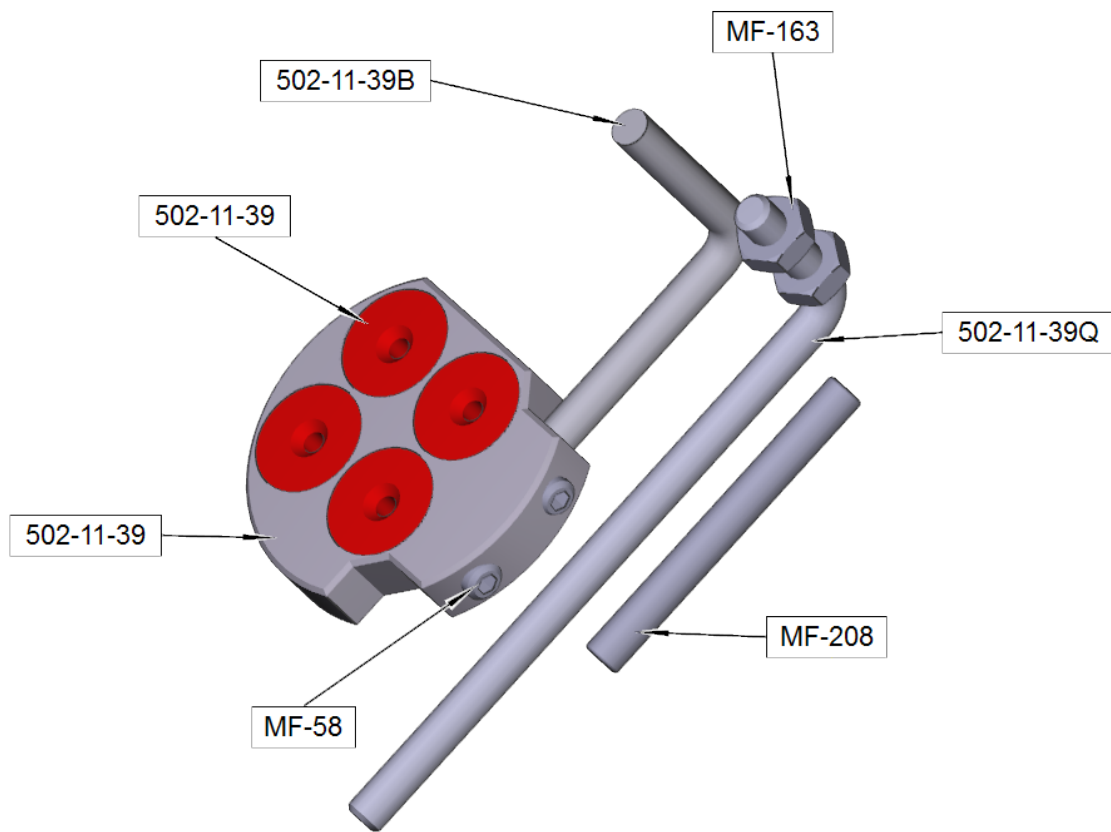


502-9-9A Mechanical Run Out Indicator

Sold only as complete assembly, no service parts available.



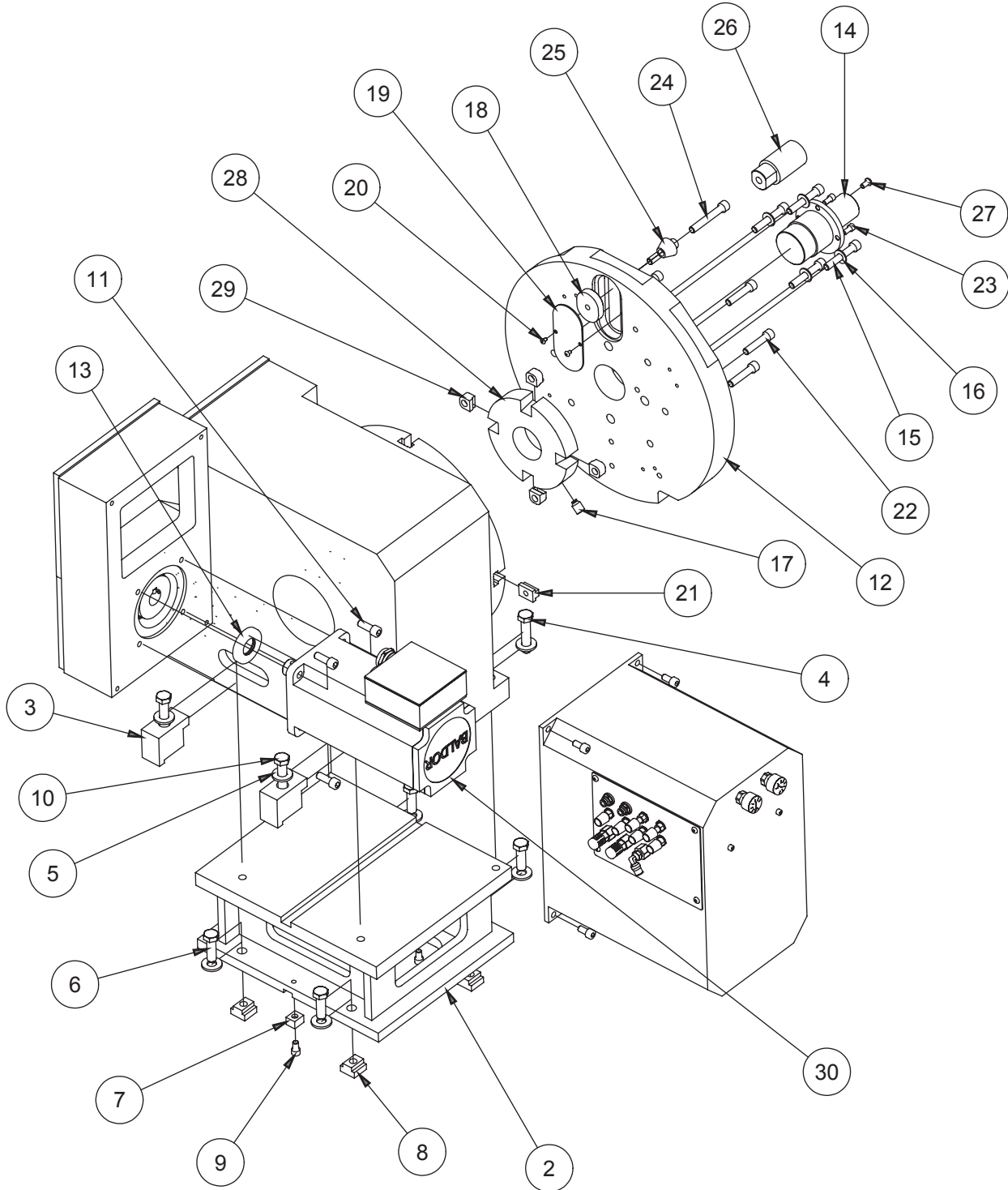
502-12-4 Magnetic Base



BLOCK FIXTURING

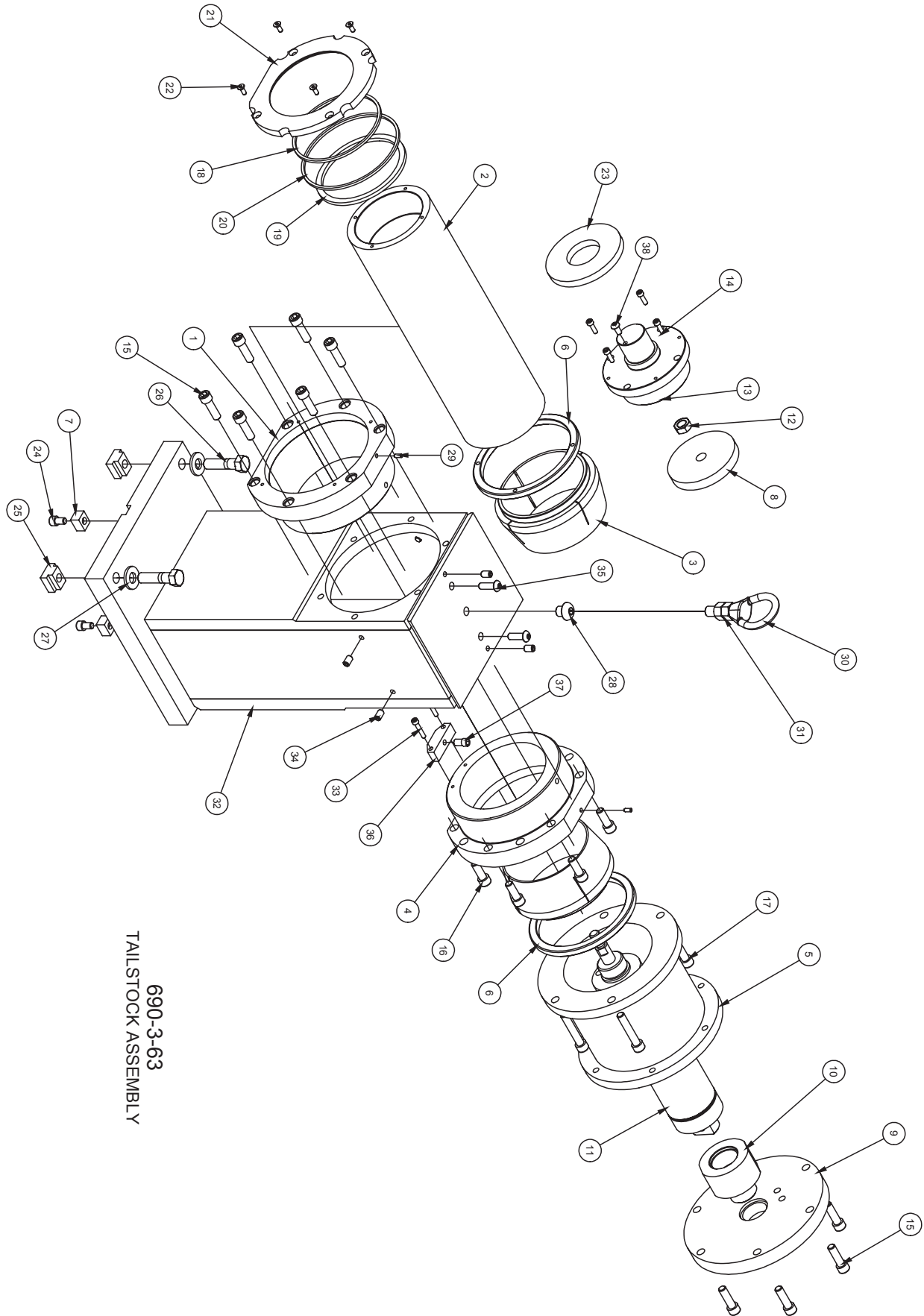
Automatic Fixtures

690-3-63 Computer Controlled Automatic 4Th Axis Block Roll Over Fixture Parts



690-3-63
HEADSTOCK ASSEMBLY

690-3-63 4TH AXIS FIXTURE HEADSTOCK ASSEMBLY			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	690-3-96	INDEXER, 4TH AXIS FIXTURE
2	1	650-3-85C	RISER, MACHINING, - 4TH AXIS INDEXER
3	2	650-3-85D	CLAMP, INDEXER - 4TH AXIS FIXTURE
4	2	MF-49A	1/2-13UNC x 2-1/4" LG. HEX BOLT
5	8	100-19A	Hardened washer 17/32 I.D.
6	4	MF-137A	1/2-13UNC x 1-1/2" LG. HEX BOLT
7	2	650-3-9	Key
8	4	650-3-10	TN-5 T-Nut
9	2	MF-21A	5/16-18UNC x 1/2" LG. S.H.C.S.
10	2	MF-150C	1/2-13UNC x 2-3/4" HEX BOLT
11	4	MF-143	3/8-16UNC x 1" LG. S.H.C.S.
12	1	650-3-62B	FACEPLATE - AUTO PERFORMANCE FIXTURE
13	1	6481H	Seal
14	1	650-3-62H	PINION, FACEPLATE - AUTO PERFORMANCE FIXTURE
15	4	MF-35	3/8-16UNC x 2-1/4" LG. S.H.C.S.
16	4	MF-178	3/8" FLAT WASHER
17	1	6310L	1/2-13UNC x 5/8" LONG SET SCREW, BRASS TIPPED
18	1	650-3-62V	NUT, EXPANDING CAM LOCATOR - AUTO PERFORMANCE FIXTURE
19	1	650-3-62G	COVER, CAM LOCATOR NUT - AUTO PERFORMANCE FIXTURE
20	2	MF-86	8-32UNC x 1/4" LG. SOCKET BUTTON HEAD CAPSCREW
21	6	650-3-61P	T-NUT, FACEPLATE - AUTO PERF. FIXTURE
22	6	MF-33A	3/8-16UNC x 1-3/4" LG. S.H.C.S.
23	4	MF-12	1/4-20UNC x 1/2" LG. S.H.C.S.
24	1	MF-36	3/8-16UNC x 2-1/2" LG. S.H.C.S.
25	1	650-3-70D	CONE WASHER, EXPANDING CAM LOCATOR - AUTO PERFORMANCE FIXTURE
26	1	650-3-62D	CAM LOCATION SET-UP TOOL - AUTO PERFORMANCE FIXTURE
27	1	MF-90	1/4-20UNC x 1/2" LG. SOCKET BUTTON HEAD CAPSCREW

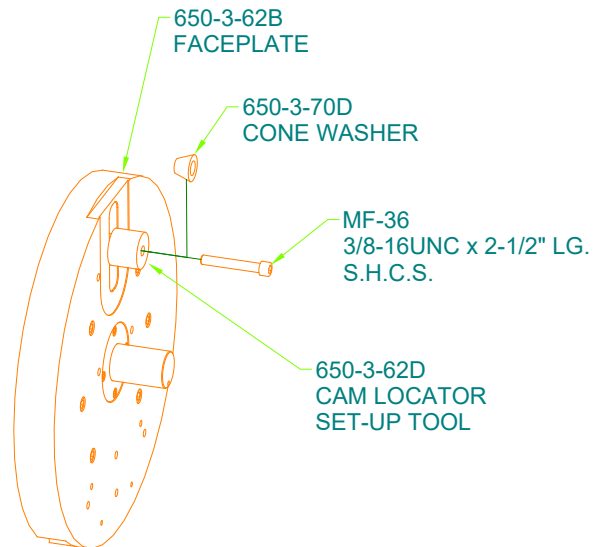


690-3-63
TAILSTOCK ASSEMBLY

690-3-63 4th AXIS FIXTURE TAILSTOCK ASSEMBLY			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	6225A	Lower Bearing Carrier
2	1	650-3-61G	PISTON TUBE, TAILSTOCK ASSEMBLY - 4TH AXIS FIXTURE
3	2	6222B	BUSHING, TAILSTOCK SPINDLE, 4TH AXIS FIXTURE
4	1	650-3-74	REAR BEARING CARRIER, TAILSTOCK - 4TH AXIS FIXTURE
5	1	650-3-61C	EXTENSION, TAIL STOCK - AUTO PERFORMANCE FIXTURE
6	2	6223	Outer Spindle Nut
7	2	650-3-9	Key
8	1	650-3-61J	NOSE PLATE, TAILSTOCK - AUTO PERFORMANCE FIXTURE
9	1	650-3-61L	ENDCAP, TAILSTOCK - AUTO PERFORMANCE FIXTURE
10	1	650-3-61M	SPACER, AIR CYLINDER, TAILSTOCK - AUTO PERFORMANCE FIXTURE
11	1	650-3-61E	STROKING CYLINDER, TAILSTOCK - AUTO PERFORMANCE FIXTURE
12	1	MF-172	1/2-20UNF HEX JAM NUT
13	1	650-3-61H	PISTON CAP, TAILSTOCK - AUTO PERFORMANCE FIXTURE
14	4	Mf-5	Socket Head Cap screw No. 10 - 24 UNC - 5/8
15	12	Mf-32	Socket Head Cap screw 3/8 - 16 UNC - 1 1/4
16	6	Mf-31	Socket Head Cap screw 3/8 - 16 UNC - 1
17	4	Mf-34	Socket Head Cap screw 3/8 - 16 UNC - 2
18	1	6248	Square Ring
19	1	6249	Felt Oiler
20	1	6251	Square Ring
21	1	6247A	Retainer Machining
22	4	Mf-79	Hexagon Socket Flat Countersunk Head Cap Screw
23	1	650-3-61K	CUSHION, TAILSTOCK - AUTO PERFORMANCE FIXTURE
24	2	Mf-21A	Socket Head Cap screw 5/16 - 18 UNC - 1/2
25	3	650-3-10	TN-5 T-Nut
26	3	MF-149C	1/2-13UNC x 2" LG. HEX BOLT
27	3	100-19A	Hardened washer 17/32 I.D.
28	1	650-3-61S	1/2-13UNC x 5/8" LG. SOCKET BUTTON HEAD SCREW
29	2	100-82-2B	Brassed Tipped Set Screw
30	1	502-3-13	Lift Eye
31	2	MF-171	1/2-13UNC HEX JAM NUT
32	1	650-3-61X	TAILSTOCK HOUSING (MACHINING) 4TH AXIS FIXTURE
33	2	MF-6A	S.H.C.S. 10 - 24 UNC - 1
34	6	MF-68D	5/16-18UNC x 1/2" LG. FLAT POINT SET SCREW
35	2	MF-95	5/16-18UNC x 1" SOCKET BUTTON HEAD SCREW
36	1	650-3-74A	KEY BLOCK
37	1	650-3-74B	KEY BOLT
38	1	MF-90	1/4-20UNC x 1/2" LG. Hexagon Socket Button Head Cap Screw

Using the 4th Axis Fixture:

The 650-3-62D cam locator set-up tool should be installed on the indexer from the factory. This tool is used to check the angle '0' of the indexer. The diameter of this tool is the same diameter as the shaft on the 650-3-62H faceplate pinion. With the indexer set to 0 degrees these two shafts should be aligned vertically. An indicator can be used to check this. With the two shafts aligned vertically, the flat machined on the top of the 650-3-62B faceplate should indicate 0. The number stamped on the machined flat is the exact distance from the flat to the headstock centerline. The two flats milled at 45 degrees to each side of this central flat are set to the same distance from centerline.

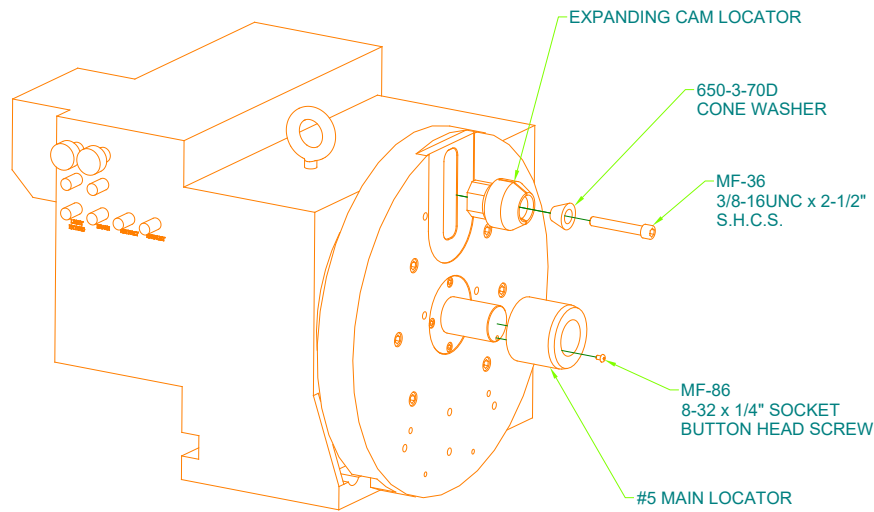


Locators: This fixture requires the use of locator sets, sized to fit individual engine blocks. These sets consist of (1) cam bearing bore locator, (1) #5 main bearing bore locator, and (1) #1 main bearing bore locator.

Main bearing bore locators: The #5 main locator is sized to fit onto the 650-3-62H faceplate pinion with the tapered end facing out. This locator is retained on the pinion by the MF-86 buttonhead screw in the pinion. The #1 main locator is sized to fit onto the 650-3-61H piston cap of the tailstock with the tapered end facing out. This locator is also retained by an MF-86 buttonhead screw.

Expanding cam bore locator: The cam bore locator is sized to fit into the 650-3-62B faceplate. To load the specific locator: remove the MF-36 3/8-16UNC capscrew and the 650-3-62D setup tool from the faceplate. The setup tool should be set aside for checking indexer '0' in the future. Install the cam locator with its socket fitting into the slot in the faceplate. The 650-3-70D cone washer is installed into the mating countersink in the locator, and held in by re-installing the 3/8-16UNC capscrew. This capscrew threads into the 650-3-62V cam locator nut that is trapped in the 650-3-62B faceplate. Tighten the capscrew just enough to hold the locator in the desired location in the slot.

CAM AND MAIN LOCATOR INSTALLATION

**Loading an Engine Block:**

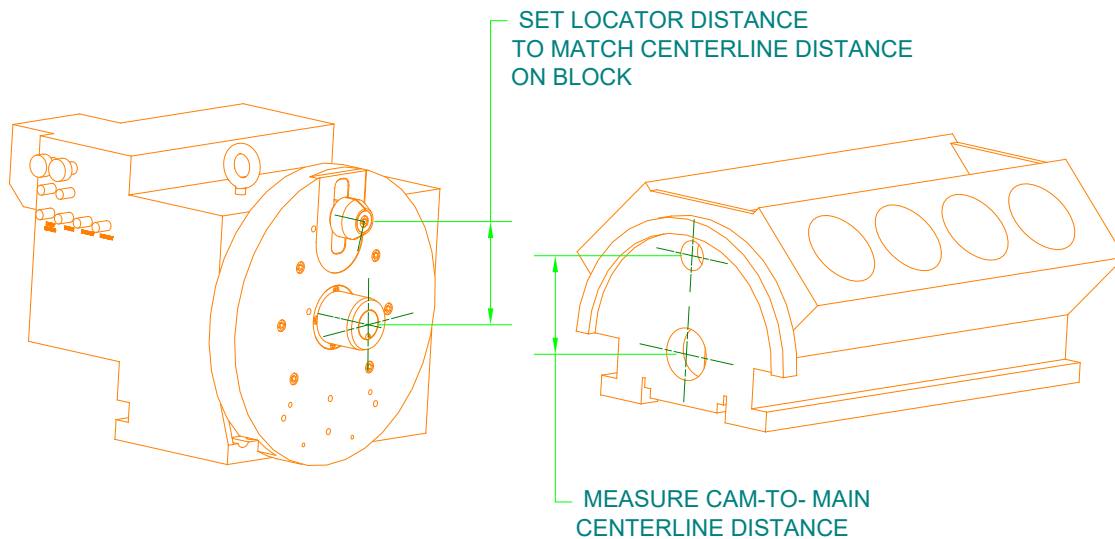
This fixture requires the main bearing bores, the rear cam bearing bore, and the transmission mounting surface of the engine block be clean and free from nicks, dings, and foreign particles. Failing to ensure this will result in poor performance of your fixture.

The tailstock must be positioned to allow space to install the engine block, but still be close enough to clamp the block within the 6" of stroke allowed by the tailstock piston. Approximately 3-1/2" of the stroke will be used to take up the required length of the locators, leaving approximately 2-1/2" of room to position the tailstock.

Generally, measure the overall length of the engine block and add 1". This will be the space to leave between the pinion noses of the headstock and tailstock with the tailstock piston retracted. Example: a 20" long engine block will require the pinion noses to be 21" apart. This will leave 1/2" of room on each end of the engine block for loading and still be within the stroke length of the tailstock.

After setting the distance between the pinion noses, tighten the tailstock down with its keys pushed back against the center keyway of the table.

Measure the distance between the centerlines of the main and cam bores of the block. Slide the adjustable cam locator to be equal to this distance. Lightly tighten the MF-36 cap screw to keep the cam locator in place.



Using a hoist, load the engine block down between the pinions with the bell housing surface facing the headstock. Slide the block's main bore over the #5 main locator on the headstock and position the block to slide the cam bore over the cam locator. Tapers on the outside of both locators will aid in positioning. Push the block flush up against the faceplate and activate the 'light extend'. This will extend the tailstock piston with limited pressure to locate the block on the tailstock. **CAUTION:** keep fingers and all other objects out of the path of the tailstock piston. Even with limited pressure, severe injury could occur if this rule is not followed. If desired, a hex socket and long extension can reach through the cam bores from the front of the block and be used to tighten the cap screw holding the cam locator in place. The 650-3-70D cone washer will expand the cam locator to provide a tighter fit on the cam bore, further centering the block on the indexer '0'. Once the block is located properly, full tailstock pressure can be applied after rotating the indexer to the desired angle.

After machining is complete, unload the block in reverse order. Loosen the cap screw on the cam locator to release pressure on the cam bore of the block. Position the hoist to hold block and retract the tailstock. Slide the block off the faceplate and locators to remove.

Readjusting Tailstock Piston Alignment

Checking for tailstock alignment may be required after heavy use or after a crash has occurred. The first step is to check all possible variables before making adjustments.

Headstock: make sure the headstock is pushed back with the keys against the back of the center keyway of the machine table. Tighten the (4) bolts to secure the headstock to the table and check faceplate for squareness.

Tailstock: the tailstock also must be pushed back with the keys against the back of the center keyway of the machine table.

With both units tightened down as described above, an indicator can be used to check the alignment between the two pinions both vertically and horizontally. If the alignment is out more than .001 in either direction an adjustment must be made.

The headstock pinion should be checked for runout. With an indicator placed on the 650-3-62H pinion, rotate the indexer. The runout here should be no more than .0005. Runout of this pinion can be adjusted by loosening the (6) MF-33A 3/8-16 cap screws holding the faceplate to the indexer and tapping the faceplate until the pinion runs true. Retighten the (6) cap screws. Check both pinions with an indicator again for alignment. If still not aligned within specs the tailstock will need adjustment.

Begin with the tailstock piston retracted. Remove the 650-3-61K cushion from the tailstock piston cap. Note the timing of the 650-3-61H piston cap relative to the piston tube to reassemble in the same configuration. Remove the (4) MF-5 cap screws from the 650-3-61H piston cap. If the cap does not slide out, the MF-5 cap screws can be threaded into the four tapped holes of the cap and evenly tightened to push the cap out of the 650-3-61G piston tube. Beneath the piston cap is the 650-3-61J nose plate which is attached to the piston of the 650-3-61E stroking cylinder with a MF-172 1/2-20 hex nut. Activating the tailstock to light extend should push the nose plate out of the piston tube. Using the flats on the cylinder piston to keep it from turning, removed the 1/2-20 hex nut. Slide the nose plate off of the cylinder piston.

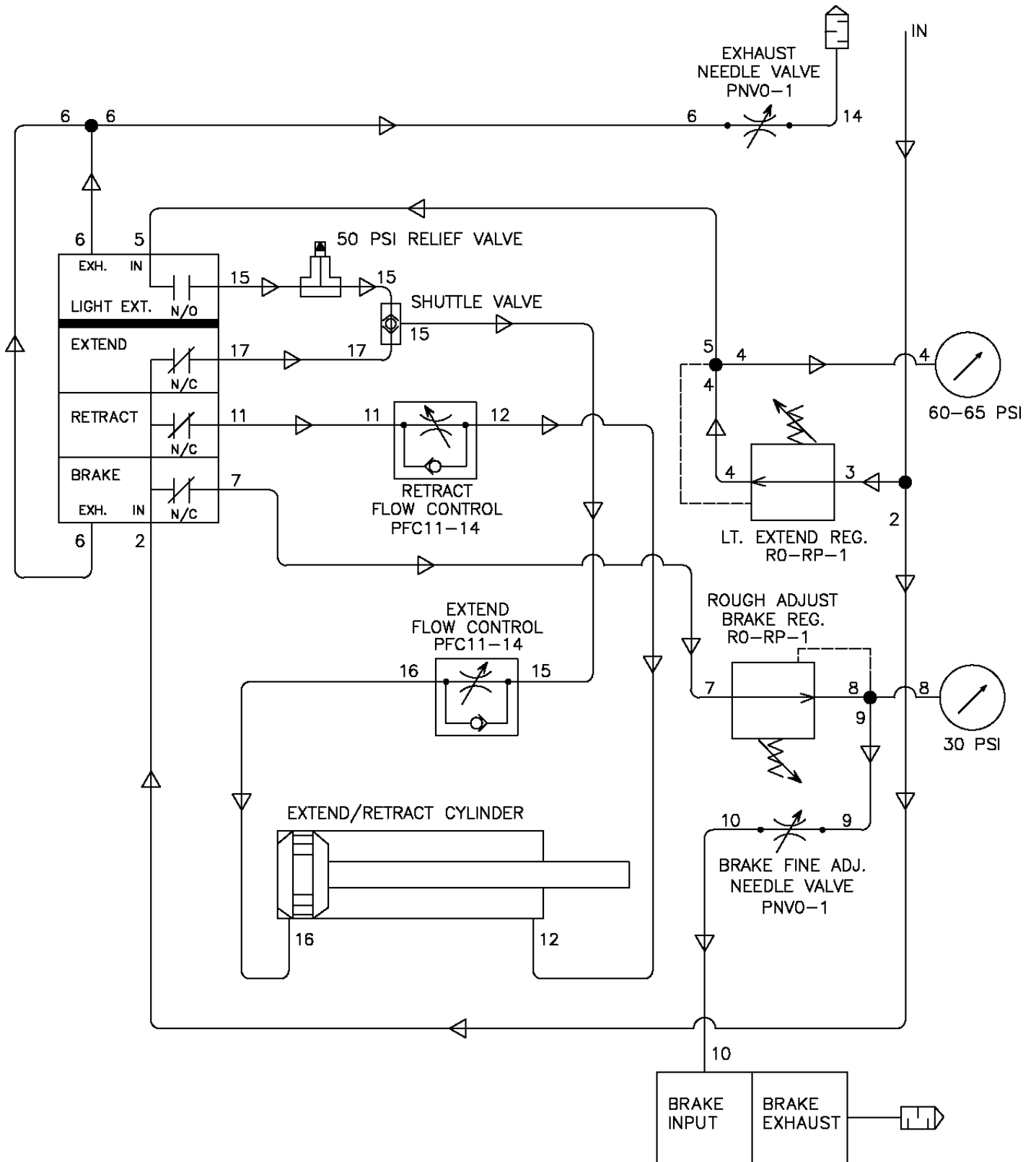
Remove the (4) MF-34 3/8-16 x 2" long cap screws holding the 650-3-61C tailstock extension on. The tailstock extension with the stroking cylinder should slide out through the back of the housing.

Slide the piston tube to be centered in the tailstock housing. Reinstall the 650-3-61H nose plate in the piston tube. Remove 6247A retainer, 6248 wiper, 6249 felt compressor, and 6251 felt oiler from front of 6225A bearing carrier. Loosen 100-82-2B 8-32 brass tipped set screw in bearing carrier. Tighten 6223 spindle nut until piston tube will not slide by hand. Loosen the (6) MF-32 3/8-16 cap screws holding the 6225A carrier on the housing. Loosen the (6) MF-31 3/8-16 cap screws holding the 650-3-61F rear bushing on the housing.

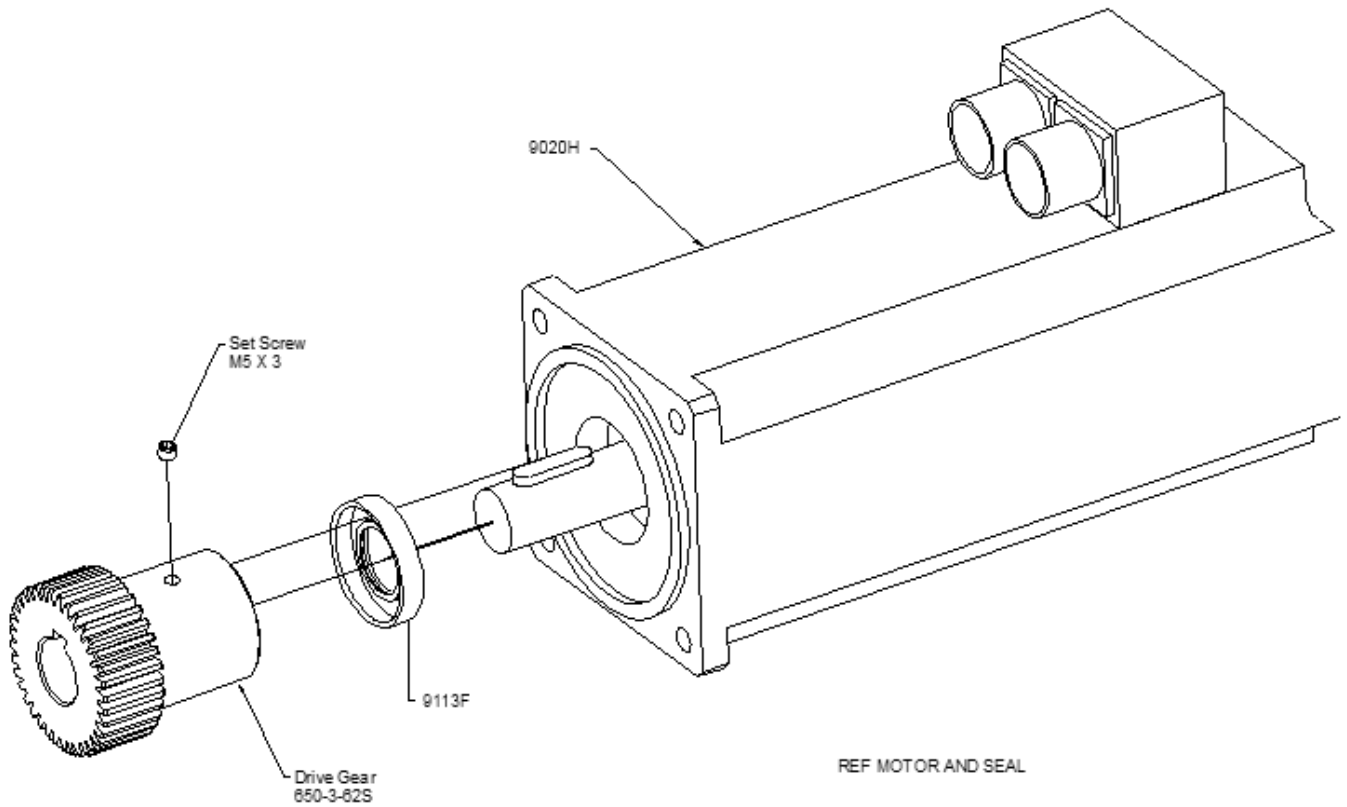
Install the 650-3-61T alignment tube assembly over the pinion of the headstock. Slide the tailstock up to fit the tailstock pinion into the alignment tube. Tighten (4) setscrews on the alignment tube to lock the two pinions in alignment. Push the tailstock housing to the rear to contact the keys with the middle keyway of the machine table and tighten its two mounting bolts. Check the piston tube with an indicator across the top and the back on both ends for straightness. Tap on either the carrier or the rear bushing to adjust alignment. The piston tube should be straight within .0005 in both directions. Retighten the 3/8-16 cap screws holding both the carrier and the rear bushing. Loosen the tailstock mounting bolts. Loosen the (4) set screws of the alignment tube assembly and slide the tailstock back from the headstock. Push the tailstock back on the middle keyway and tighten the mounting bolts. Recheck alignment of the pinions with an indicator in both directions. Recheck the straightness of the piston tube with an indicator. If alignment is within specs, reassemble the tailstock as follows:

Loosen the 6223 spindle nut until the piston tube can be moved by hand applying about 40-50 lbs. of force. Tighten the 100-82-2B set screw to lock the nut in place. Remove the 650-3-61H piston cap. Reinstall the 650-3-61C tailstock extension with the stroking cylinder attached and lightly tighten its (4) mounting cap screws. The stroking piston cylinder should be sticking out the front of the piston tube. Reinstall the 650-3-61J nose plate and tighten the 1/2-20 nut to secure. Release the air pressure from the stroking cylinder and slide its piston back by hand into the piston tube until the nose plate contacts the bottom of the counterbore in the piston tube. Tighten the (4) cap screws holding the 650-3-61C tailstock extension on. Reinstall the 650-3-61H piston cap and 650-3-61K cushion.

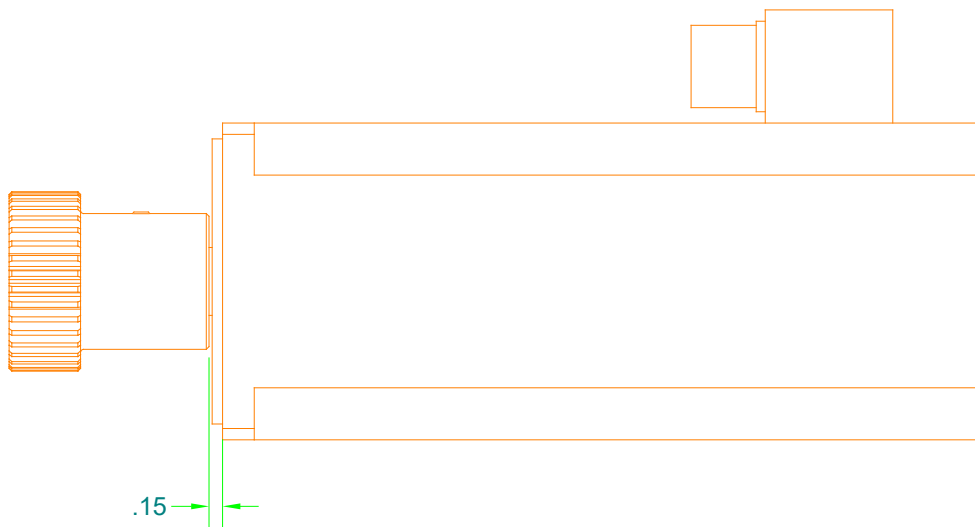
Pneumatic Diagram



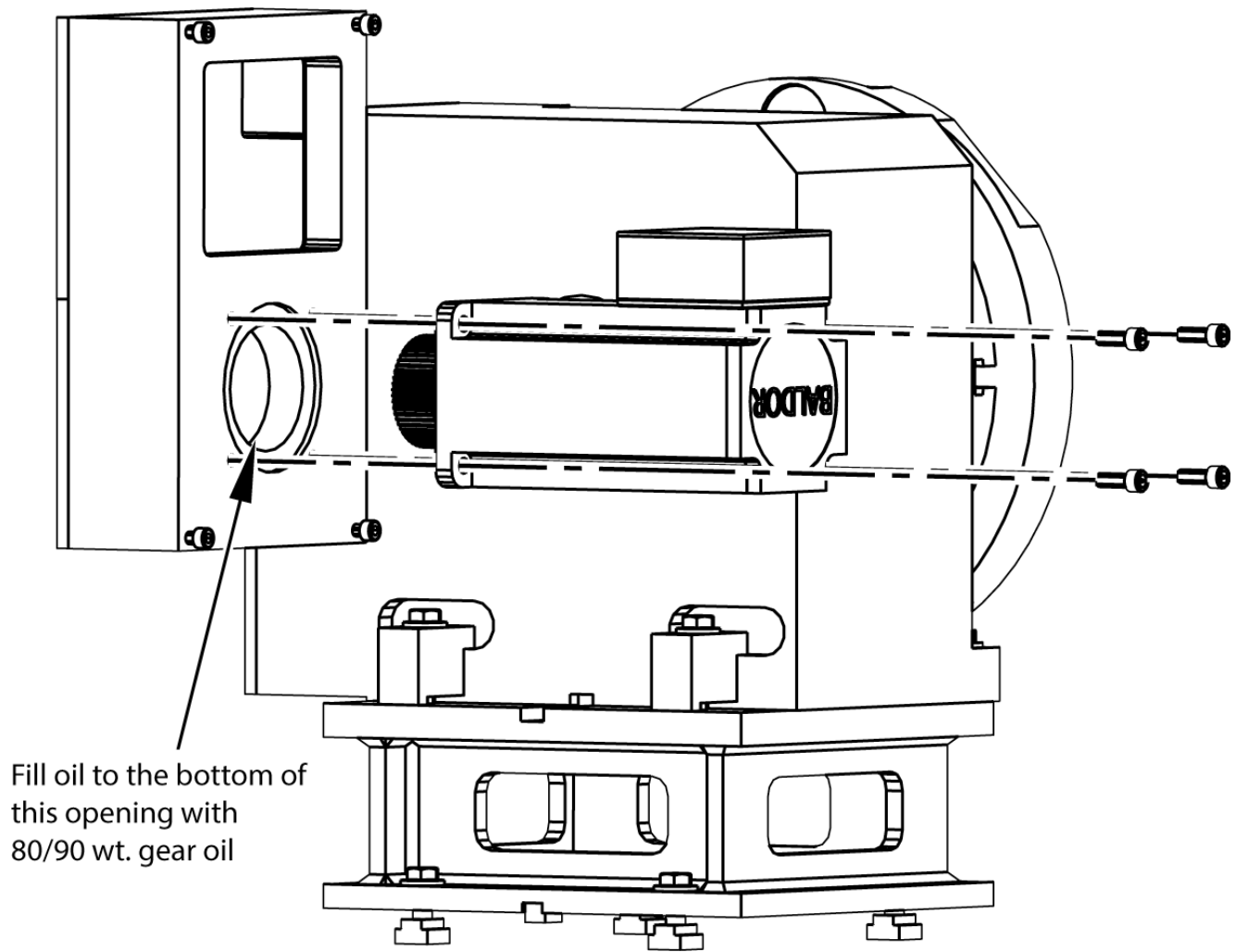
Drive Gear Installation



Adjust the gear on motor shaft to the correct distance. Using keyway set screw to determine depth by turning setscrew in to bottom out at the end of the key on the shaft, and then tighten both set screws.

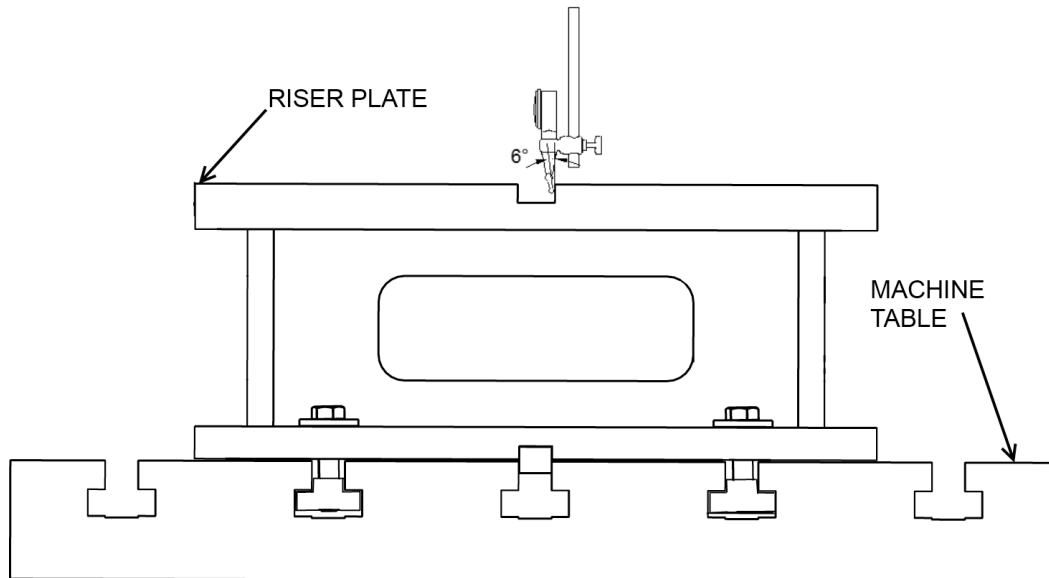


Fill with 80/90 weight gear oil to the bottom of the hole before mounting the motor.

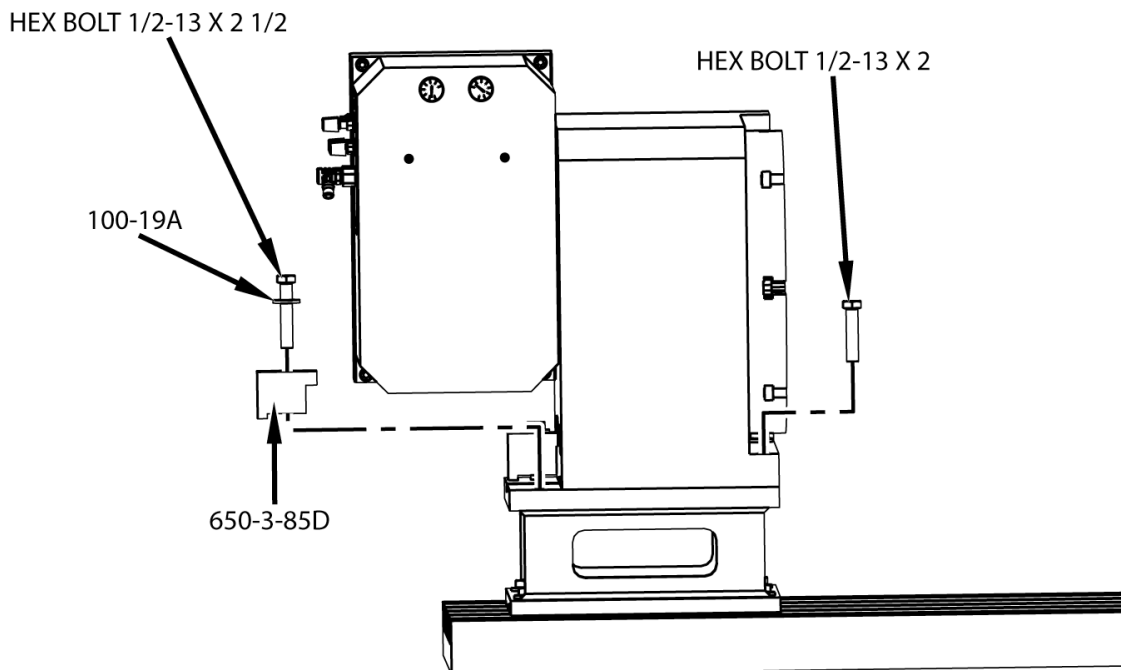


Fill oil to the bottom of
this opening with
80/90 wt. gear oil

Place the magnetic base indicator on the bottom of the Spindle or cutterhead. Place the Probe of the indicator on the front edge of the Riser plate as shown at no more than a 15 degree angle. Placing the probe at too steep of an angle will result in inaccurate readings. 6 Degree angle shown. Adjust the Riser Plate as needed for less than a .002" runout. If the Riser Plate will not align with in the .002" the keys on the bottom of the Riser plate may need to be ground. Indicate the amount of grinding required and give to the Team Leader. Tighten bolts on Riser Plate.



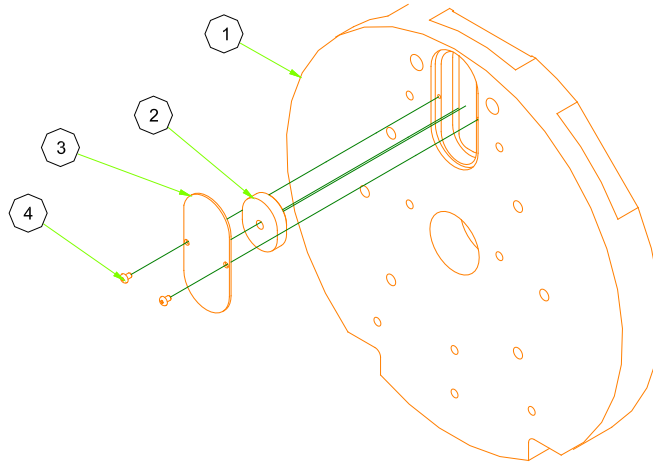
Using Lift Eye supplied with the indexer. Place the Indexer on the Riser Plate. Using the following hardware, mount the Indexer to the Riser Plate. Do not tighten bolts all the way down.



Using an indicator in the same manner as described earlier, check the indexer plate run out Vertical and In/Out. Align indexer on Riser plate within .0003"

Install the 650-3-62V Nut into the slot on the back side of the Face Plate. The Boss on the nut needs to be facing in towards the face plate.

Install the 650-3-62G cover using (2) 8-32 x .25 BHCS, trapping the nut into the back slot of the face plate.

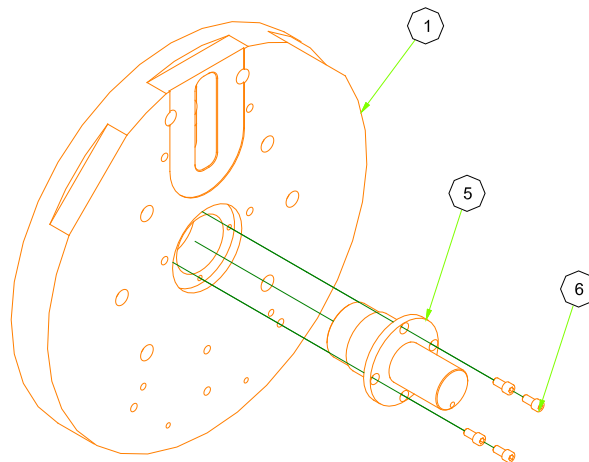


Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-3-62B	FACEPLATE - AUTO PERFORMANCE FIXTURE
2	1	650-3-62V	NUT, EXPANDING CAM LOCATOR - AUTO PERFORMANCE FIXTURE
3	1	650-3-62G	COVER, CAM LOCATOR NUT - AUTO PERFORMANCE FIXTURE
4	2	Mf-86	Socket Button Head Cap Screw 8 - 32 x 1/4

REF4TH06

Press the 650-3-62H Pinion into the faceplate. Use long 1/4-20 to line up the holes in the Pinion with the tapped holes in the face plate. Install the (4) 1/4-20 x .5" SHCS

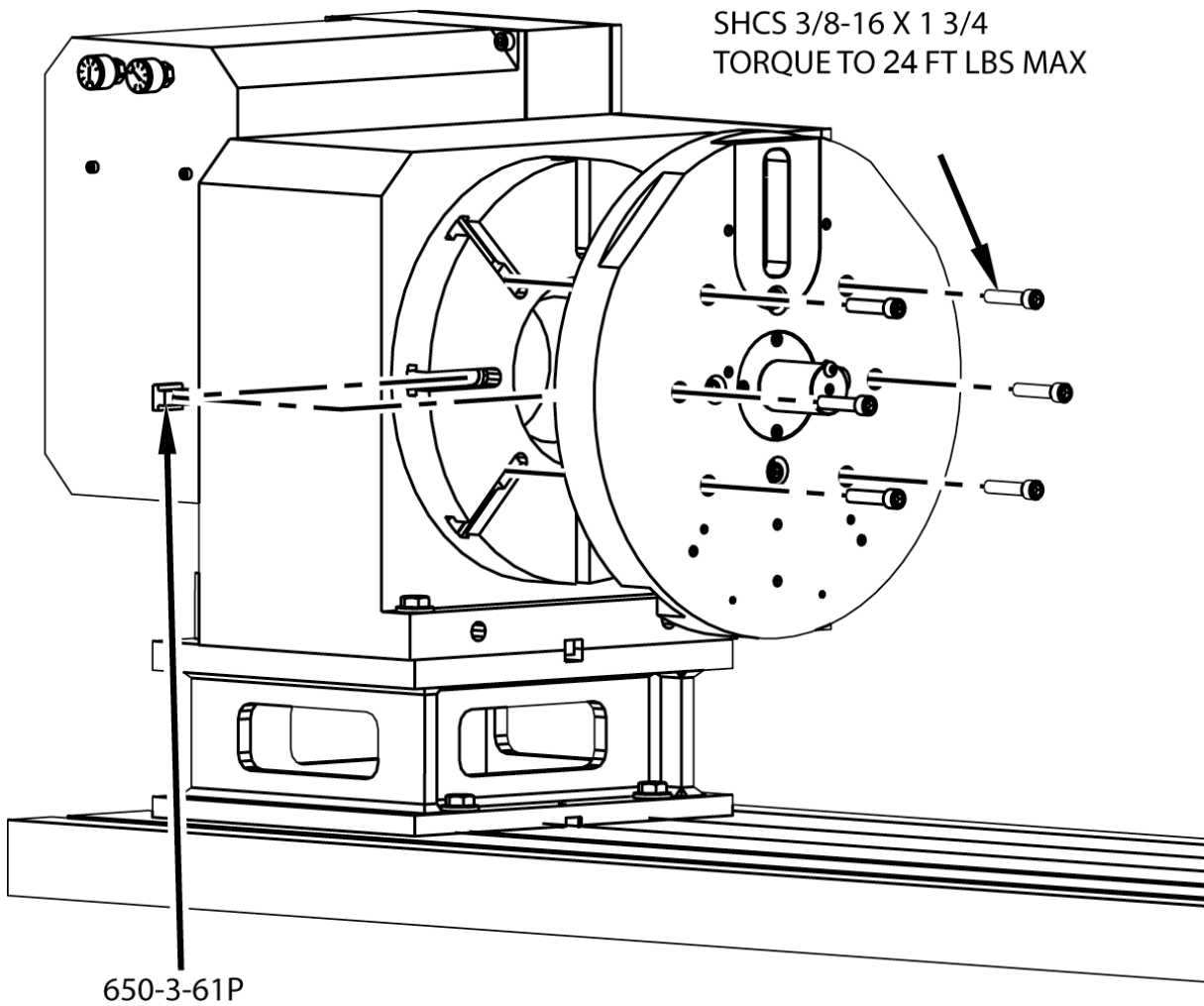
DO NOT use the long 1/4-20 screws to pull the Pinion into the faceplate. This will damage the Pinion.



Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-3-62B	FACEPLATE - AUTO PERFORMANCE FIXTURE
5	1	650-3-62H	PINION, FACEPLATE - AUTO PERFORMANCE FIXTURE
6	4	Mf-12	Socket Head Cap screw 1/4 - 20 UNC - 1/2

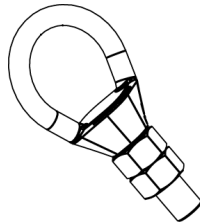
REF4TH07

Install 650-3-62B faceplate onto indexer plate



Using an indicator in the same manner as described earlier, check the run out of the 650-3-62B plate Vertical and In/Out.

Install (2) 1/2-13 Hex nuts onto Lift Eye. This is so the lift eye does not thread too far into the tail stock and damage the spindle.



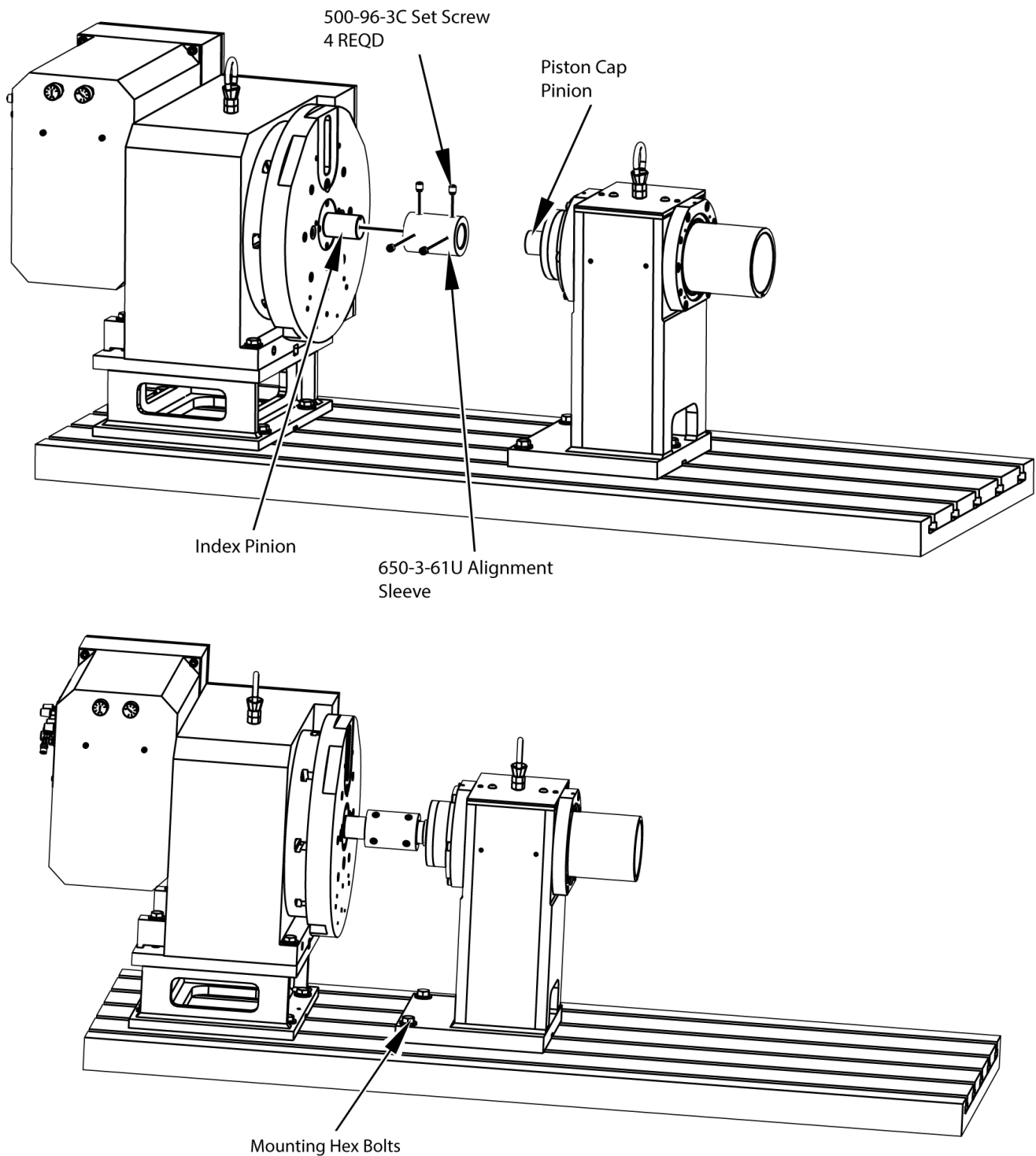
Place Tail Stock Housing on the machine bed. Push the tail stock towards the rear of machine so the keys on the bottom of the tail stock press on the back side of the center key way.

Place the 650-3-61T Alignment tool on the Pinion Shaft of the Indexer. Tighten Set Screws on Alignment Tool.

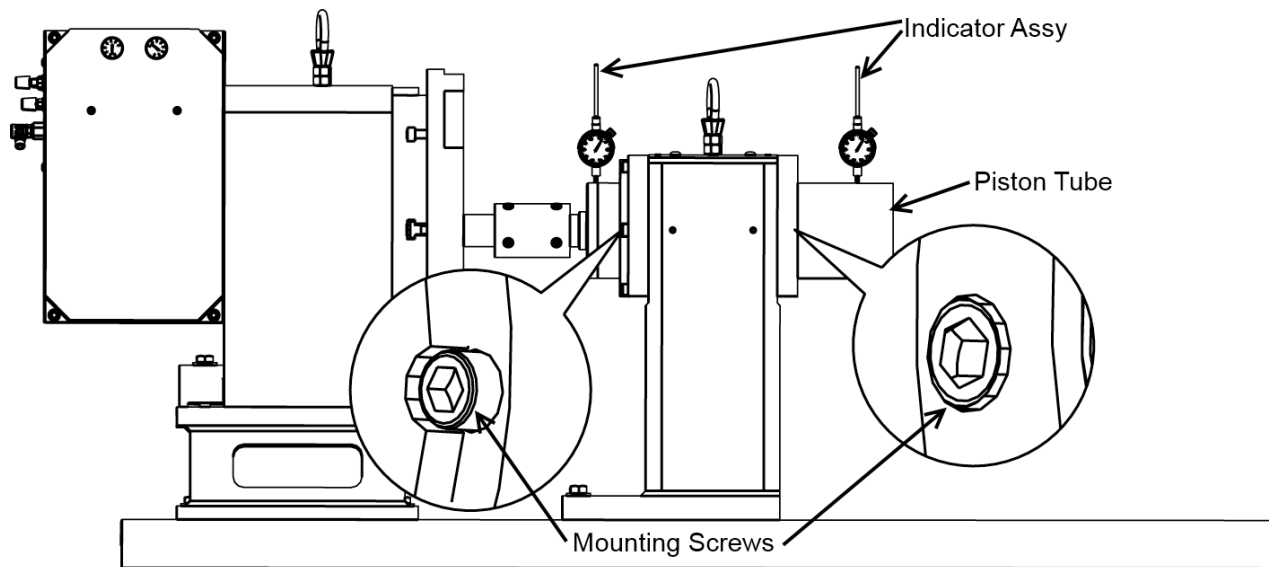
Slide the tail Stock toward the Indexer and place the Nose of the 650-3-61H Piston cap into the remaining end of the alignment tool. Tighten Set Screws on Alignment Tool.

Push the tail stock toward the rear of the machine. This should place the keys on the bottom of the tailstock against the back of the middle T-Slot.

Tighten down mounting Hex Bolts.



Place the Magnetic Base of the indicator assembly on the spindle or cutterhead. Using the same indicating procedure described earlier... Indicate the front and rear of the Piston Tube. Adjust as needed for less than .0004" difference from front to rear. Tighten Bearing Carrier and Rear Bushing mounting screws.

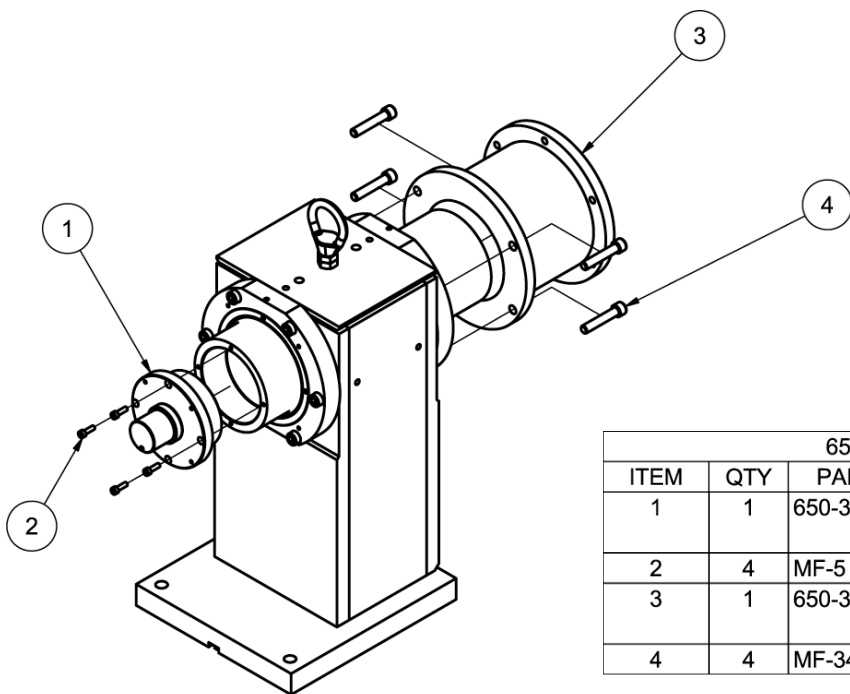


Remove the 650-3-61T Alignment Tool. Slide the Tail stock back away from the Indexer for further assembly. Indicate the Indexer and Cap Pinions. They should be within .0003" of each other.

Loosen the 6223 Nut until the Piston Tube slides in and out of the Housing by hand using 40-50 lbs. of force.

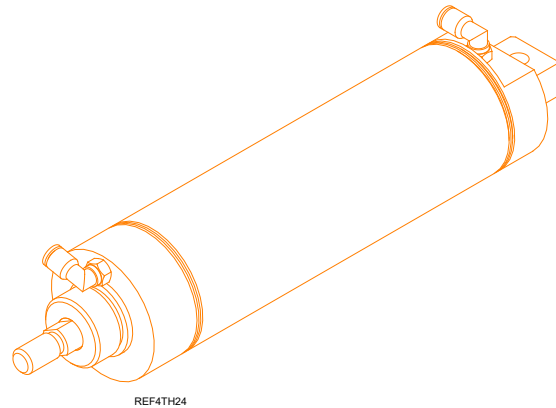
Remove the 650-3-61H Piston Cap from the assembly.

Install the 650-3-61C Housing Extension onto the 650-3-61F Rear Bushing using (4) 3/8-16 x 1" SHCS.



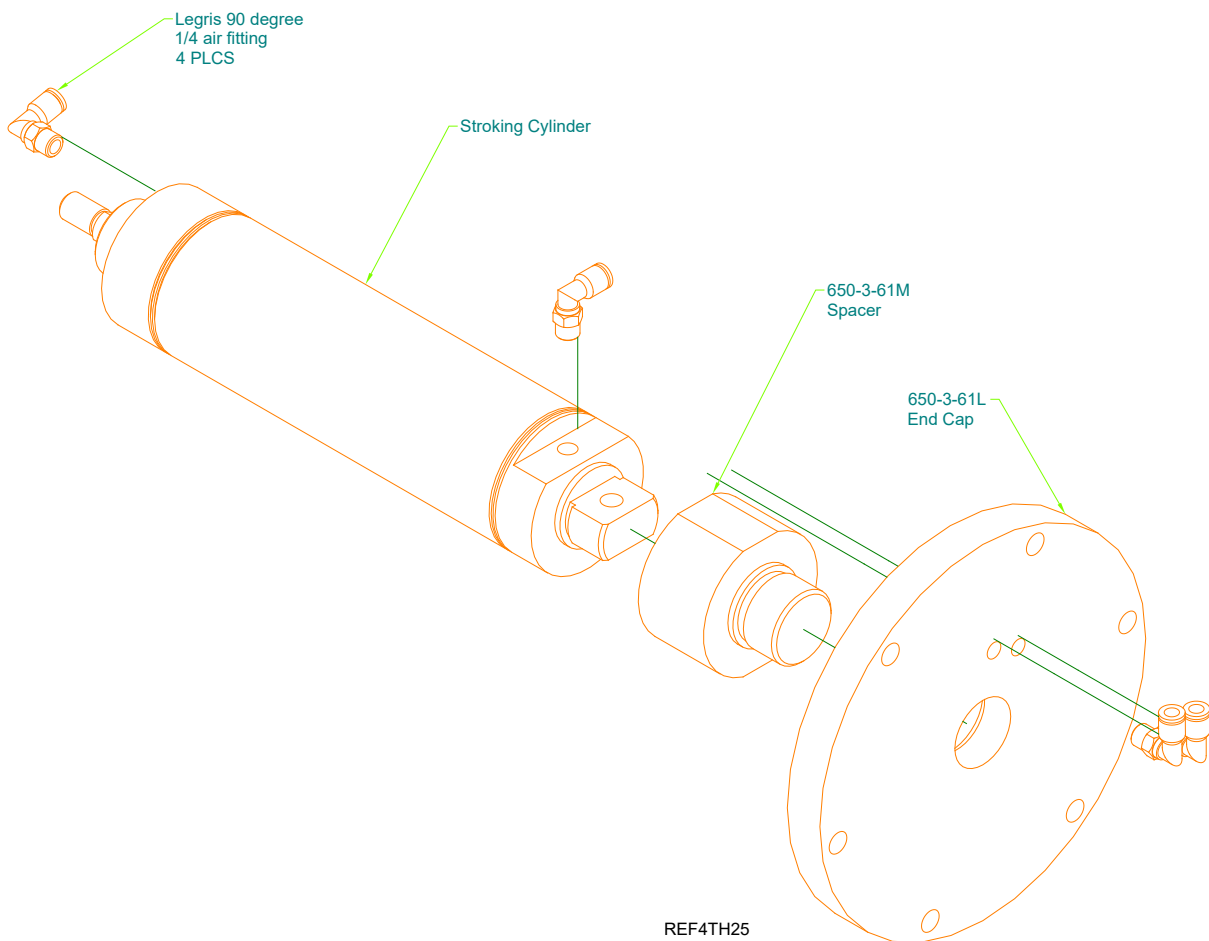
650-3-59 TAIL STOCK ASSEMBLY			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-3-61H	PISTON CAP, TAILSTOCK - AUTO PERFORMANCE FIXTURE
2	4	MF-5	10-24UNC x 5/8" LG. S.H.C.S.
3	1	650-3-61C	EXTENSION, TAIL STOCK - AUTO PERFORMANCE FIXTURE
4	4	MF-34	3/8-16UNC x 2" LG. S.H.C.S.

Install fittings and Plumb air lines onto the 650-3-61E Stroke Cylinder.



Thread the 650-3-61M spacer onto the threaded end of the Stroking Cylinder.

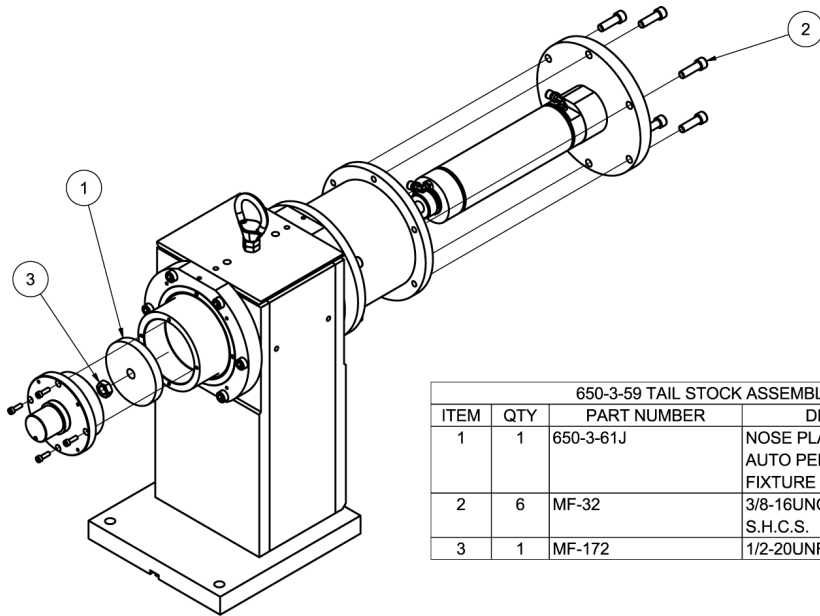
Thread Spacer into 650-3-61L Endcap (shoulder on spacer fits into counter bore of endcap)



Install (2) 90 degree air fittings into the End Cap.

Run air lines from Stroking Cylinder to the End Cap.

Extend the Piston Rod of the stroking Cylinder out all the way. Slide the Cylinder into Housing through the Tail Stock Extension. Attach End Cap with (6) 3/8-16 x 1.25" SHCS.



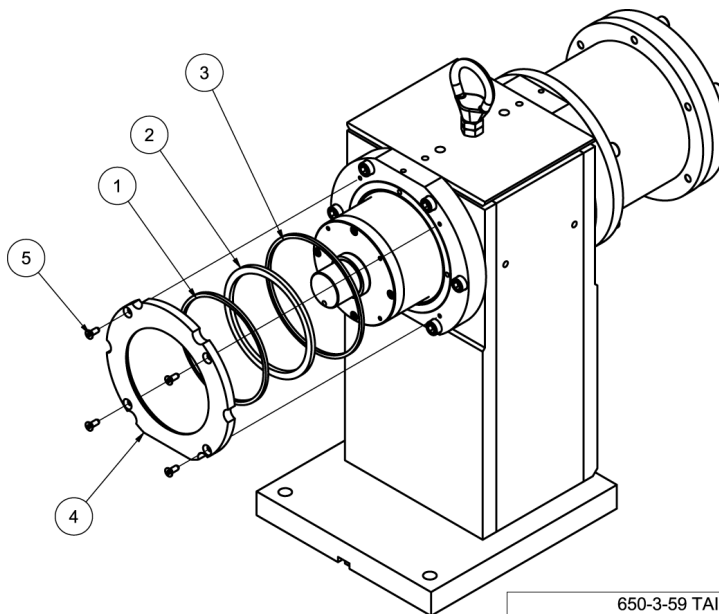
650-3-59 TAIL STOCK ASSEMBLY			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-3-61J	NOSE PLATE, TAILSTOCK - AUTO PERFORMANCE FIXTURE
2	6	MF-32	3/8-16UNC x 1-1/4" LG. S.H.C.S.
3	1	MF-172	1/2-20UNF HEX NUT

Push the Nose Plate into counter bore in Piston Tube, compressing the stroking Cylinder.

Re-install the 650-3-H Piston Cap onto Piston tube.

Install 6249 Felt Oiler, 6251 Felt Compressor and 6248 Square 'O' Ring onto Piston Tube.

Install 6247 Wiper Retainer onto 6225A Bearing Carrier using (4) 10-24 x .5" Socket Flat Head Screws.



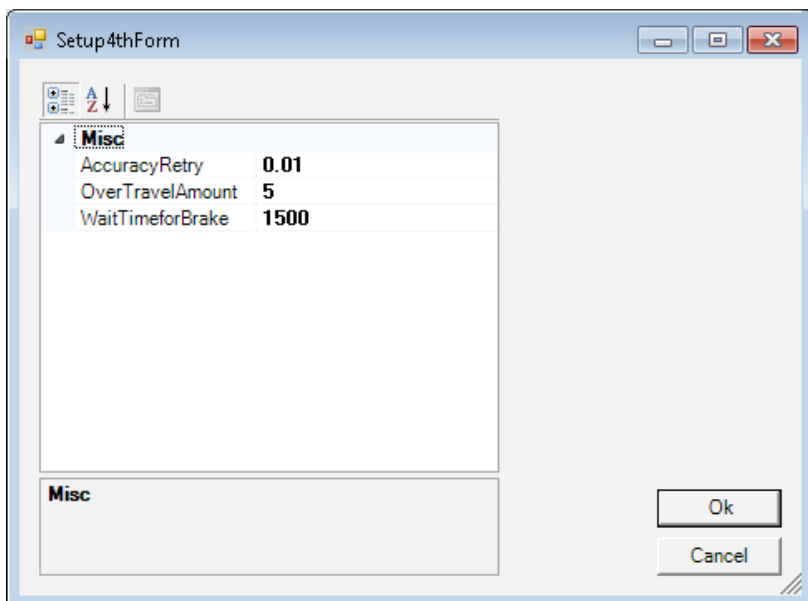
650-3-59 TAIL STOCK ASSEMBLY			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	6248	Square Ring
2	1	6249	Felt Oiler
3	1	6251	Square Ring
4	1	6247A	Retainer Machining
5	4	MF-79	10-24UNC x 1/2" LG. SOCKET HEX FLAT HEAD SCREW

Program Set Up

From the Setup Software menu, select Addins and then choose 4th Axis Setup, as seen below.



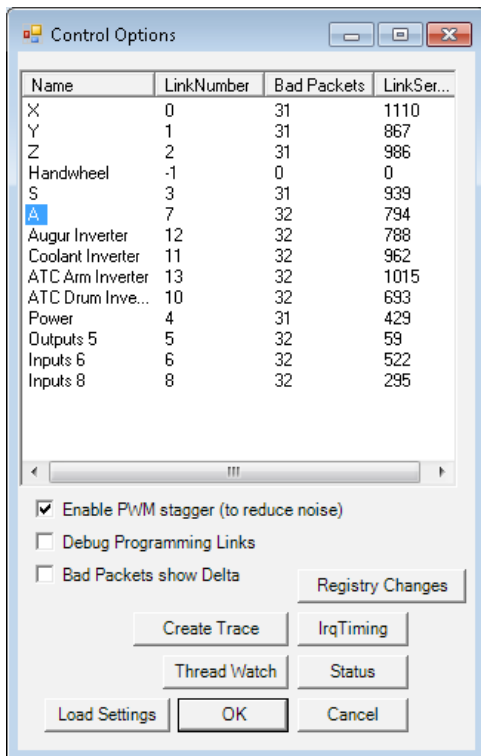
The following screen will appear. Verify the settings are correct.



From the Setup Electronics menu, choose Control.



A new window will appear, choose A.



Verify the settings are correct.

Settings Status

Operations test

- 1. Hi speed link setup
 - 1. Encoder settings

Biss_Interpolation	0
Biss_MultiTurnBits	12
Biss_SingleTurnBits	17
CheckIndexPulse	True
DesiredCommutationMode	IndexCommutation_WithValidUVW
EncoderType	Biss_Encoder
Home Preset	283.85769653320312
InvertEncoderCountingDirection	False
Motor Revs to Axis Units Ratio	0.25
PhaseToIndexOffsetforThisMotor	24650
PulsesPerIndex	131072
 - 1. Power Settings

AdvancePhaseRatio	2
Invert3Phase	False
MaxAdvancePhase	0.0714
MotorType	AC3PhasePermanent Magent Servo
Number of motor poles	8
PWM Dead Zone	0
PWM Percent to Align	22.0703125
ReleasePoweronZeroVelocity	True
Continuous Current Limit (RMS)	8.3999996185302734
Peak Current Limit (RMS)	8.4000000000000128
SinWaveProfile	Third_Harmonic
ValidCurrentSensor	AllValid
 - 2. Tuning Factors
 - 2b. Resonance Damping
 - 3. Speed and Accel settings

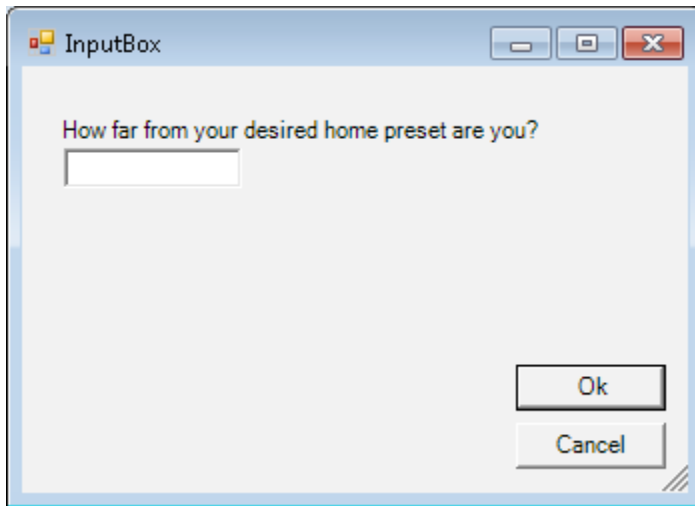
Handwheel Acceleration Rate	10
EOT hit Acceleration Rate	50
Acceleration Rate	30
Max Jog Speed	2800 (46.67Hz)
Max Rapid Speed	2800 (46.67Hz)
 - 3. BackLash settings
 - 3. Limit settings

Heat Sink Fan on Temperature	0
Motor Cooling Fan on Temperatur	0
Motor Temperature Limit	-1
EnableBottomSoftLimit	False
EnableTopSoftLimit	False
Soft Bottom Limit Location	0
Soft Top Limit Location	0
- Read only Error Counts

3. Limit settings

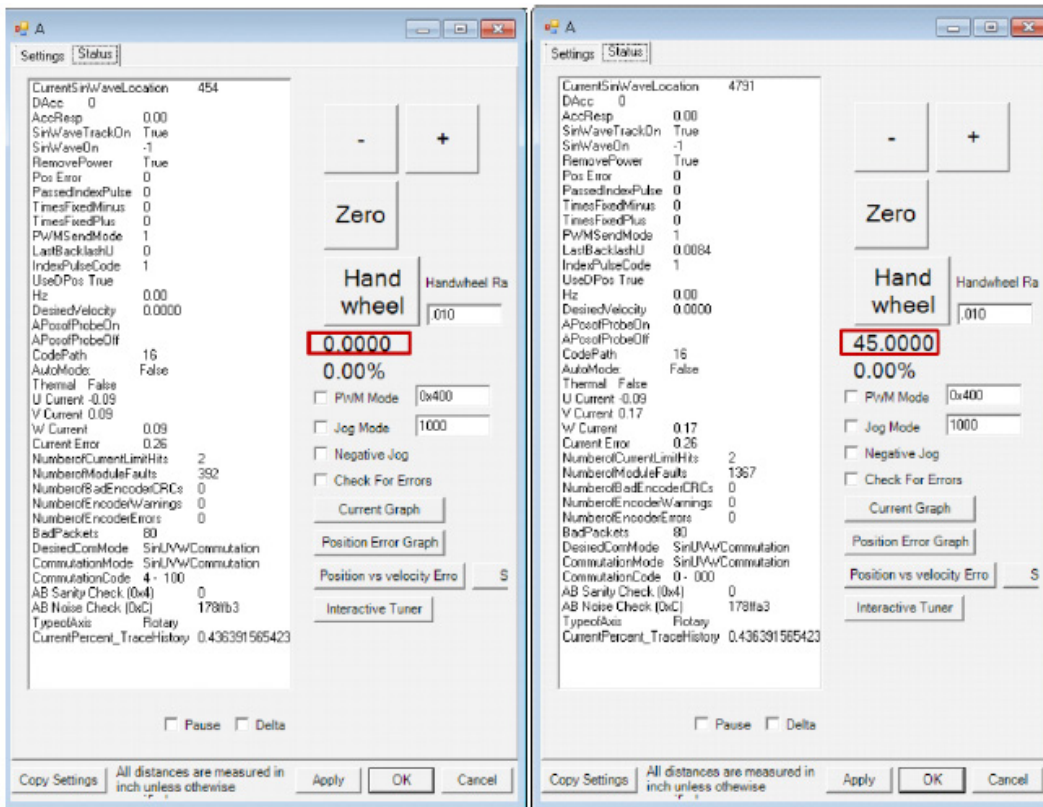
Copy Settings All distances are measured in inch unless otherwise specified Apply OK Cancel

Enter 0 in the box below when the 4th axis zero location is verified.



Setting 4th Axis Backlash

With the vertical slot at zero, open the status page for the A axis.



Rotate the block to the +45 degrees position. Place a 1" travel .001" indicator from the spindle nose to the rear of the +45 degree flat.

Put at least .010" of pressure on the indicator.

Select .001" and rotate the 4th with the hand-wheel in the negative direction one click at a time until you see movement on the indicator. Record the difference in the position readout, of the 4th axis, on the status page DRO and the 45 _____. This is the amount of backlash in degrees. Enter this number in Setup Electronics>Control>A>Hand-wheel Backlash.

Place this number in the Auto Backlash also.

Use the "Move To" button; move the 4th axis to 00.000 degrees. It should indicate in flat.

Use the "Move To" button; move the 4th Axis to the -45 position. This should indicate in flat.

Use the "Move To" button; move the 4th Axis to the 45 position. Indicate across the flat and record amount of error _____.

Depending on the direction of the error, increase or decrease the amount of Auto Backlash until it is within .0005"

Record the actual Auto Backlash setting _____.

Milling Faceplate

DO NOT move the 4th axis, indicate the middle or 0 degree flat, and record any error _____. DO NOT dial the flat in.

Use the "Move To" button; move the 4th to -360 degrees. Indicate the flat, record any error _____. What, if any is the difference in the reading between step 4 and 5? _____. DO NOT dial in the flat.

Use the "Move To" button; move the 4th to -45 degrees. Indicate the flat, record any error _____. DO NOT dial in the flat.

Use the "Move To" button; move the 4th to -315 degrees. Indicate the flat, record any error _____. DO NOT dial in the flat.

Use the "Move to" button; move the 4th to -360 degrees. Zero the 4th axis.

Remove the Indicator from spindle and install the 2 Flute .900" Carbide End Mill. This should be marked 4th Axis Squaring in the F60 area.

Align the one of the cutting teeth of the end mill up with the back of the flat to the vertical plane. Zero the Horizontal position.

Use the Vertical hand-wheel in .001", bring the end mill down until it just touches the flat with a piece of paper between the end mill and the flat. Zero the vertical position.

Wipe some tapping fluid across all flats.

Mill the middle or 00.000 flat at 750 RPM with a .002" Feed Rate.

Use the "Move To" button, move the 4th axis to -45 and Mill the Flat.

Use the "Move To" button, move the 4th axis to -315 and Mill the Flat.

Remove the End Mill from machine and re-install the indicator.

Use the "Move To" button, move the 4th to -360 degrees and zero the 4th axis position.

Verify the Mill cuts be running the indicator along the 0 degree flat, record any error _____.

Use the "Move To" button; move the 4th to -45 degrees. Indicate the flat, record any error _____. DO NOT dial in the flat.

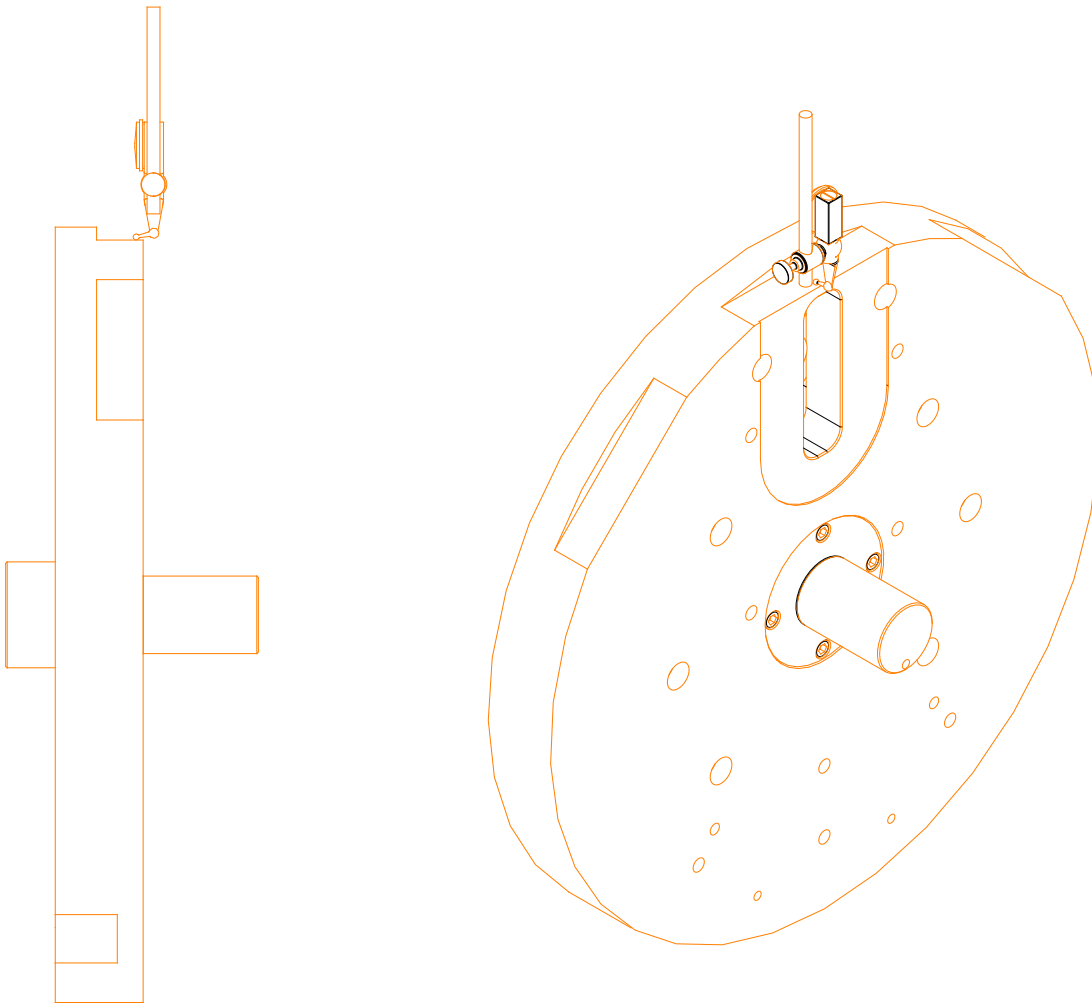
Use the "Move To" button; move the 4th to -315 degrees. Indicate the flat, record any error _____. DO NOT dial in the flat.

Setting Home Position

Press the "HOME MACHINE" button from the SET ZEROS screen. All axes will home including the 4th axis.

When the screen displays the message: "Homing Complete" ... Set the 4th Axis zero.

Place the magnetic base of the indicator assembly on the spindle nose. Place the Probe of the indicator on the middle or degree flat on the indexer plate.



REF4TH29

Run the indicator back and forth across the flat... Use the hand-wheel to indicate the surface within .0003".

Note the numeric value in the position read out for the 4th Axis. Record the value here _____. This is the Distance from home (in degrees) to the 4th Axis zero position.

From the Setup Electronics menu, choose IO.



The following list will appear.

Verify the settings are correct for Forth Axis Addin.

Verify the settings are correct for A.

The screenshot shows a window titled "IO List Form" with a table of IO configurations. The table has 7 columns and lists various components and their settings. The "Forth Axis Addin" and "A" sections are highlighted in blue.

Component	IO Type	IO Number	IO Name	Timer	Default State
X					
Y					
Z					
Handwheel					
S					
Misc					
Forth Axis Addin					
- A.LightExtend	Outputs 5	12	DigitalOutput	NoTimer	False
- A.FullExtend	Outputs 5	13	DigitalOutput	NoTimer	False
- A.Retract	Outputs 5	14	DigitalOutput	NoTimer	False
- A.Brake	Outputs 5	15	DigitalOutput	NoTimer	True
A					
- A Thermal	Unassigned	-1	DigitalOutput	NoTimer	False
- A Home Switch	Inputs 6	9	DigitalInput	NoTimer	False
- A Top Limit Switch	Unassigned	-1	DigitalInput	NoTimer	False
- A Bottom Limit Switch	Unassigned	-1	DigitalInput	NoTimer	False
- A Emergency Brake	Unassigned	-1	DigitalOutput	NoTimer	False
Augur Addin					
Augur Inverter					
Coolant Inverter					
DualATC Addin					
ATC Arm Inverter					
ATC Drum Inverter					
Oiler Addin					
Probe Addin					
LineBore Addin					
Spindle Addin					

Buttons at the bottom: Update, OK, Cancel

Air Settings: Set the air pressure for the 4th axis as shown on the air diagram.

Light extend = 50 PSI this may vary a little up or down to get smooth operation that is not too slow.

Brake = 30 PSI

Set the Flow controls

Brake = Full CW and one CCW

Extend = Full CW and two turns CCW

Retract = Full CW and two turns CCW

Exhaust = Full CW and 5 turns CCW

Set the relief valve to PSI. Any pressure over 50 PSI on the Light Clamp air gauge should cause the relief valve to bleed off pressure.

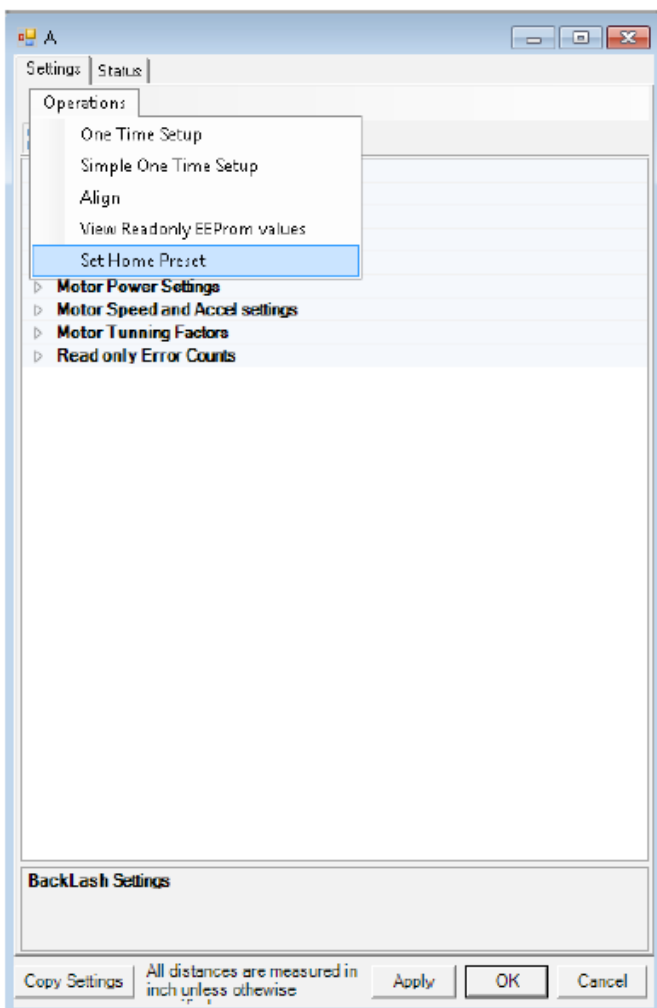
4th Axis Faceplate Indexer Accuracy Setup and Qualification

Go to Setup Electronics>Control>A, set the Auto and Hand-wheel backlash to 00.000

Install a .0001" indicator onto the spindle nose.

Indicate the vertical slot on the face plate to within .0002". The last move when indicating in MUST be in the Negative direction.

Set the 4th axis zero using the Home Preset in Setup Electronics>Control>A>Operations.



CHEVROLET LOCATOR SETS

650-3-68 Locator Assembly (Small Block Chevy)

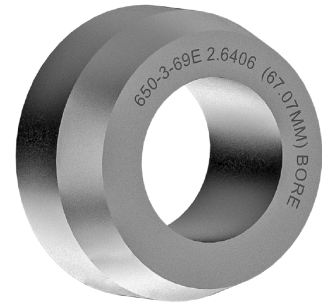
650-3-70C



650-3-69



650-3-69E



650-3-68B Locator Assembly (Big Block Chevy)

650-3-62W



650-3-69B



650-3-69G

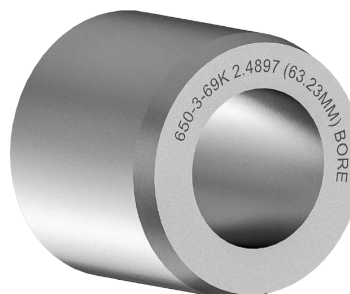


650-3-68L Locator Assembly (327 Small Journal Crank)

650-3-70C



650-3-69K



650-3-69L



650-3-68J Locator Assembly (400 Small Block Chevy)

650-3-70C



650-3-69T



650-3-69U



650-3-68G Locator Assembly (Chevy Bowtie Block)

650-3-70B



650-3-69



650-3-69E



650-3-68F Locator Assembly (Chevy 58mm Cam Bore) for 55mm Cam Journal

650-3-70A



650-3-69



650-3-69E



650-3-68E Locator Assembly (Chevy 63mm Cam Bore) for 60mm Cam Journal

650-3-70



650-3-69



650-3-69E



650-3-68M Locator Assembly (Chevy 5.3 liter 99 & Up)

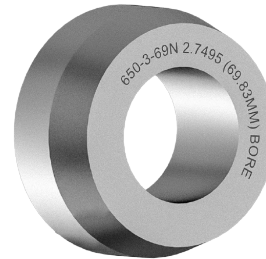
650-3-70C



650-3-69M



650-3-69N



650-3-68R Locator Assembly (Chevy Gen3 LS1 to LS6)

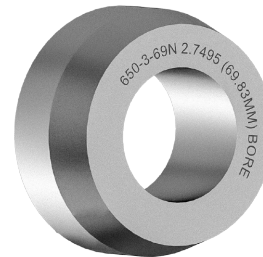
650-3-70H



650-3-69M

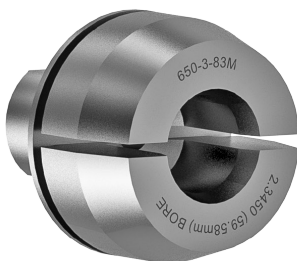


650-3-69N



650-3-68T Locator Assembly (Chevy LS7)

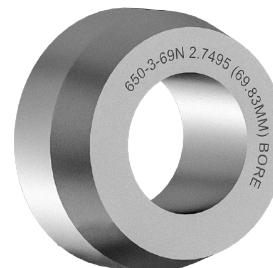
650-3-83M



650-3-69M



650-3-69N



FORD LOCATOR SETS

650-3-68A Locator Assembly (Ford 289/302)

650-3-62Z



650-3-69A



650-3-69F



650-3-68H Locator Assembly (Ford 351W)

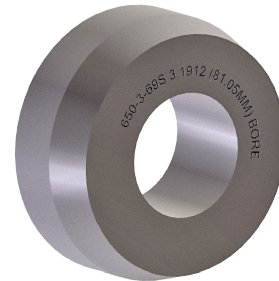
650-3-62Z



650-3-69R

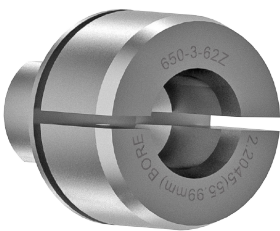


650-3-69S



650-3-68P Locator Assembly (Ford 351C)

650-3-62Z



650-3-69V

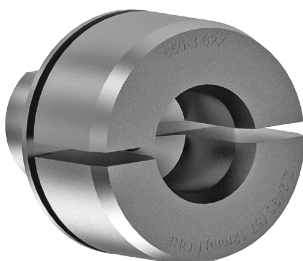


650-3-69W

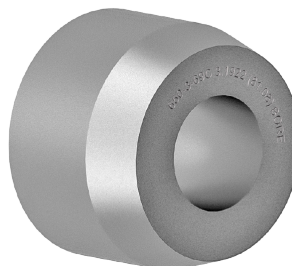


650-3-68C Locator assembly (Ford 460)

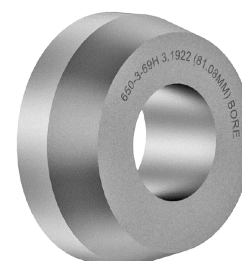
650-3-62X



650-3-69C



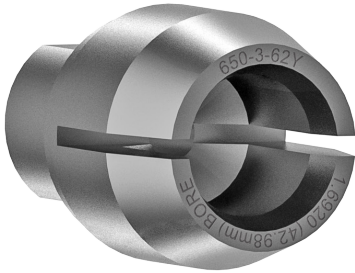
650-3-69H



MOPAR LOCATOR SETS

650-3-68K Locator Assembly (Mopar 318)

650-3-62Y



650-3-69P

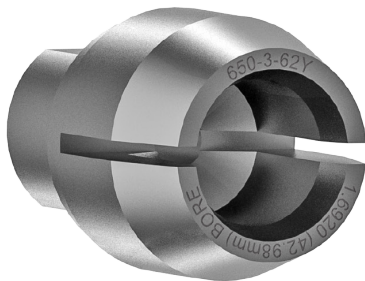


650-3-69Q

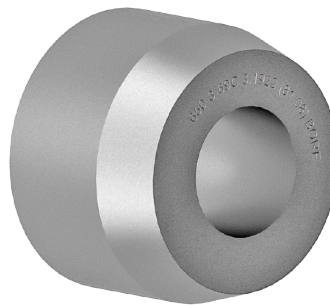


650-3-68D Locator Assembly (Mopar 360)

650-3-62Y



650-3-69D

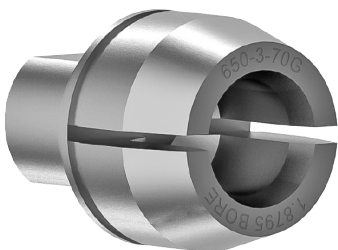


650-3-69J



650-3-68Q Locator Assembly (Mopar 383,426,440)

650-3-70G



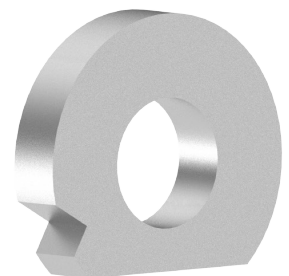
650-3-69Z



650-3-71G

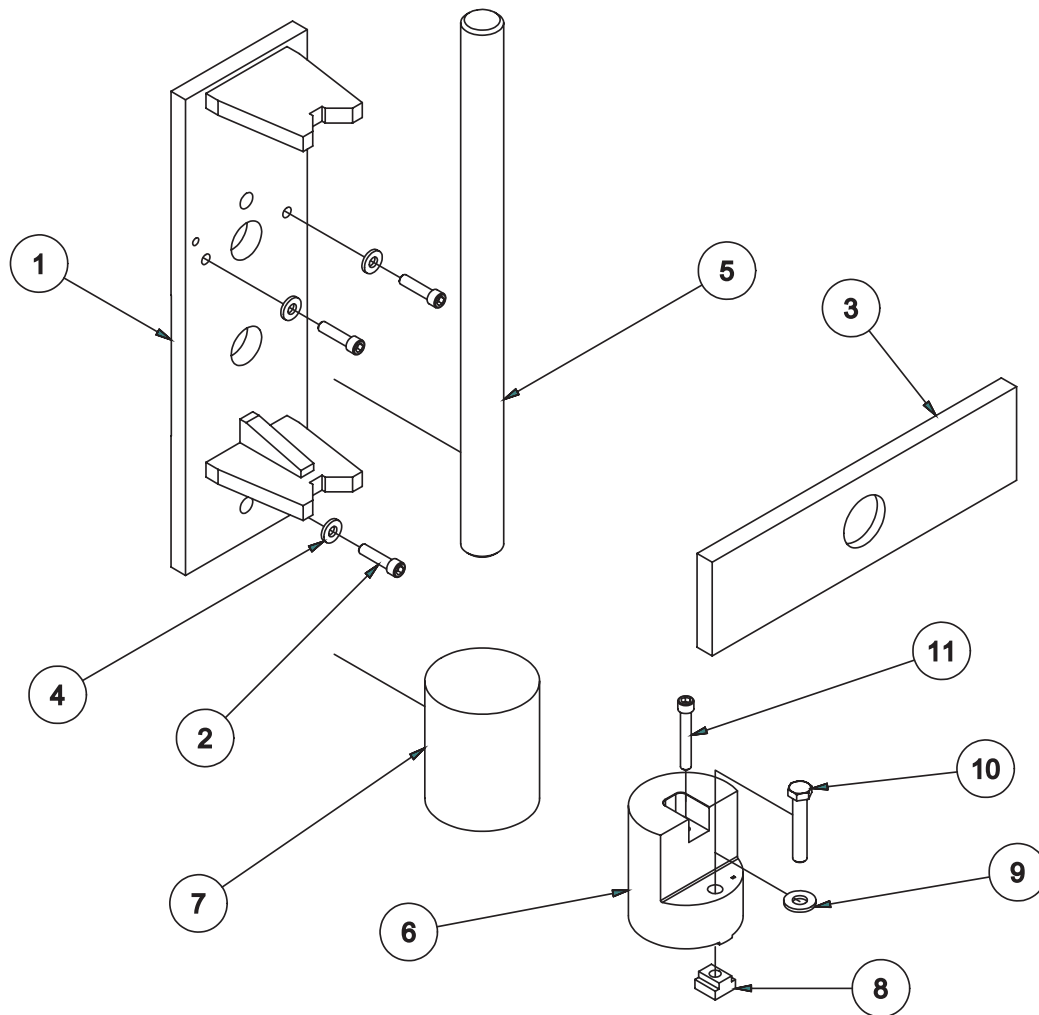


650-3-61V



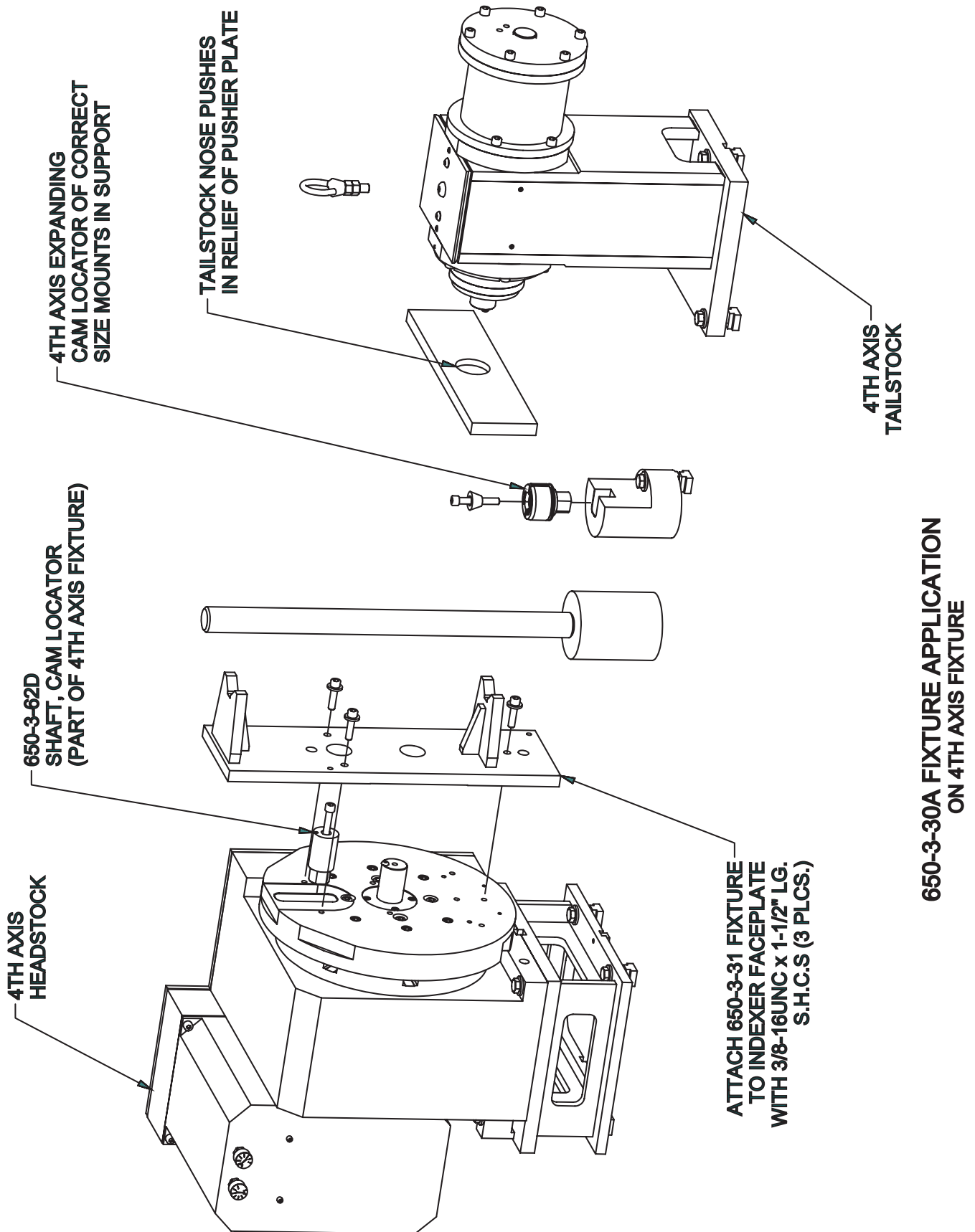
BLOCK END TRUING

650-3-30A Block End Truing Fixture Assembly Parts



650-3-30A BLOCK END TRUING FIXTURE ASSEMBLY, 4TH AXIS FIXTURE			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-3-31	BLOCK END TRUING FIXTURE (MACHINING)
2	3	MF-33	3/8-16UNC x 1-1/2" LG. S.H.C.S.
3	1	650-3-32	PUSHER PLATE BLOCK END TRUING FIXTURE
4	3	100-28-18	Washer
5	1	650-3-33A	BAR (1-1/2") VERTICAL BLOCK END TRUING FIXTURE
6	1	650-3-43X	SUPPORT LOCATOR, CAM - (4.7" RISER) CAM LINE BORING FIXTURE
7	1	650-3-43V	RISER, BLOCK END TRUING
8	1	650-3-10	TN-5 T-Nut
9	1	100-19A	Hardened washer 17/32 I.D.
10	1	MF-150C	1/2-13UNC x 2-3/4" LG. HEX BOLT
11	1	Mf-36	3/8-16UNC x 2-1/2" LG. S.H.C.S.

650-3-30A Block End Truing Fixture Assembly Setup

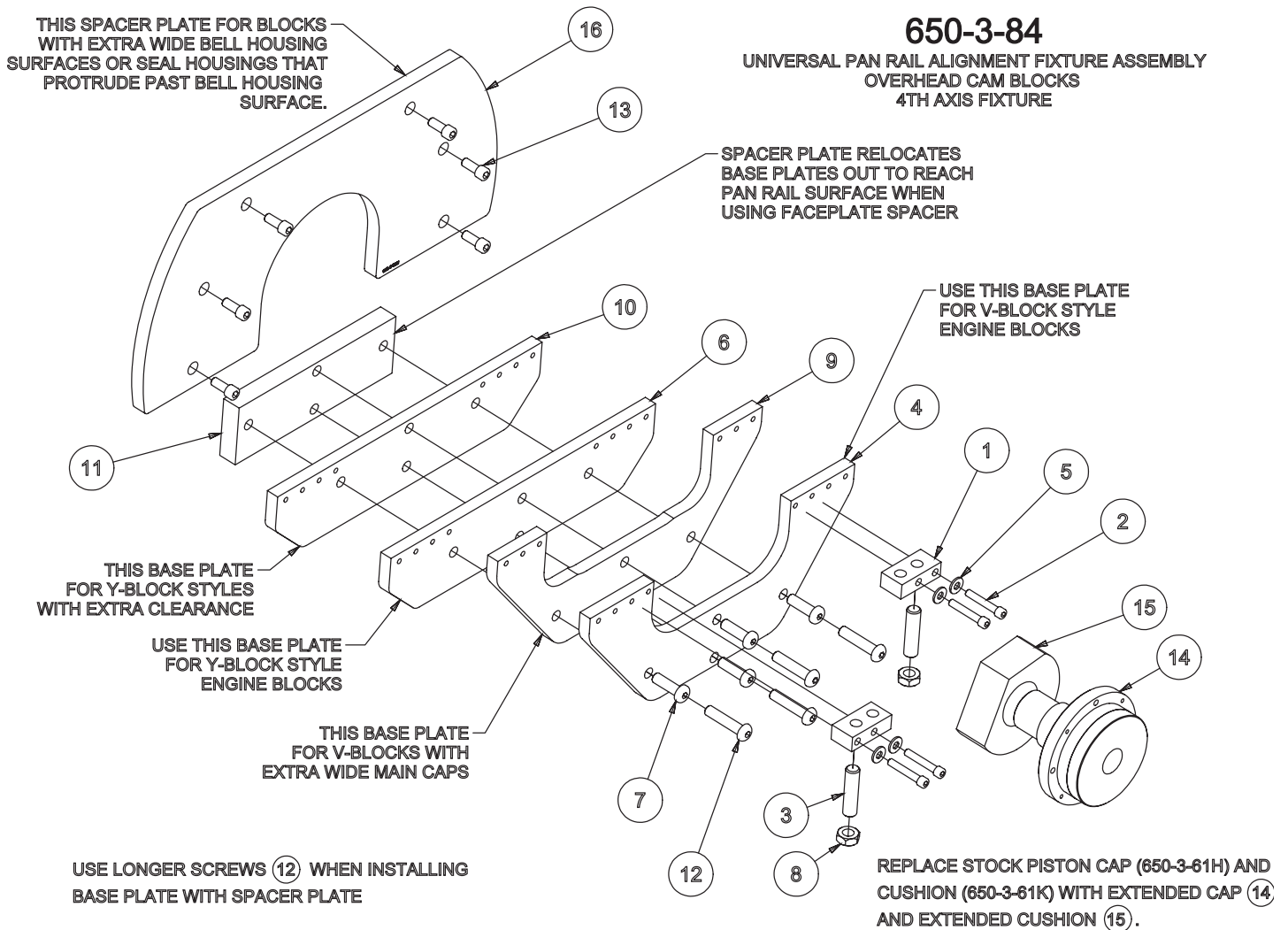


OVERHEAD CAM BLOCK MACHINING

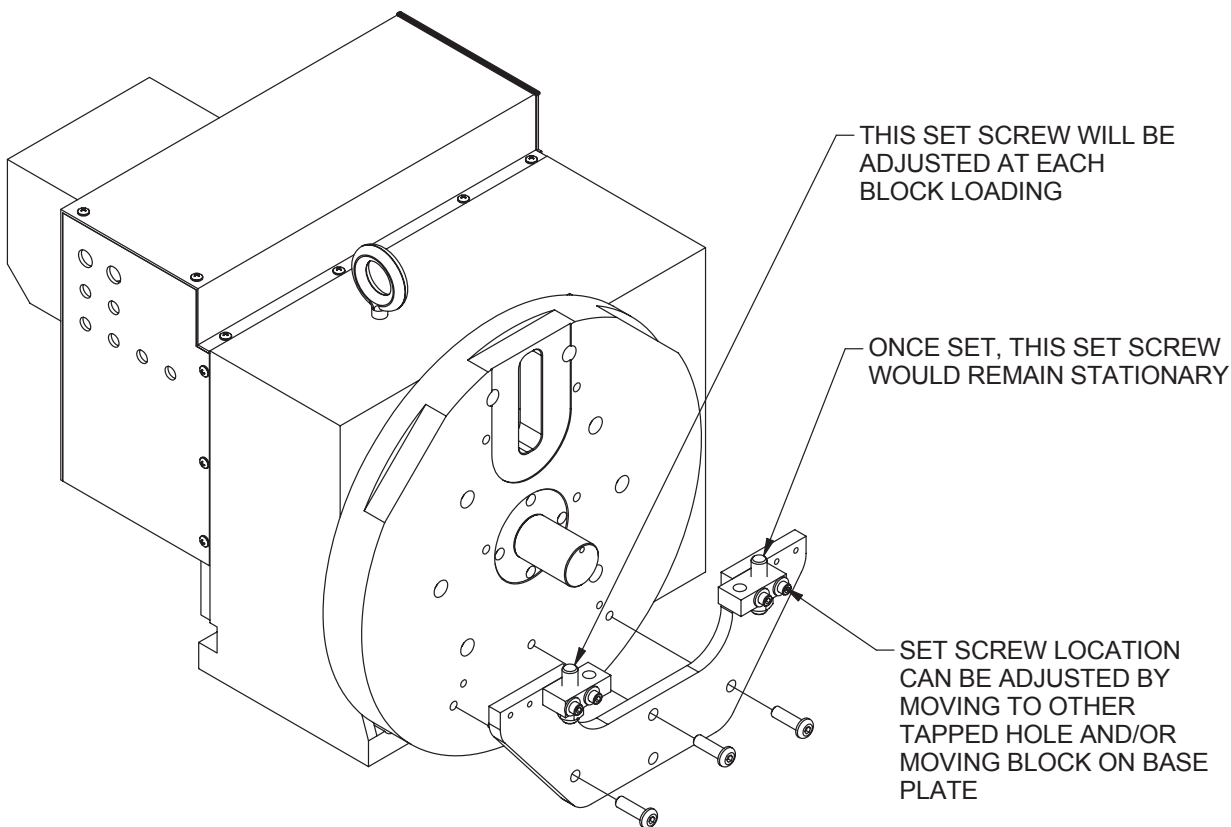
650-3-84 Overhead Cam Block Fixture Parts

650-3-84

UNIVERSAL PAN RAIL ALIGNMENT FIXTURE ASSEMBLY OVERHEAD CAM BLOCKS 4TH AXIS FIXTURE



650-3-84 Overhead Cam Block Fixture Setup V-Block



650-3-84 OVERHEAD CAM BLOCK FIXTURE INSTALLATION AND OPERATING INSTRUCTIONS V-BLOCK APPLICATIONS

INSTALLATION: LOCATE THE 650-3-84A BASE PLATE ONTO THE 650-3-62B INDEXER FACEPLATE USING (4) EXISTING 3/8-16UNC TAPPED HOLES IN FACEPLATE. FASTEN BASE PLATE USING (4) MF-97C SOCKET BUTTONHEAD SCREWS.

OPERATING: THIS FIXTURE LOCATES THE PAN RAILS OF V-STYLE OVERHEAD CAM BLOCK USING (2) 650-3-84D FLAT POINT SET SCREWS TO LEVEL THE BLOCK.

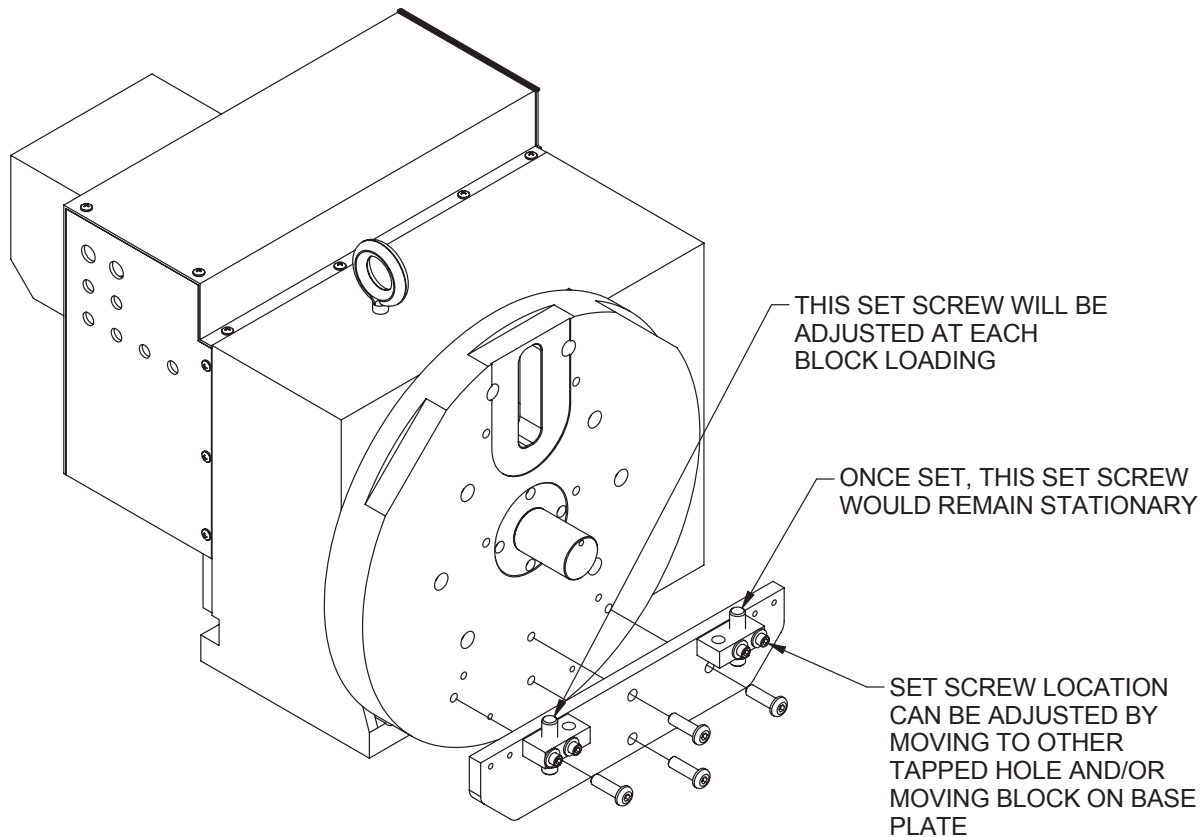
INSTALL THE BLOCK USING THE APPROPRIATE MAIN LOCATORS WITH THE INDEXER SET AT 0 DEGREES.

WITH THE MF-171 HEX NUTS LOOSE, ADJUST THE 650-3-84D SET SCREWS TO CONTACT THE PAN RAIL OF THE BLOCK. MULTIPLE MOUNTING HOLES ARE PROVIDED TO ALTER THE LOCATION OF THE 650-3-84C PUSH BLOCKS AND THE SET SCREWS CAN BE MOVED TO EITHER HOLE TO FIT DIFFERENT BLOCKS.

ONCE THE BLOCK IS LEVEL AND THE SET SCREWS ARE BOTH CONTACTING THE PAN RAILS, TIGHTEN THE MF-171 HEX NUTS, CHECK THE BLOCK FOR LEVEL, AND MACHINE.

TO UNLOAD THIS BLOCK AND LOAD ANOTHER BLOCK OF THE SAME STYLE:
LOOSEN THE HEX NUT AND SET SCREW NEAREST TO THE OPERATOR. REMOVE THE BLOCK AND INSTALL THE NEXT BLOCK. ROTATE THIS BLOCK TO CONTACT THE SET SCREW TO THE REAR OF THE FACEPLATE (FURTHEST FROM THE OPERATOR). ADJUST FRONT SET SCREW TO CONTACT THE BLOCK AND TIGHTEN THE HEX NUT. IT IS ADVISABLE TO CHECK THE BLOCK FOR LEVEL DUE TO THE POSSIBILITY OF VARIATION BETWEEN BLOCKS.

650-3-84 Overhead Cam Block Fixture Y-Block



650-3-84 OVERHEAD CAM BLOCK FIXTURE INSTALLATION AND OPERATING INSTRUCTIONS Y-BLOCK APPLICATIONS

INSTALLATION: LOCATE THE 650-3-84E BASE PLATE ONTO THE 650-3-62B INDEXER FACEPLATE USING (4) EXISTING 3/8-16UNC TAPPED HOLES IN FACEPLATE. FASTEN BASE PLATE USING (4) MF-97C SOCKET BUTTONHEAD SCREWS.

OPERATING: THIS FIXTURE LOCATES THE PAN RAILS OF OVERHEAD CAM BLOCKS USING (2) 650-3-84D FLAT POINT SET SCREWS TO LEVEL THE BLOCK.

INSTALL THE BLOCK USING THE APPROPRIATE MAIN LOCATORS WITH THE INDEXER SET AT 0 DEGREES.

WITH THE MF-171 HEX NUTS LOOSE, ADJUST THE 650-3-84D SET SCREWS TO CONTACT THE PAN RAIL OF THE BLOCK. MULTIPLE MOUNTING HOLES ARE PROVIDED TO ALTER THE LOCATION OF THE 650-3-84C PUSH BLOCKS AND THE SET SCREWS CAN BE MOVED TO EITHER HOLE TO FIT DIFFERENT BLOCKS.

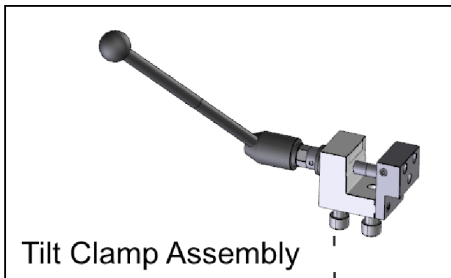
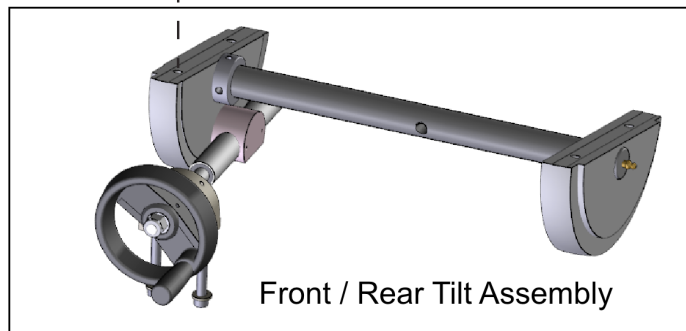
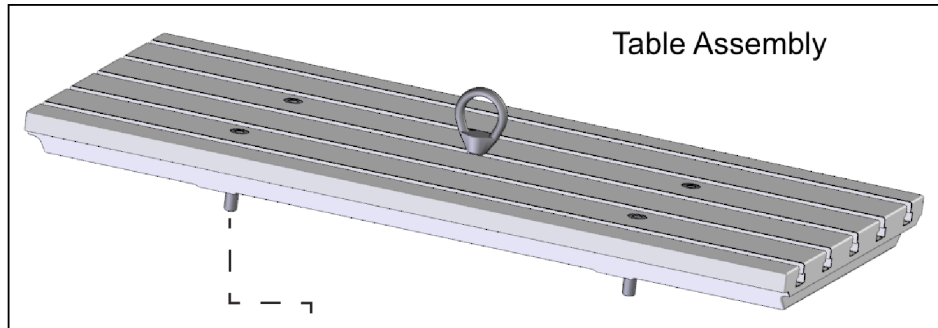
ONCE THE BLOCK IS LEVEL AND THE SET SCREWS ARE BOTH CONTACTING THE PAN RAILS, TIGHTEN THE MF-171 HEX NUTS, CHECK THE BLOCK FOR LEVEL, AND MACHINE.

TO UNLOAD THIS BLOCK AND LOAD ANOTHER BLOCK OF THE SAME STYLE:
LOOSEN THE HEX NUT AND SET SCREW NEAREST TO THE OPERATOR. REMOVE THE BLOCK AND INSTALL THE NEXT BLOCK. ROTATE THIS BLOCK TO CONTACT THE SET SCREW TO THE REAR OF THE FACEPLATE (FURTHEST FROM THE OPERATOR). ADJUST FRONT SET SCREW TO CONTACT THE BLOCK AND TIGHTEN THE HEX NUT. IT IS ADVISABLE TO CHECK THE BLOCK FOR LEVEL DUE TO THE POSSIBILITY OF VARIATION BETWEEN BLOCKS.

CYLINDER HEAD SURFACING FIXTURE

7209M Leveling Table Sections

7209M Leveling Table Sections



Tensioner Assembly

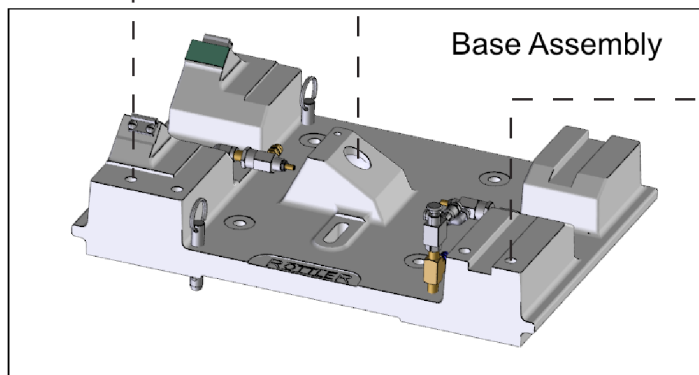
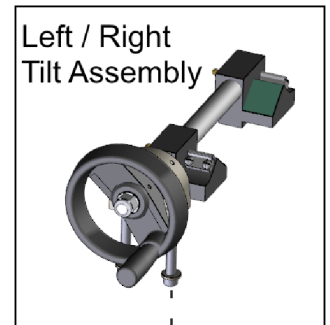
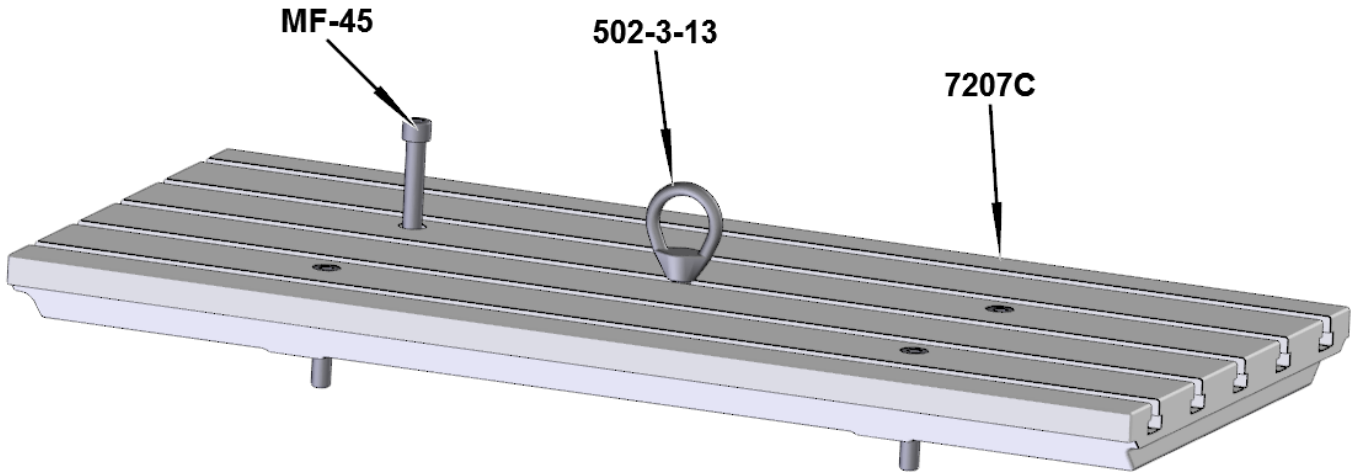
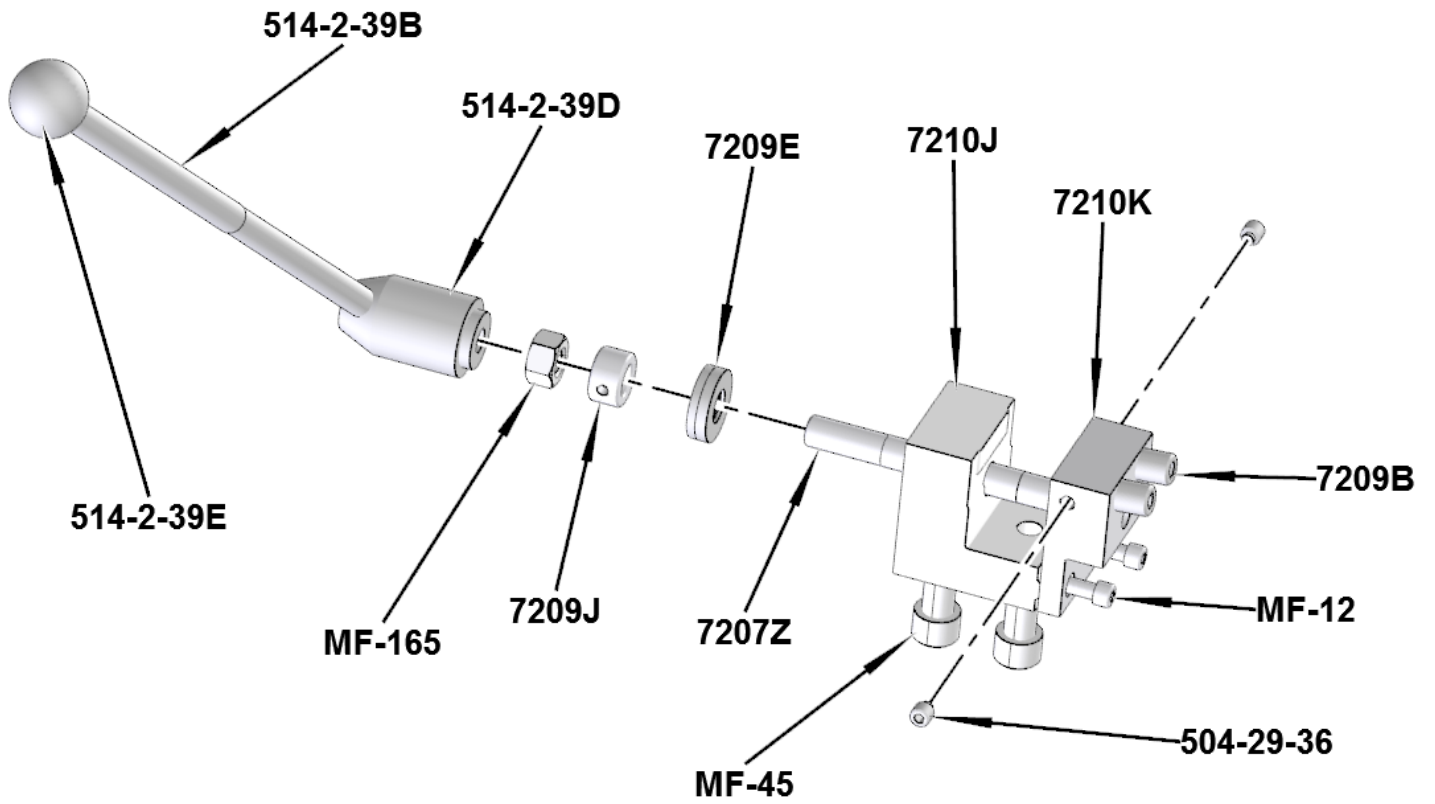


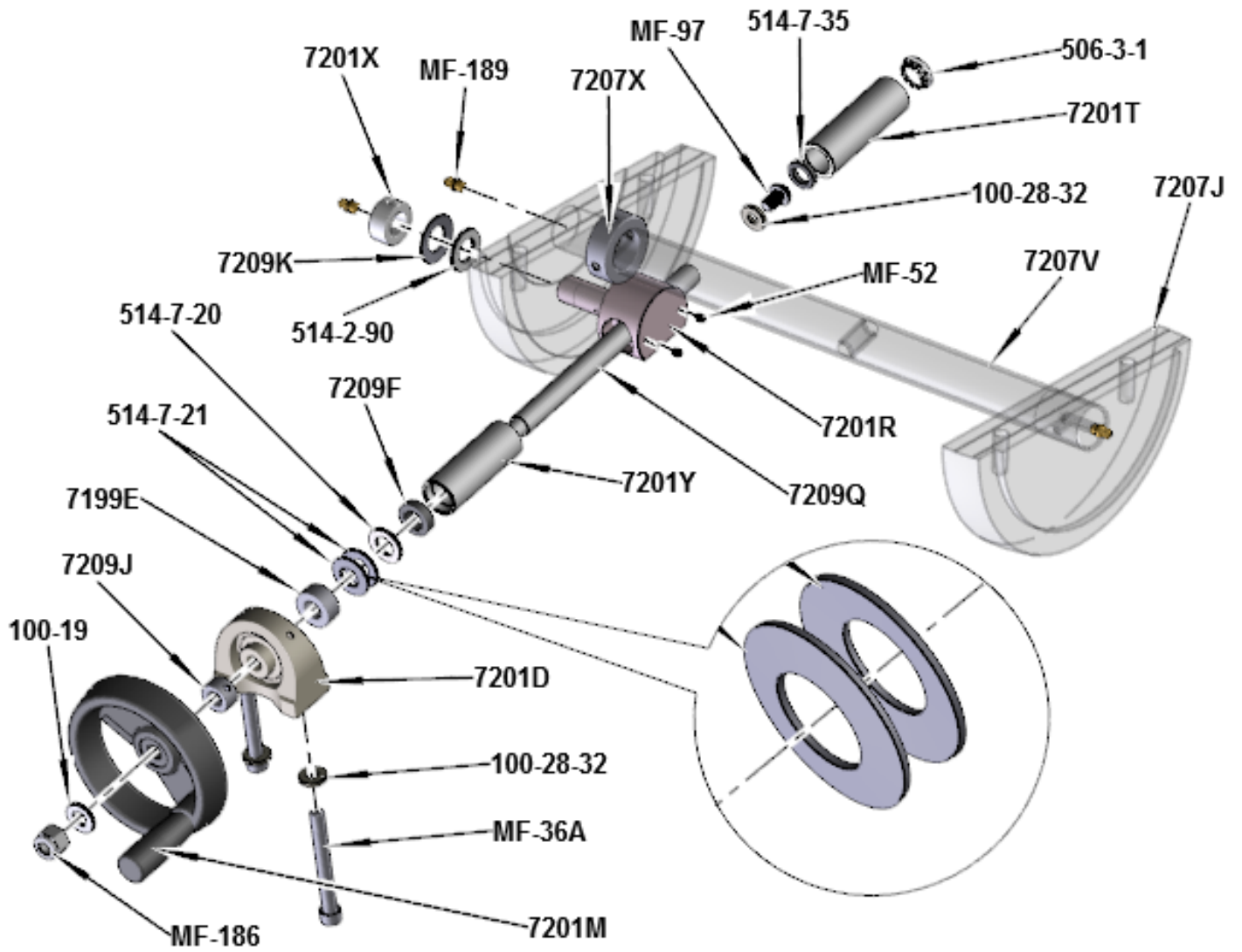
Table Section Parts



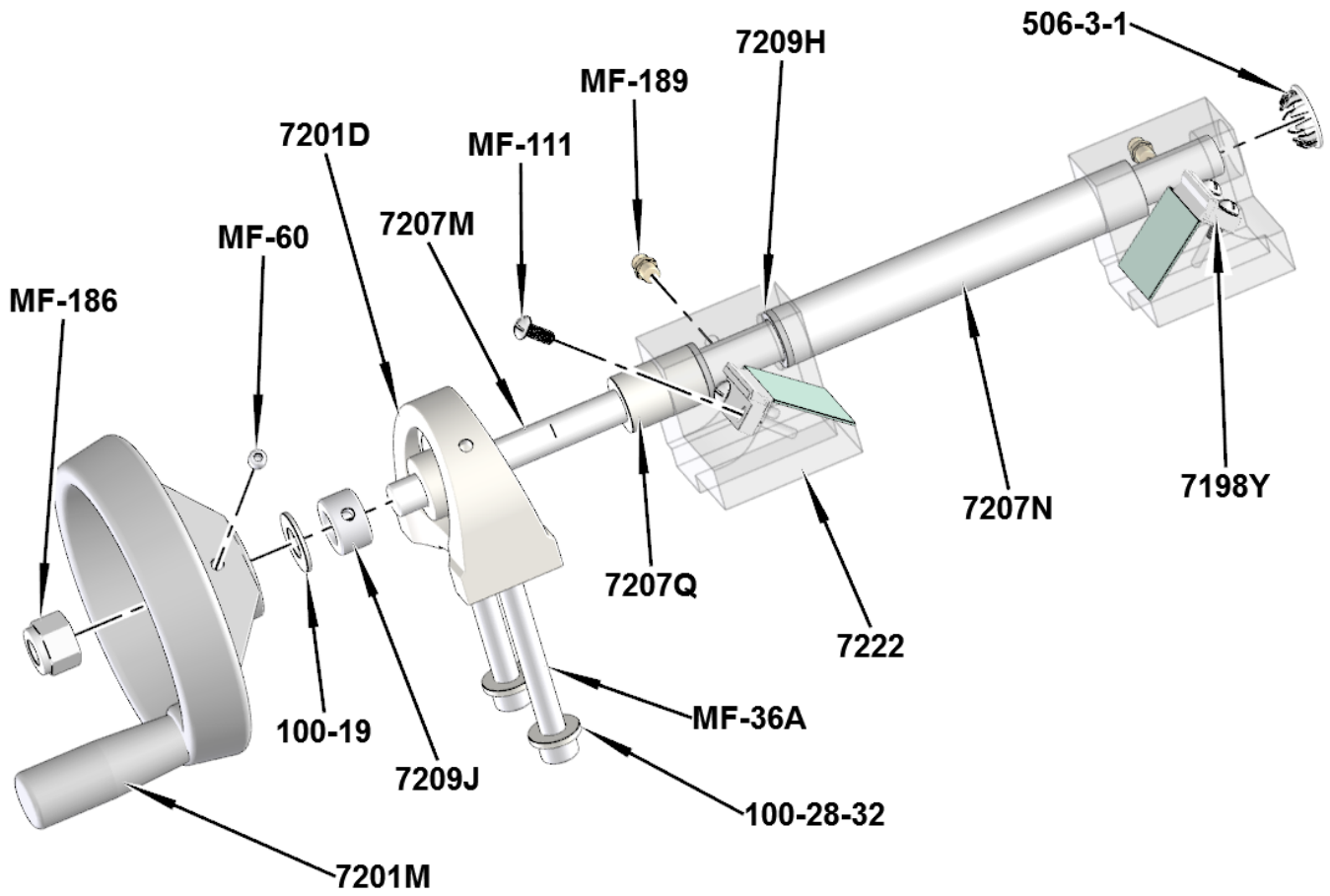
Tilt Clamp Section Parts



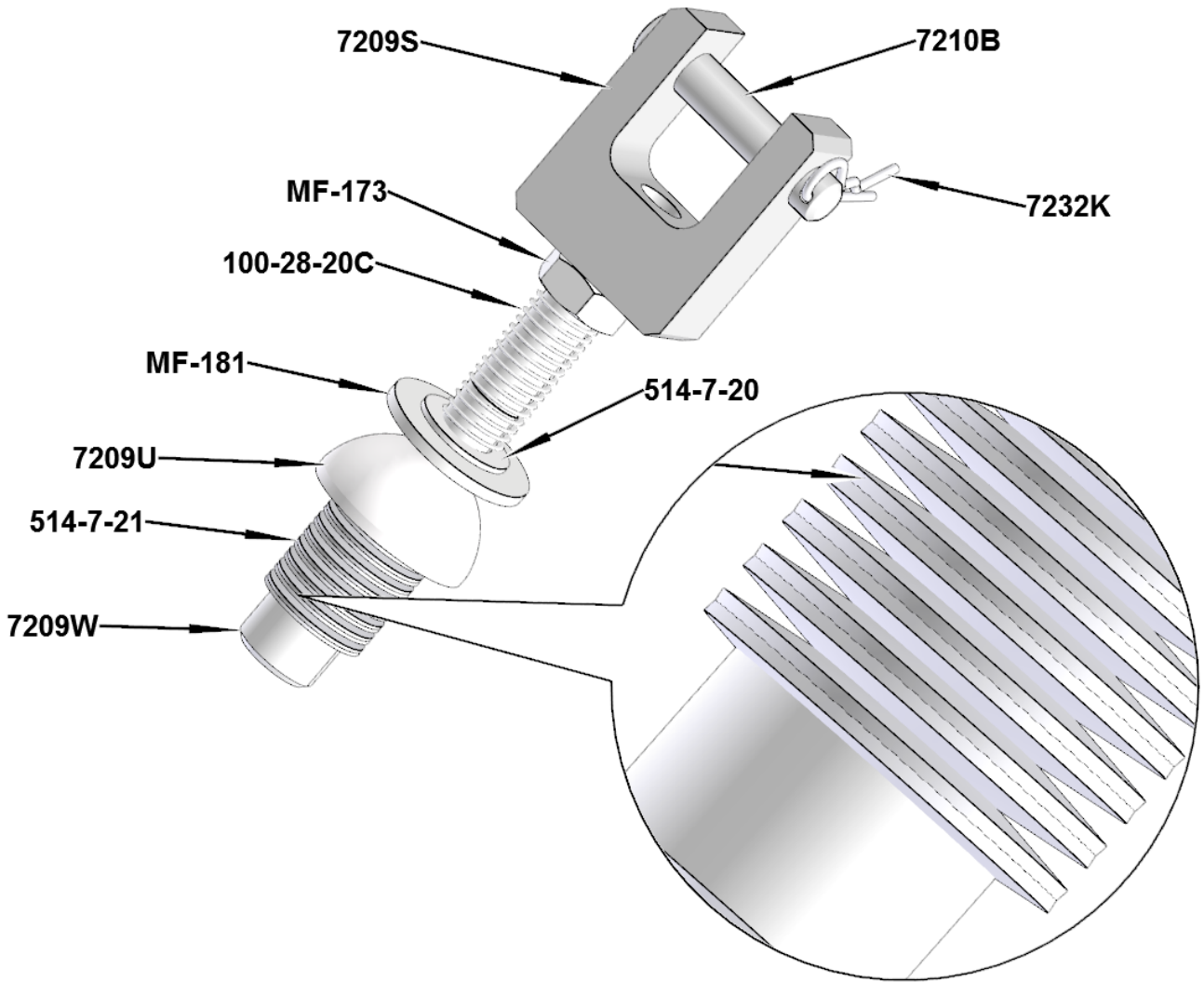
Front / Rear Tilt Section Parts



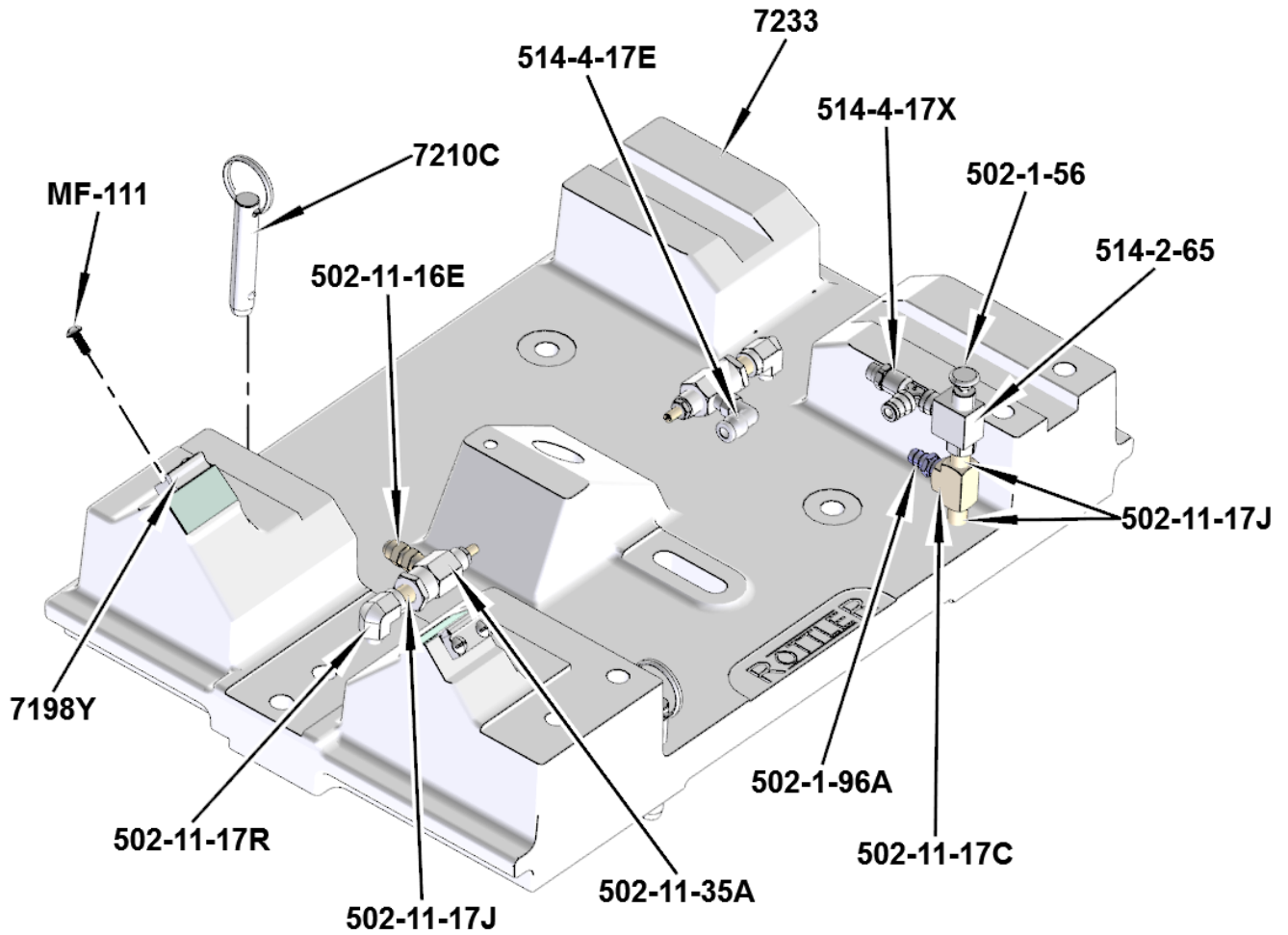
Left / Right Tilt Section Parts



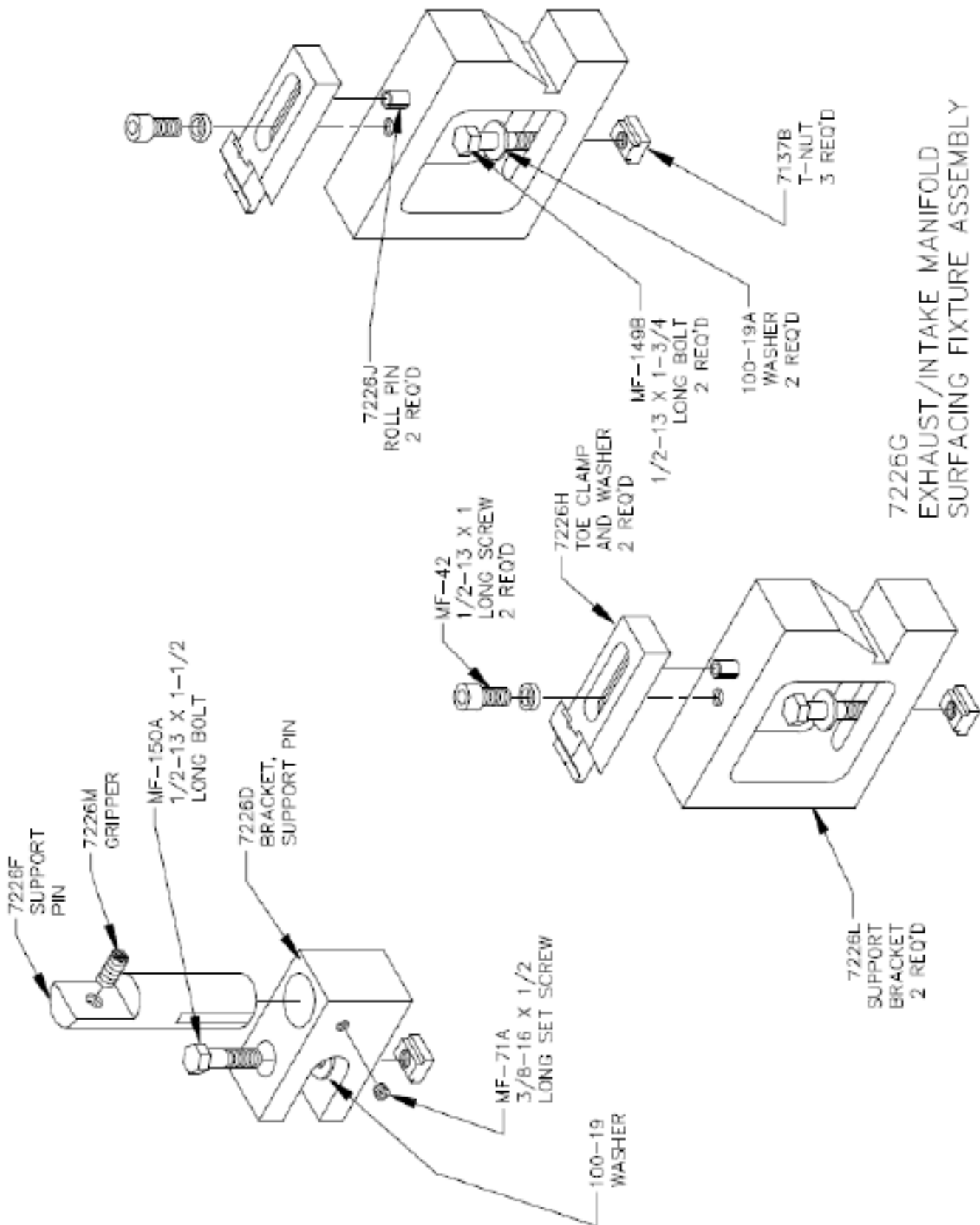
Tensioner Section Parts



Base Section Parts

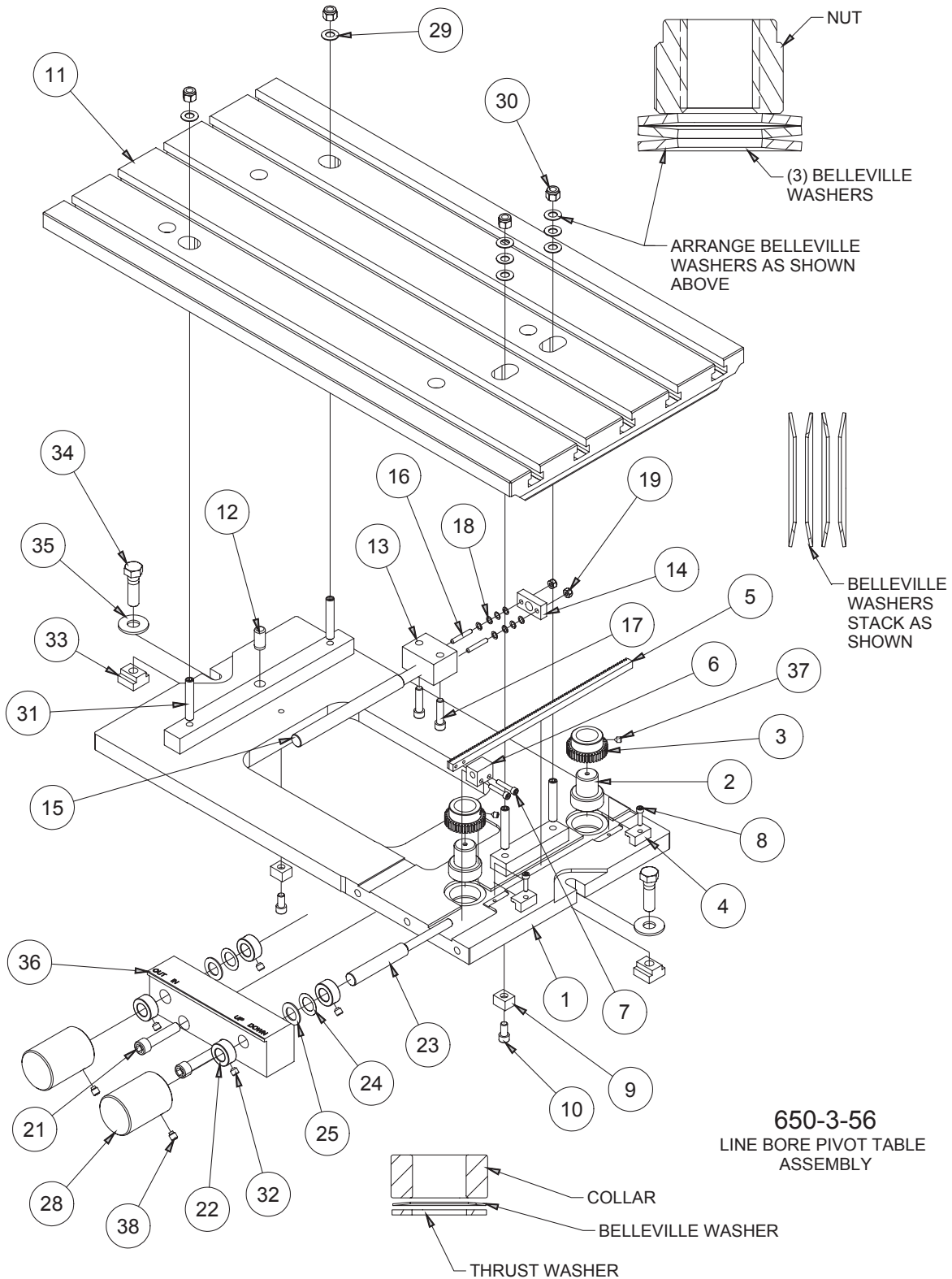


7226G Exhaust and Intake Manifold Surfacing Fixture Parts



BLOCK MAIN LINE BORING AND CAM BORING FIXTURES

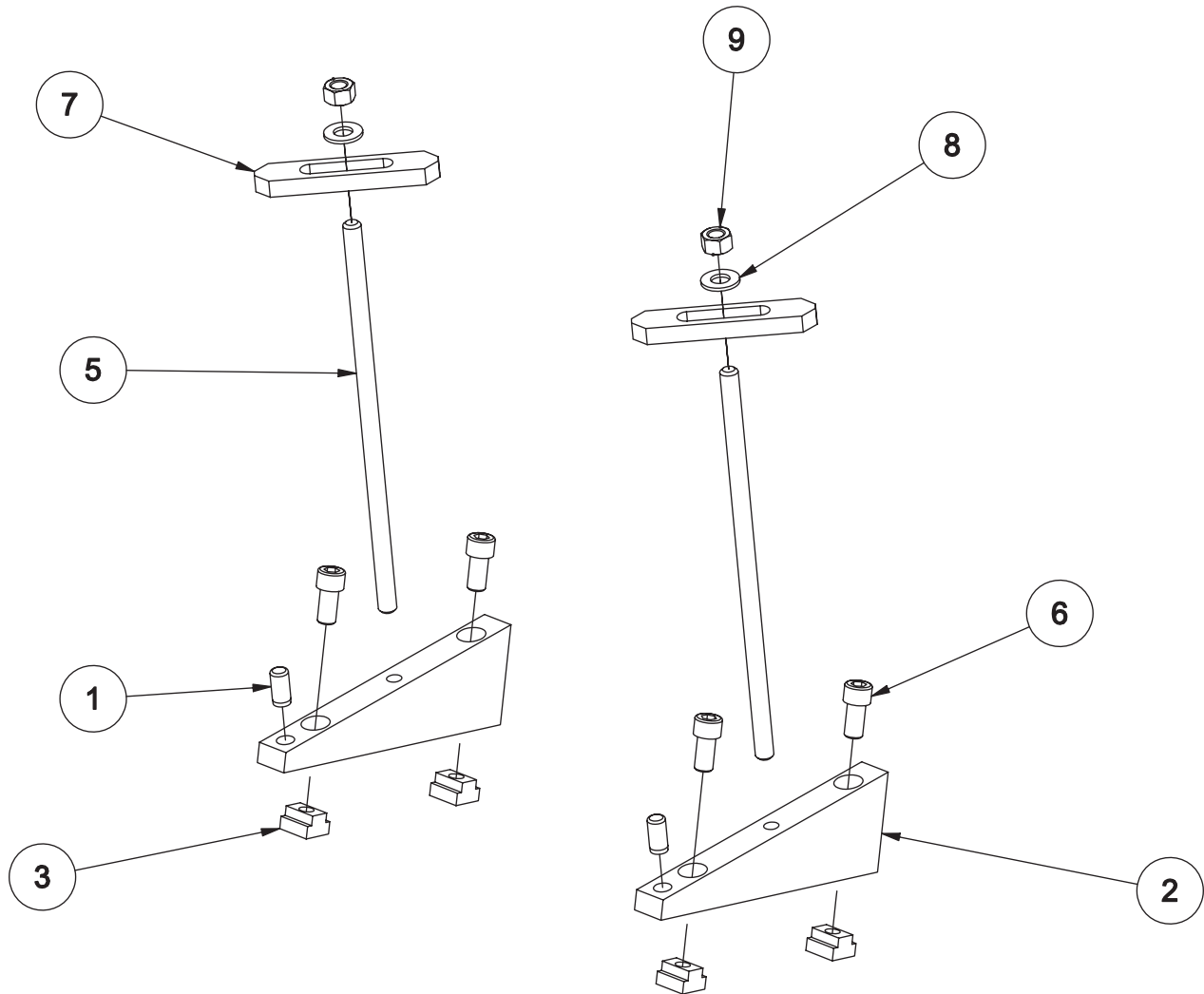
650-3-56 Line Bore Pivot Table Parts



650-3-56
LINE BORE PIVOT TABLE
ASSEMBLY

650-3-56 LINE BORE PIVOT TABLE ASSEMBLY			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-3-56C	LINE BORE PIVOT TABLE ASSEMBLY
2	2	650-3-56D	JACK SCREW - PIVOT TABLE
3	2	650-3-56F	GEAR, JACK SCREW - PIVOT TABLE
4	2	650-3-56K	RETAINER, RACK - PIVOT TABLE
5	1	650-3-56V	RACK - PIVOT TABLE
6	1	650-3-56W	THREADED BLOCK - PIVOT TABLE
7	2	MF-6A	10-24UNC x 1" LG. S.H.C.S.
8	2	MF-6	10-24UNC x 3/4" LG. S.H.C.S.
9	2	650-3-9	Key
10	2	MF-21	5/16-18UNC x 5/8" LG. S.H.C.S.
11	1	650-3-56A	TABLE TOP - PIVOT TABLE
12	1	MF-213B	1/2" x 1" LG. DOWEL PIN
13	1	650-3-56N	THREADED BLOCK, PIVOT - PIVOT TABLE
14	1	650-3-56R	LOCK PLATE - PIVOT TABLE
15	1	650-2-29D	SHAFT, ROTATE ADJUST - PIVOT TABLE
16	2	MF-57A	10-24UNC x 1-1/4" LG. SOCKET SET SCREW
17	2	MF-24	5/16-18UNC x 1-1/4" LG. S.H.C.S.
18	8	650-3-56Q	BELLEVILLE SPRING
19	2	MF-186B	10-24UNC HEX NYLOCK NUT
21	2	MF-40A	7/16-14UNC x 2" LG. S.H.C.S.
22	4	7199E	COLLAR 1/2"
23	1	650-3-56U	lift Adjust Shaft
24	2	650-3-56S	Belleville spring Reid BDB-65
25	2	514-7-20	THRUST WASHER
28	2	650-2-29E	HANDLE
29	8	650-2-28P	BELLEVILLE WASHER
30	4	MF-187B	3/8-16UNC NYLOCK NUT
31	4	MF-75B	3/8-16UNC x 2-1/4" LG. SOCKET SET SCREW
32	4	6863	5/16-18 x 5/16" LG. CONE POINT SET SCREW
33	2	650-3-10	TN-5 T-Nut
34	2	MF-137F	1/2-13UNC x 1-3/4" LG. HEX BOLT
35	2	MF-180	1/2" FLAT WASHER
36	1	650-3-56L	CONTROL BLOCK - PIVOT TABLE
37	2	MF-59B	1/4-20UNC x 5/16" CONE POINT SET SCREW
38	2	504-29-36	5/16-18UNC x 5/8" LG. SOCKET HALF DOG SET SCREW

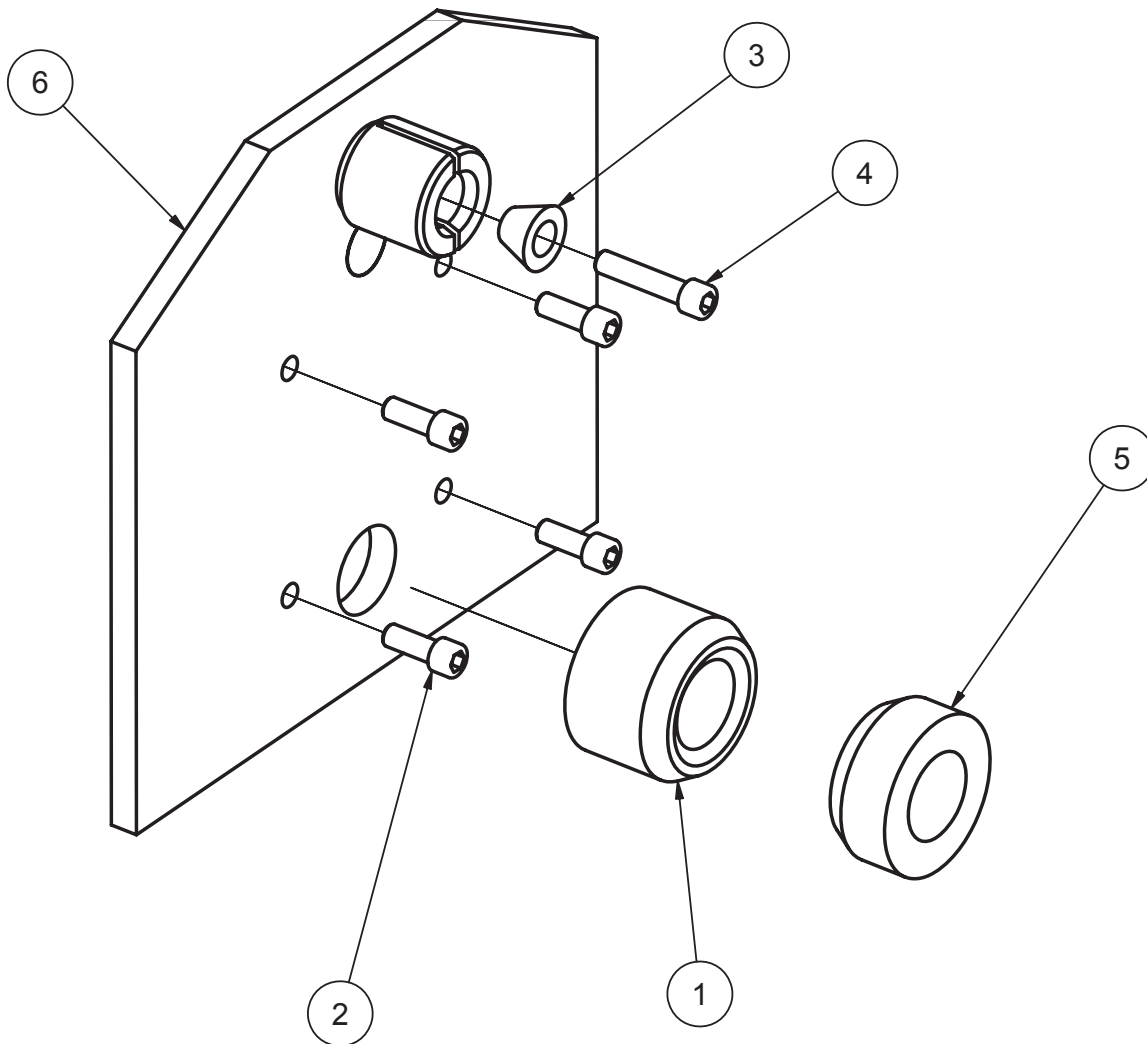
6866 Wedge for Cummins 5.9liter Camshaft Line Boring Parts



6866 15 DEG. WEDGE ASSEMBLY			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	MF-213B	1/2 x 1 Dowel Pin
2	2	6866A	15 DEGREE WEDGE CUMMINS DIESEL CAM BORING FIXTURE
3	4	7137B	T-Nut
5	2	6833B	CLAMP ROD 12"
6	4	MF-42	S.H.C.S. 1/2 - 13 UNC - 1
7	2	650-3-57B	CLAMP BAR
8	2	MF-180	1/2" FLAT WASHER
9	2	MF-165	1/2-13UNC HEX NUT

SPECIAL APPLICATION FIXTURE

650-3-82 Mopar 5.7L Hemi Fixture Assembly Parts

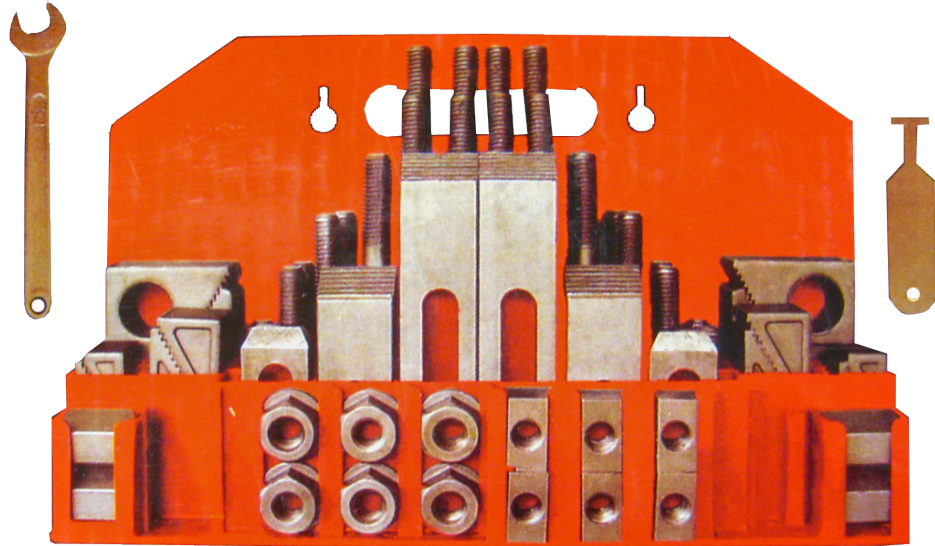


650-3-82 MOPAR 5.7L HEMI FIXTURE ASSEMBLY			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-3-82D	LOCATOR, #5 MAIN 1.7509 DIA. BORE, MOPAR 5.7L HEMI - 4TH AXIS FIXTURE
2	4	Mf-31	Socket Head Cap screw 3/8 - 16 UNC - 1
3	1	650-3-70D	CONE WASHER, EXPANDING CAM LOCATOR - AUTO PERFORMANCE FIXTURE
4	1	Mf-33A	Socket Head Cap screw 3/8 - 16 UNC - 1 3/4
5	1	650-3-82E	LOCATOR, #1 MAIN, 1.7509 DIA. BORE, MOPAR 5.7L HEMI - 4TH AXIS FIXTURE
6	1	650-3-82F	ADAPTER PLATE ASSEMBLY, MOPAR 5.7L HEMI - 4TH AXIS FIXTURE

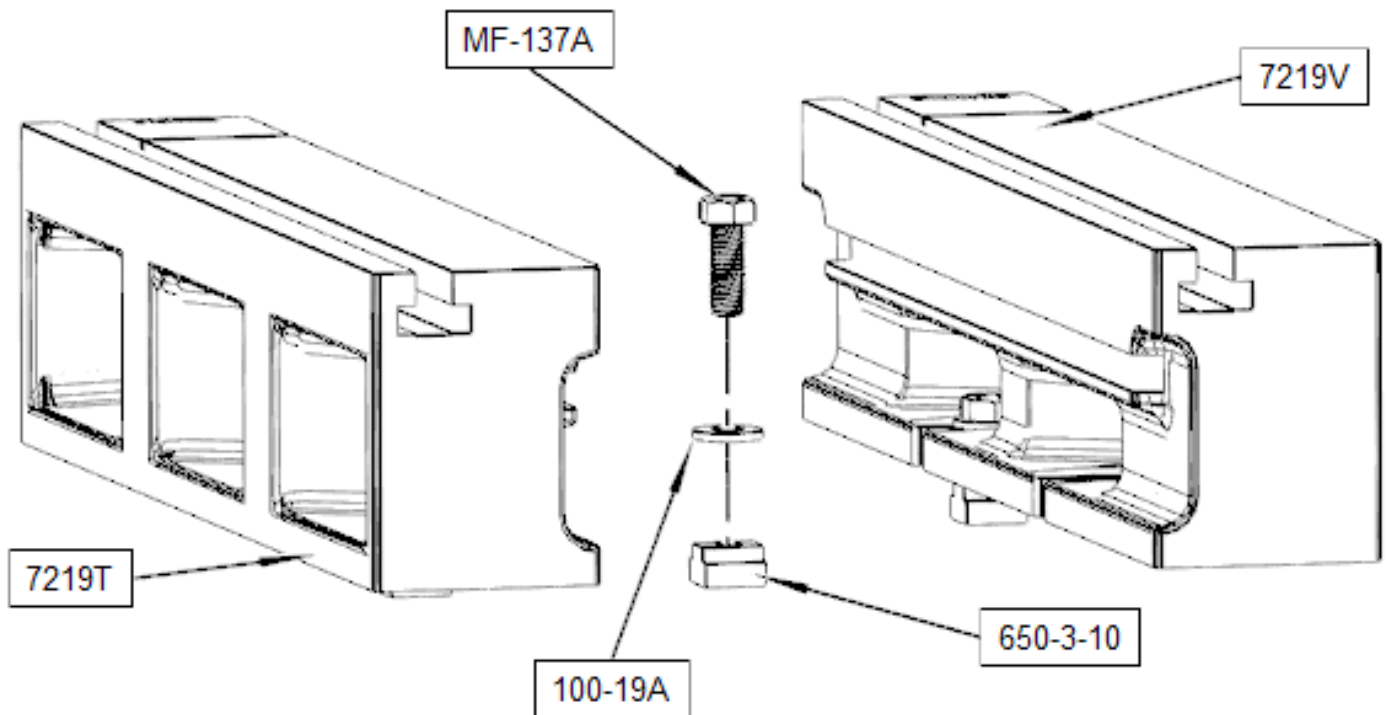
MISCELLANEOUS ACCESSORIES

650-3-37 1/2" (12.7mm) Universal Clamping Kit

Sold only as complete kit.

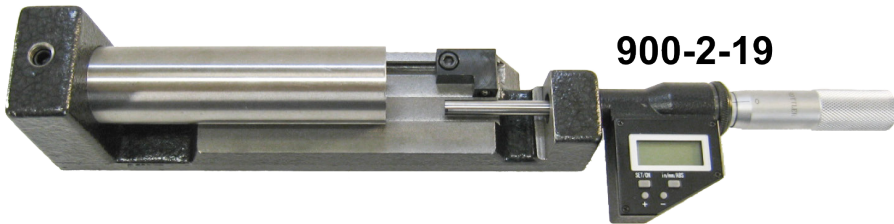
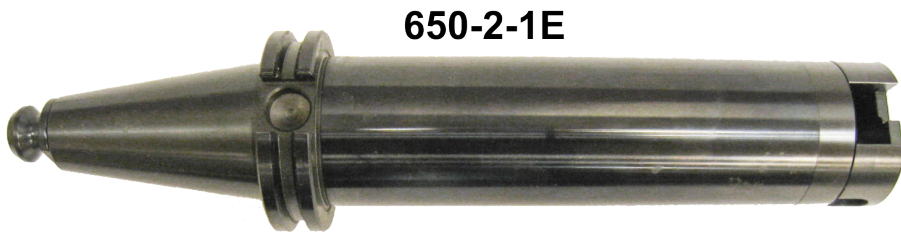


7219W 5.2" (138.08mm) Heavy Duty T-Slot Universal Parallel Parts

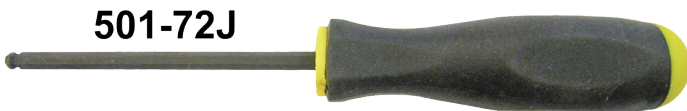
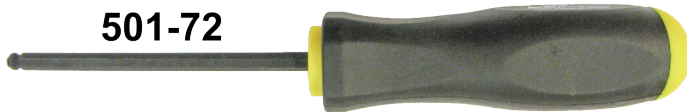
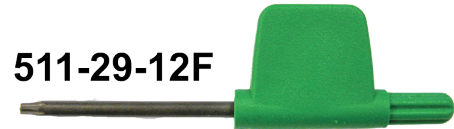
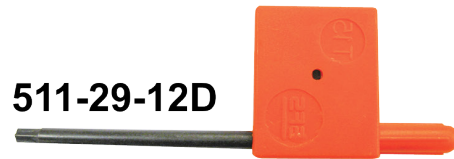
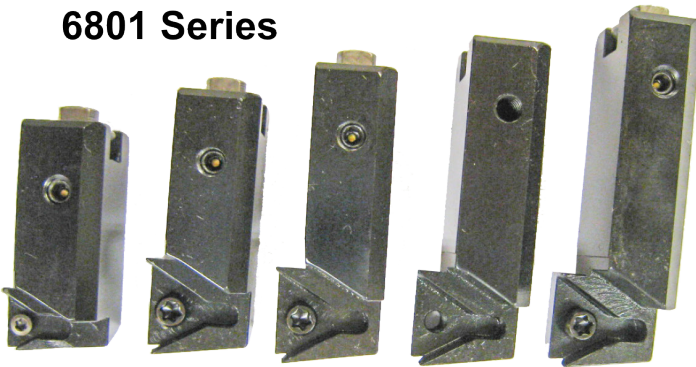


TOOLING FOR ENGINE BLOCK BORING AND RESLEEVEING

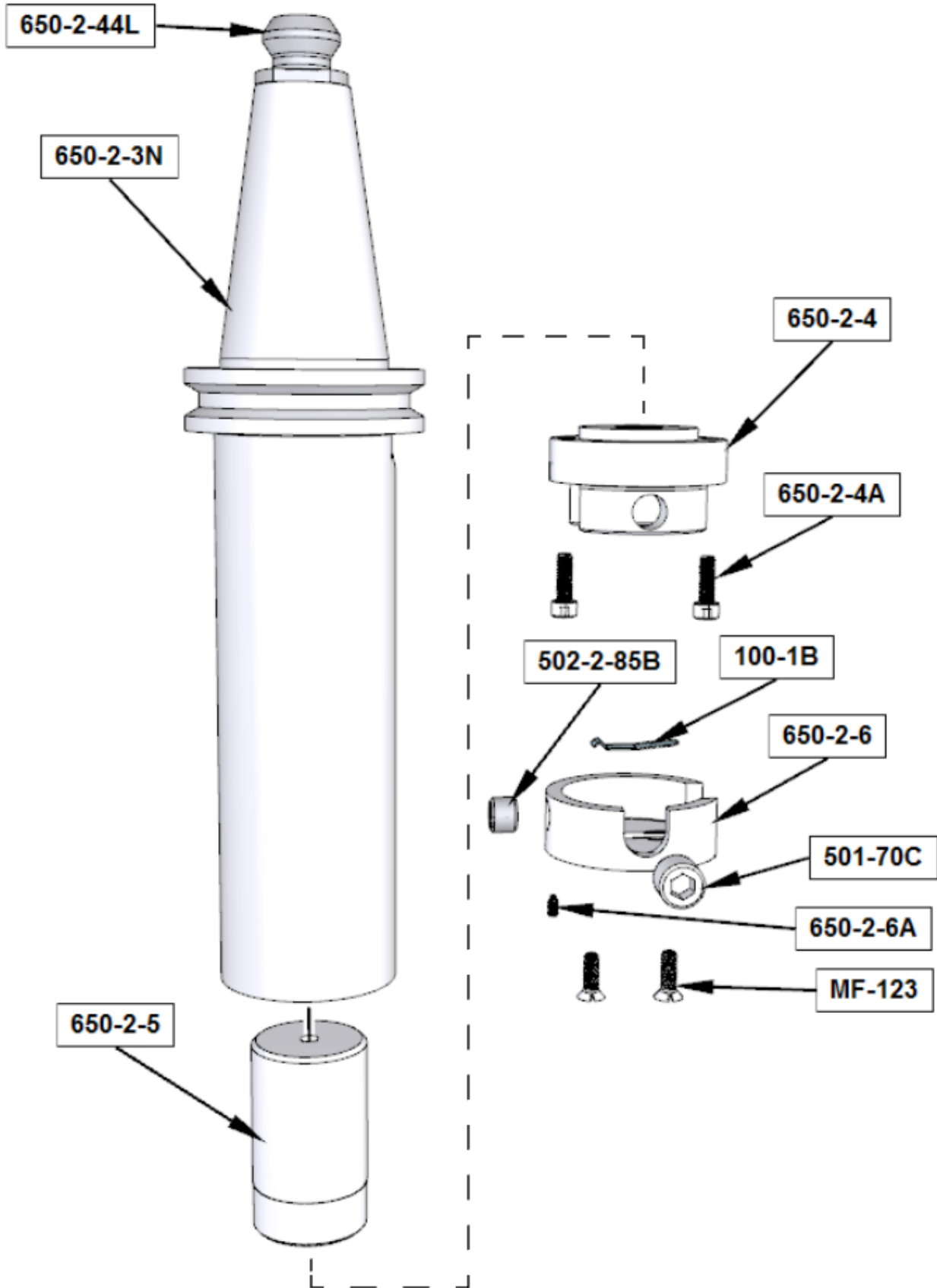
650-2-1D Cutterhead Package Components



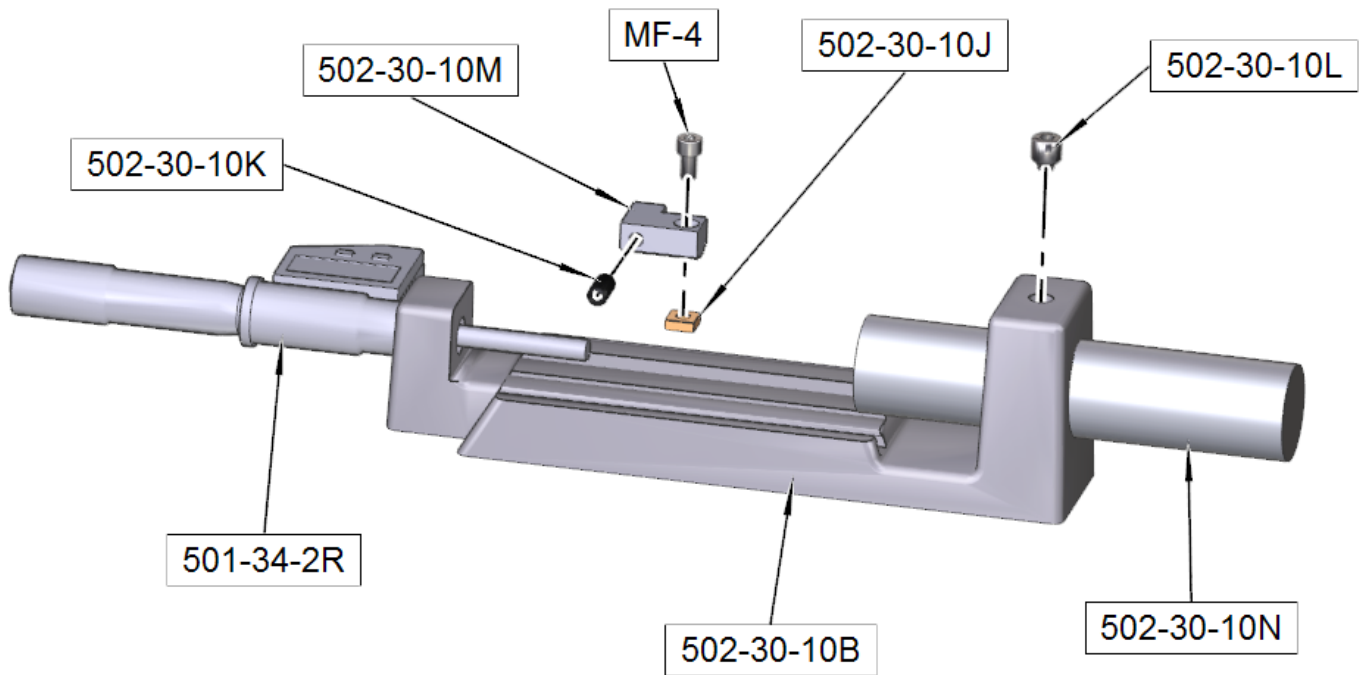
6801 Series



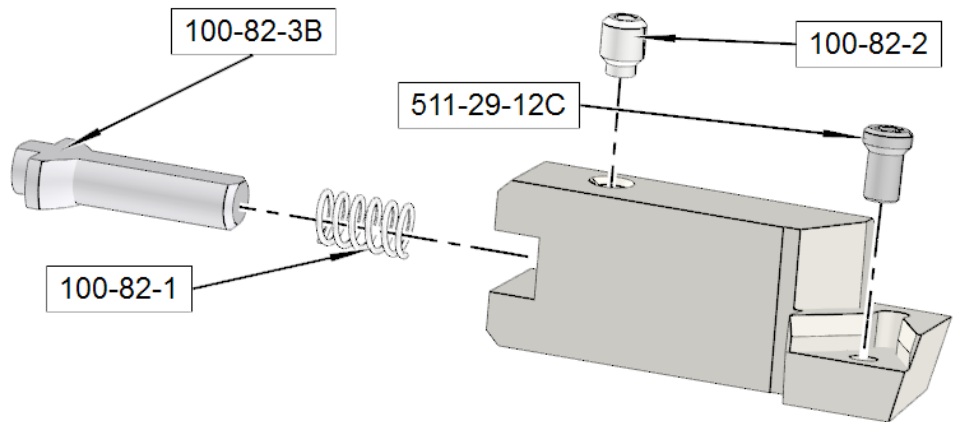
650-2-1E Cutterhead Assembly Parts



900-2-19 Micrometer Parts



6801 Series Insert Holder Parts

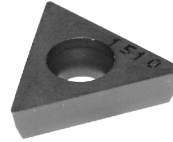


650-2-14B Cutterhead Package Components

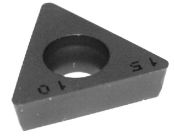
650-2-14C



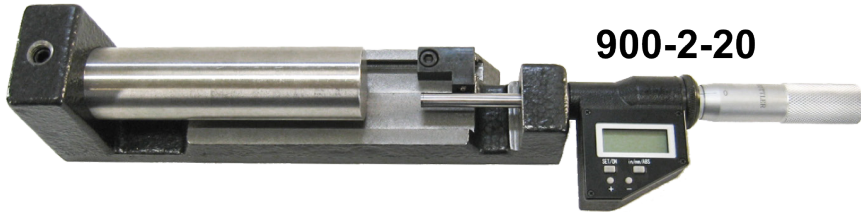
RT321



RT322

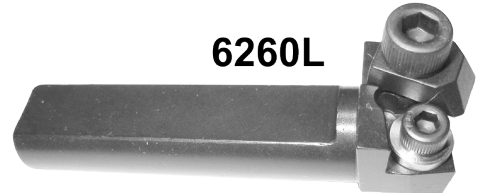


RS322

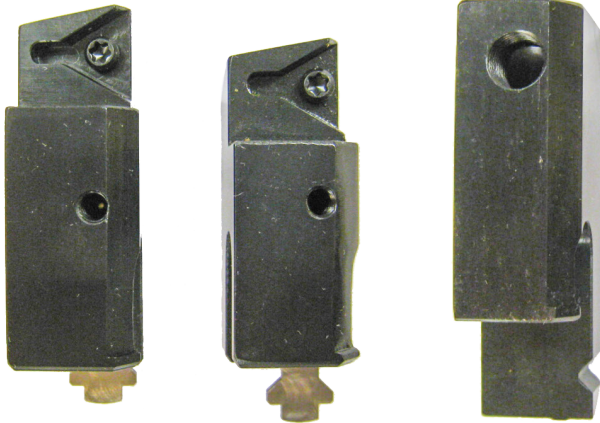


900-2-20

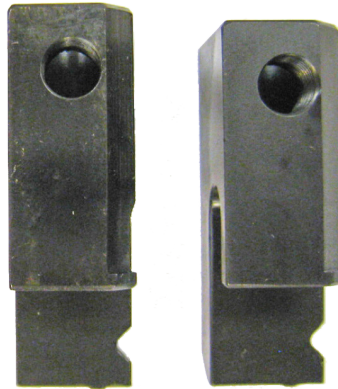
6260L



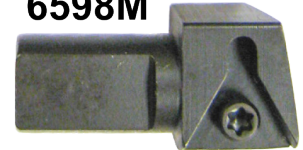
6593 Series



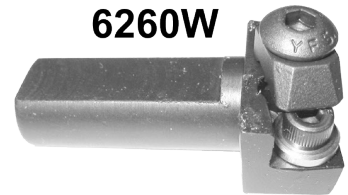
6520 Series



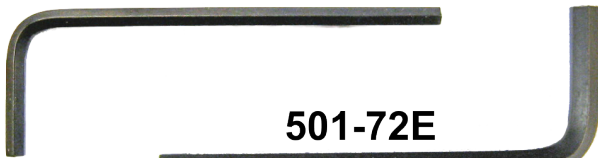
6598M



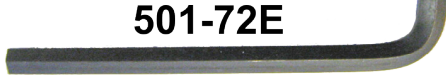
6260W



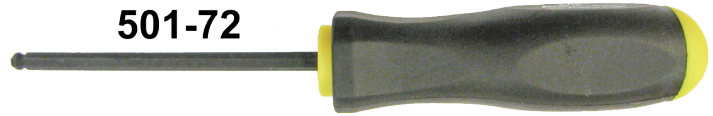
501-72B



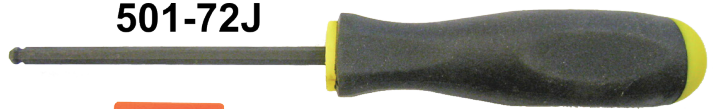
501-72E



501-72



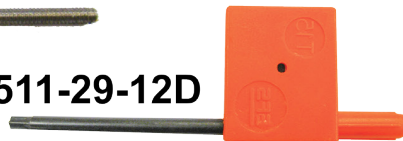
501-72J



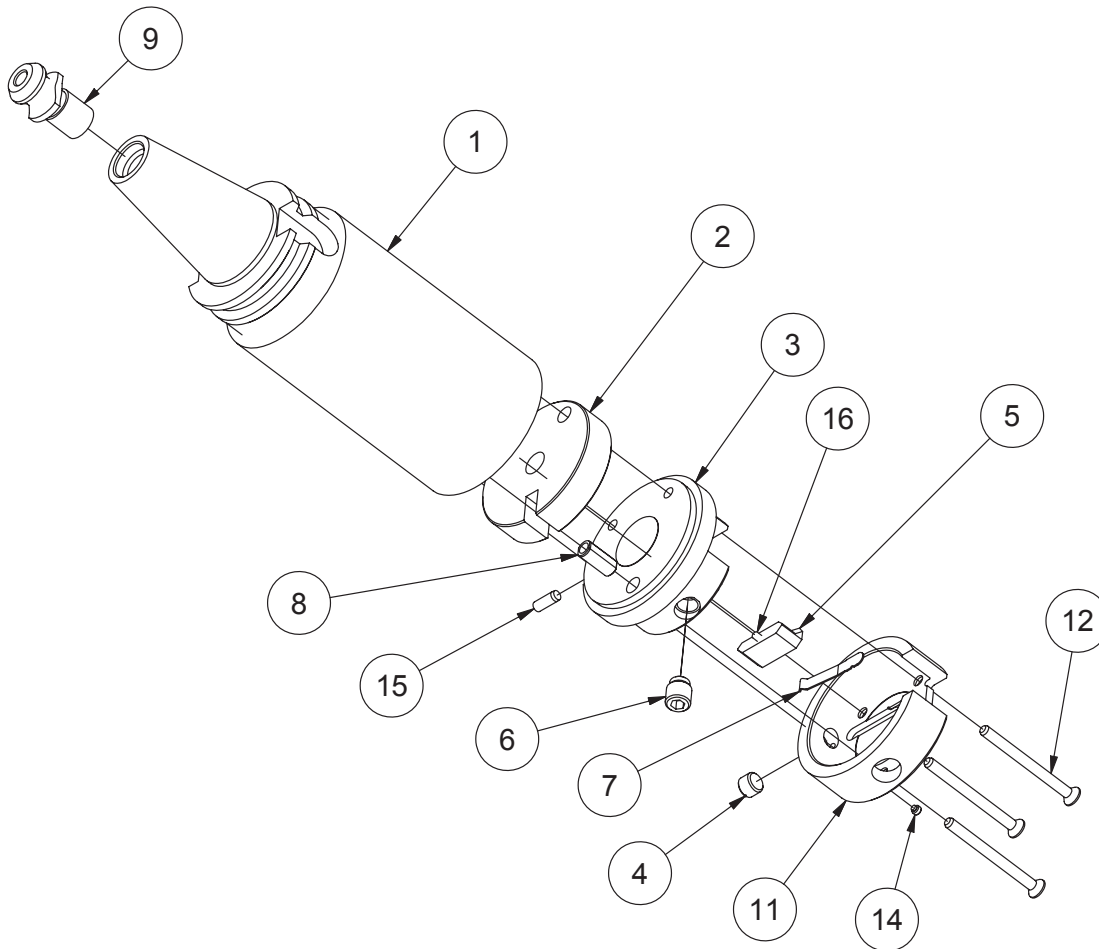
100-24



511-29-12D

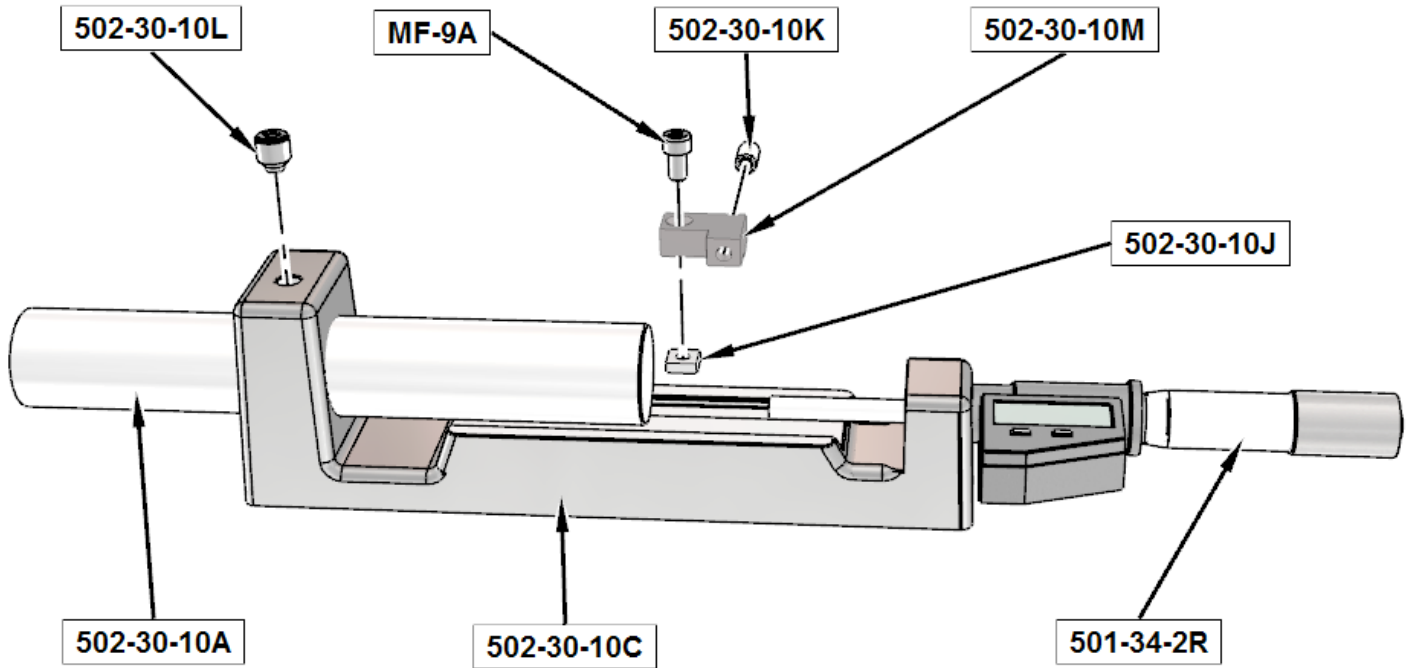


650-2-14C Cutterhead Assembly Parts

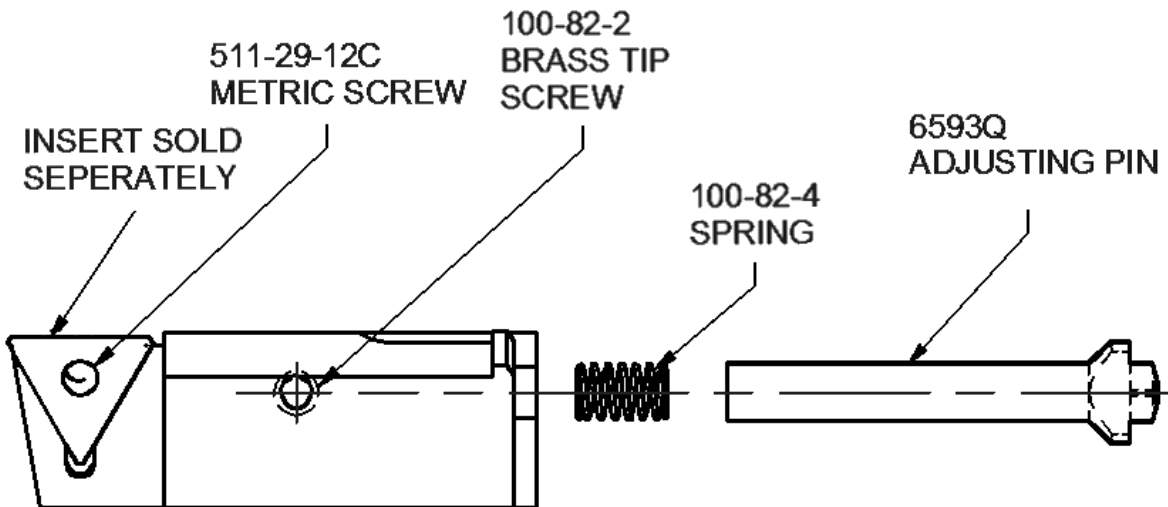


CUTTERHEAD ASSEMBLY W/O TOOLING 2.9" TO 5.0" x 7.0"			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-2-15E	ADAPTER, 2.9" STUB BAR CAT 40 TAPER (INCH)
2	1	6521	Counter Weight
3	1	650-2-16	BODY, 2.9" STUB BAR
4	1	502-2-85B	Index Screw
5	1	6263A	Tool Holder Clamp Screw
6	1	501-70A	Tool Holder Lock Screw ass'y
7	1	100-1A	Tool Lock Spring
8	1	502-2-45B	Bushing - Counterweight
9	1	650-2-44L	CAT40 RETENTION KNOB
11	1	650-2-17	Cap, 2.9" Stub Bar
12	3	MF-81C	Socket Flat Head 10-24 UNC x 2.25
14	1	502-12-4D	SOCKET SET SCREW, BRASS TIPPED 8-32 X 1/8
15	1	MF-196	3/16 x 1/2 Dowel Pin
16	1	MF-193C	1/8 x 3/8 Dowel Pin

900-2-20 Micrometer Parts

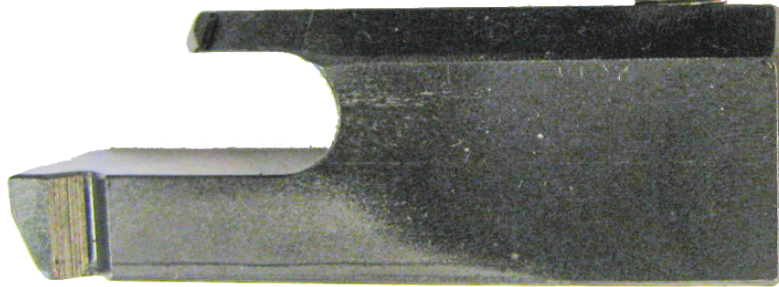
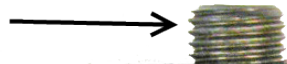


6593 Series Insert Holder Parts



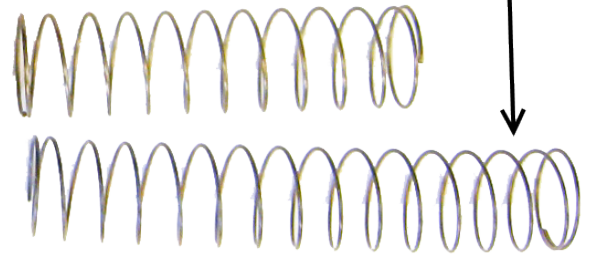
6520 Series Tool Holder Parts

502-2-85 Set Screw



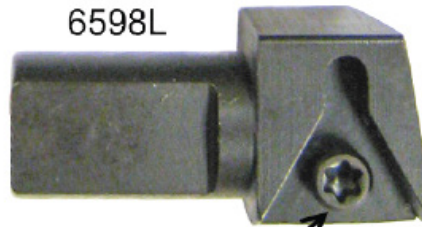
6300C Long Spring

6300B Short Spring



6598M Insert Cartridge Parts

6598L



511-29-12C



6260L Insert Cartridge Parts

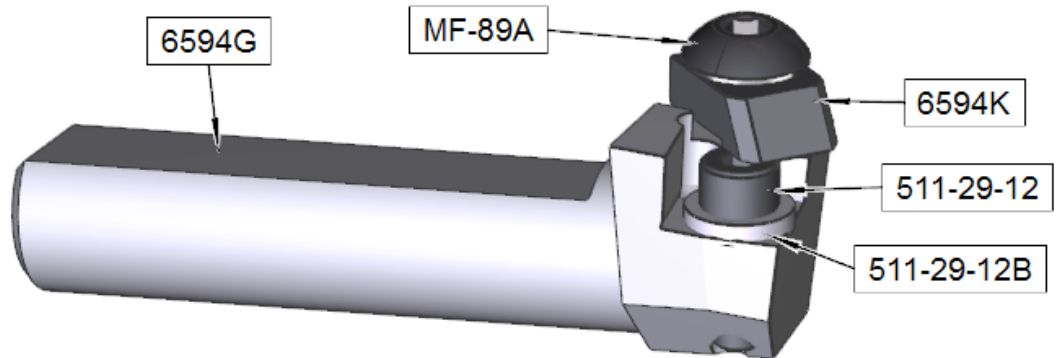
6594G

MF-89A

6594K

511-29-12

511-29-12B



6260W Insert Cartridge Parts

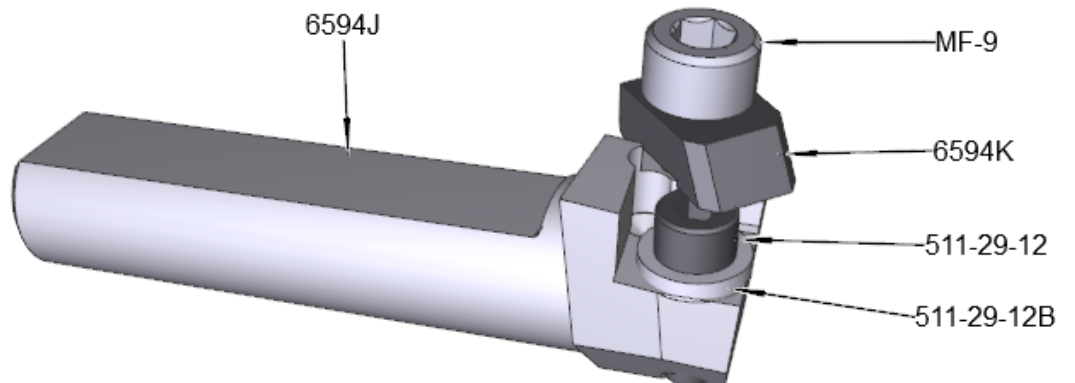
6594J

MF-9

6594K

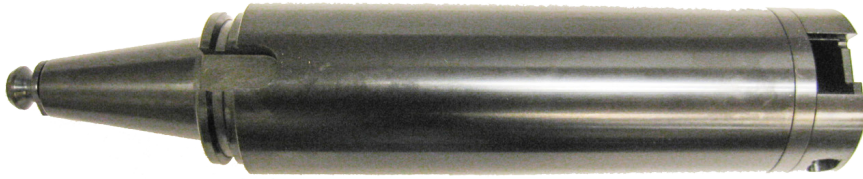
511-29-12

511-29-12B

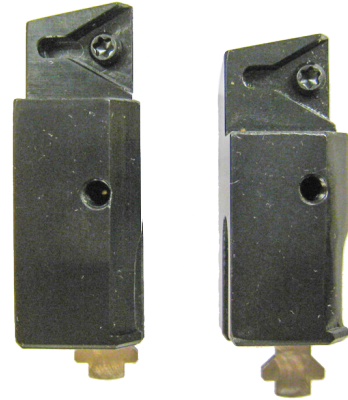


650-2-14F Cutterhead Package Components

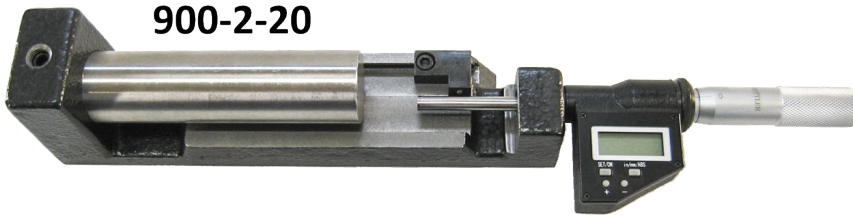
650-2-14G



6593 Series



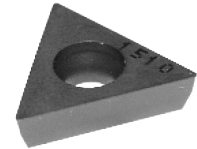
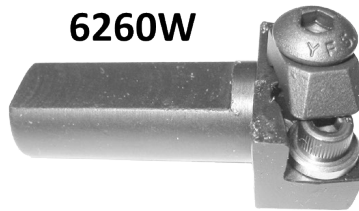
900-2-20



6520 Series

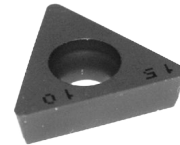
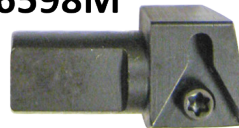


6260W



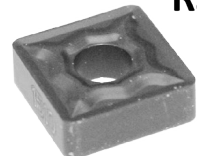
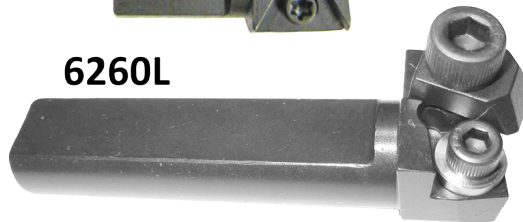
RT321

6598M



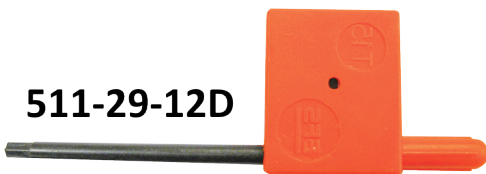
RT322

6260L

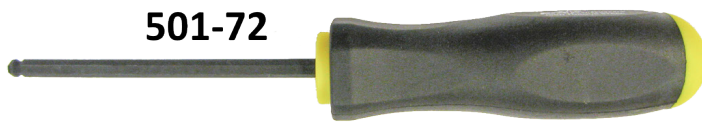


RS322

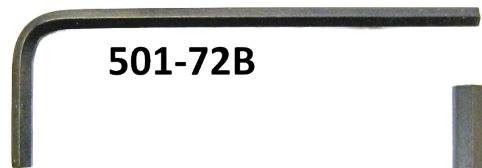
511-29-12D



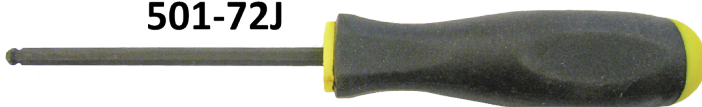
501-72



501-72B



501-72J



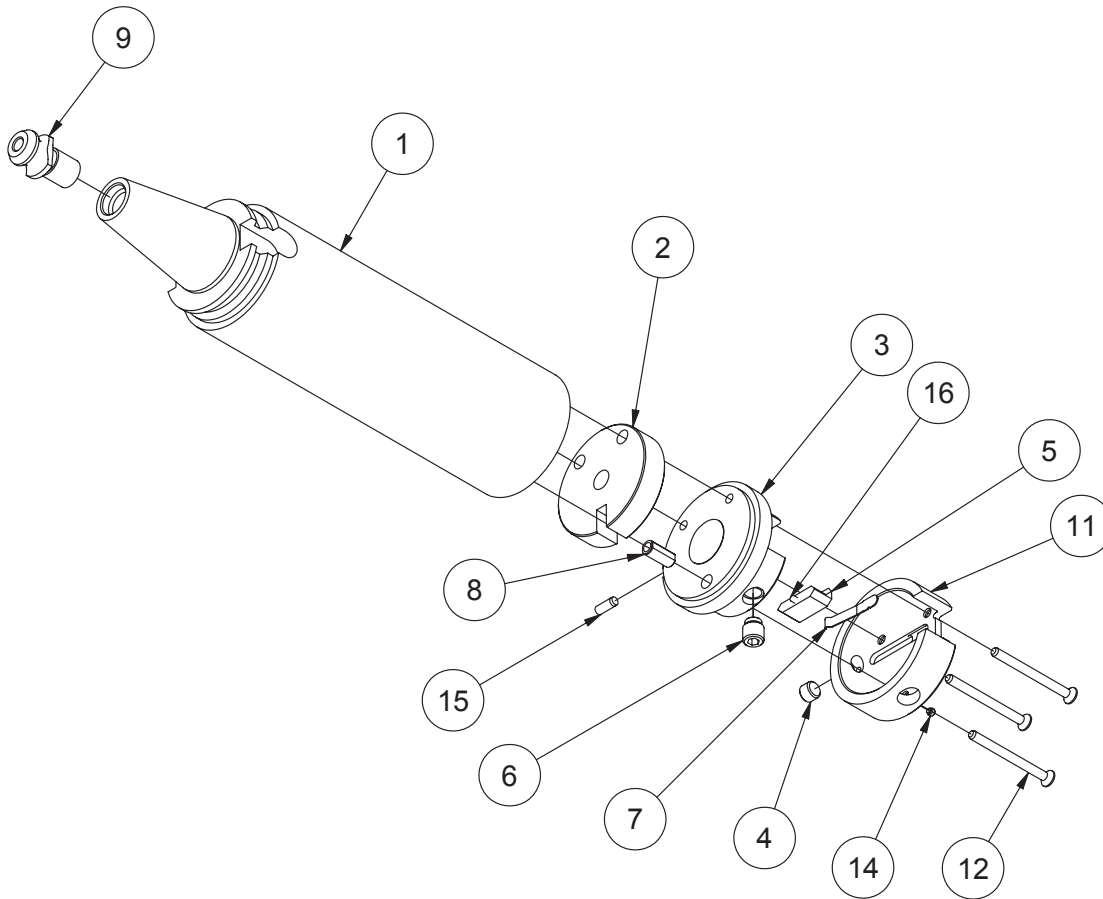
501-72E



100-24

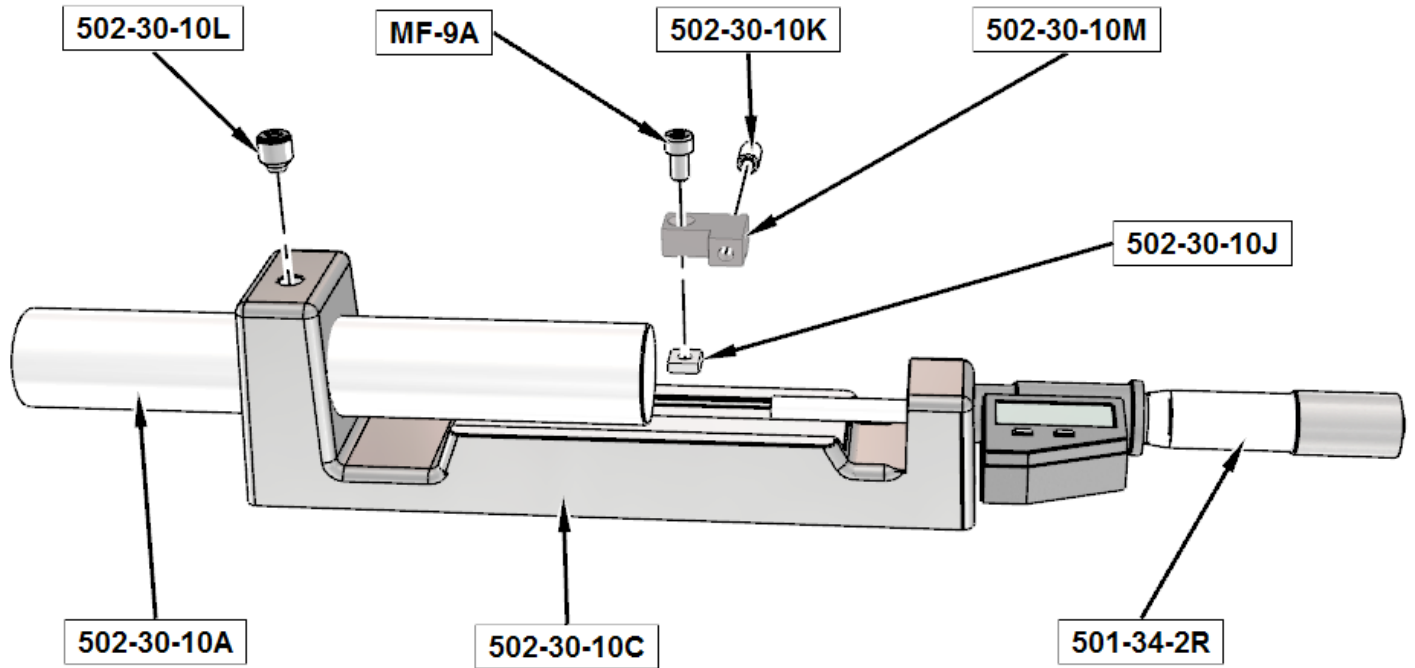


650-2-14G Cutterhead Assembly Parts

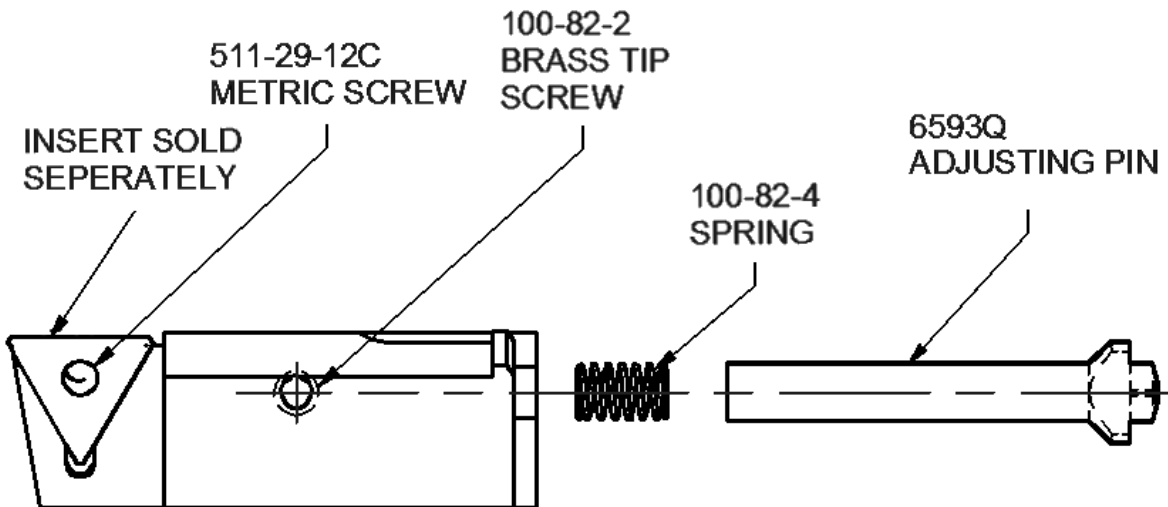


650-2-14G STUB BAR ASSEMBLY 2.9" TO 5.0" x 10" LG. CAT40(INCH)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-2-15K	ADAPTER, 2.9" STUB BAR x 10" LG. CAT 40 TAPER (INCH)
2	1	6521	Counter Weight
3	1	650-2-16	BODY, 2.9" STUB BAR F60
4	1	502-2-85B	Index Screw
5	1	6263A	Tool Holder Clamp Screw
6	1	501-70A	Tool Holder Lock Screw ass'y
7	1	100-1A	Tool Lock Spring
8	1	502-2-45B	Bushing - Counterweight
9	1	650-2-44L	CAT40 RETENTION KNOB
11	1	650-2-17	Cap, 2.9" Stub Bar
12	3	MF-81C	Socket Flat Head 10-24 UNC x 2.25
14	1	502-12-4D	SOCKET SET SCREW, BRASS TIPPED 8-32 X 1/8
15	1	MF-196	3/16 x 1/2 Dowel Pin
16	1	MF-193C	1/8 x 3/8 Dowel Pin

900-2-20 Micrometer Parts

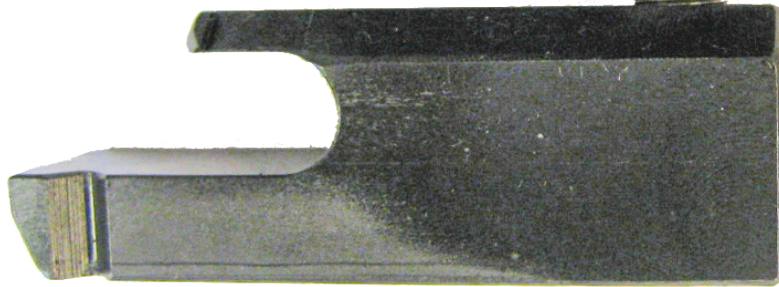
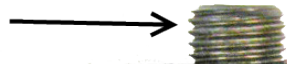


6593 Series Insert Holder Parts



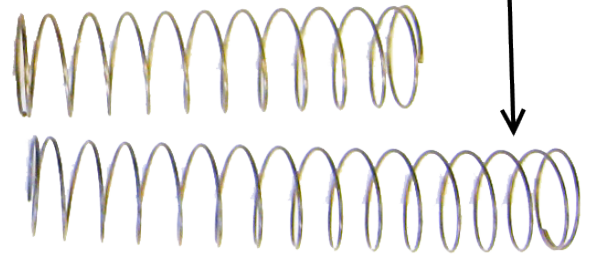
6520 Series Tool Holder Parts

502-2-85 Set Screw



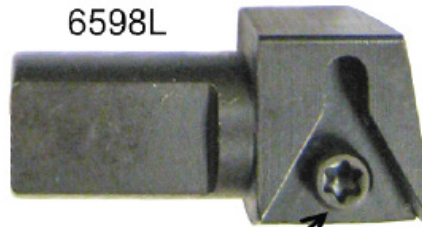
6300C Long Spring

6300B Short Spring



6598M Insert Cartridge Parts

6598L



511-29-12C



6260L Insert Cartridge Parts

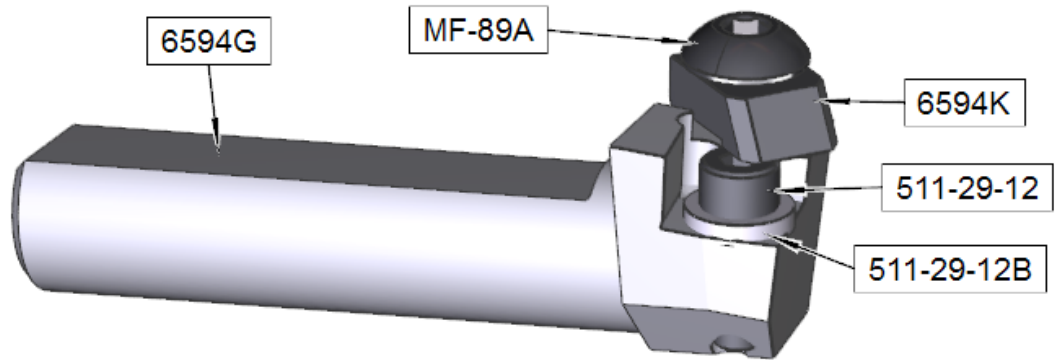
6594G

MF-89A

6594K

511-29-12

511-29-12B



6260W Insert Cartridge Parts

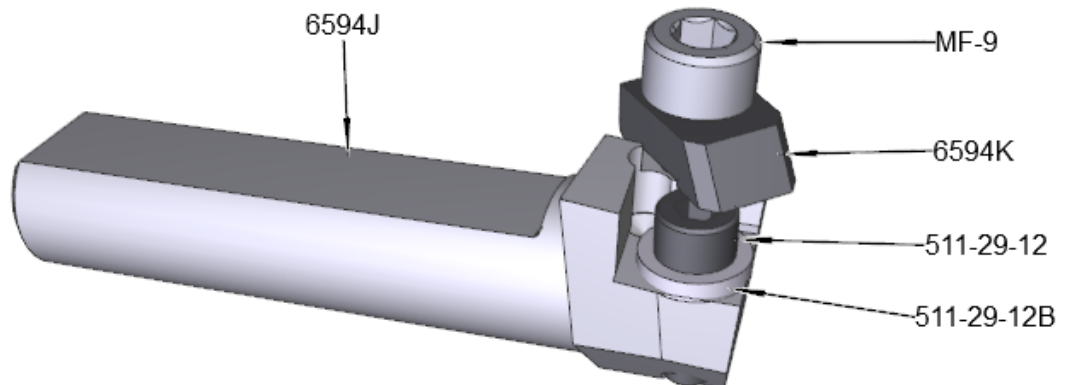
6594J

MF-9

6594K

511-29-12

511-29-12B



650-2-16D 1.400" (35.5mm) Spacer (Extension) for 650-2-14B&F Cutterheads

Sold only as complete assembly.

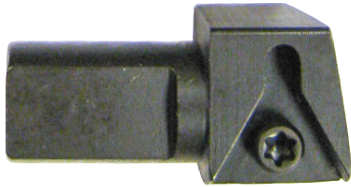


Miscellaneous Tooling for 650-2-14B&F Cutterheads

<p>501-29-6K PCD Tipped Triangular Insert For Boring/Counterboring Aluminum Only</p> 	<p>6513J Brazed Carbide Tool Bit .037" Wide O Ring Grooving</p> 	<p>6513L Brazed Carbide Tool Bit .039" Wide O Ring Grooving</p> 
<p>6513N Brazed Carbide Tool Bit .060" Wide O Ring Grooving</p> 	<p>6513P Brazed Carbide Tool Bit .085" Wide O Ring Grooving</p> 	<p>6513Q Brazed Carbide Tool Bit .120" Wide O Ring Grooving</p> 

6598M Cartridge Assembly

Positive Rake, 13/16 Shank Length, for Counter Boring



6747K Cartridge Assembly

5 Degree Chamfer for Triangular Positive Rake Inserts



6747P Cartridge Assembly

10 Degree Chamfer for Triangular Positive Rake Inserts



6747G Cartridge Assembly

15 Degree Chamfer for Triangular Positive Rake Inserts



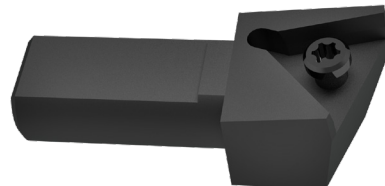
6747F Cartridge Assembly

20 Degree Chamfer for Triangular Positive Rake Inserts



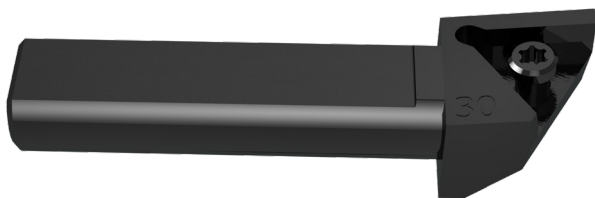
6747M Cartridge Assembly

20 Degree Chamfer for Triangular Positive Rake Inserts
(Special Application Only)



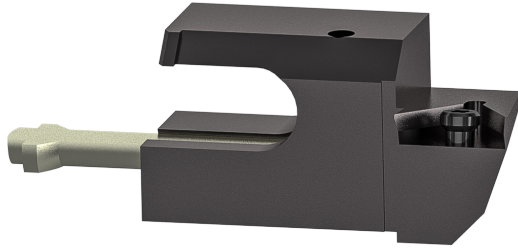
6747H Cartridge Assembly

30 Degree Chamfer for Triangular Positive Rake Inserts



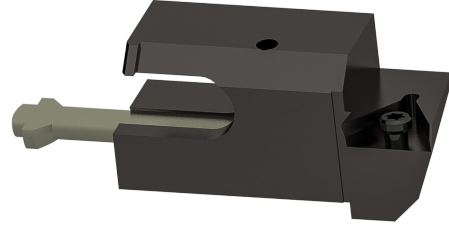
6593L Cartridge Assembly

Offset Indexable Insert, Triangular Positive Rake (3.14 - 3.40" Diameter)



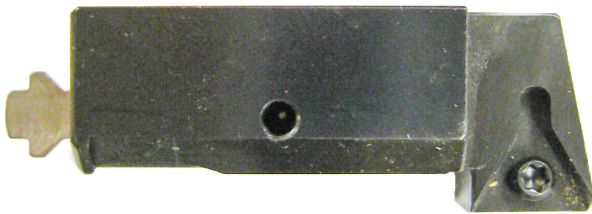
6593M Cartridge Assembly

Offset Indexable Insert, Triangular Positive Rake (3.40 - 3.90" Diameter)



6593N Cartridge Assembly

Offset Indexable Insert, Triangular Positive Rake (3.90 - 4.40" Diameter)






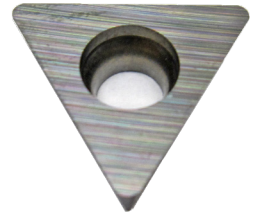
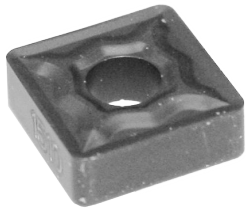


6593P Cartridge Assembly

Offset Indexable Insert, Triangular Positive Rake (4.40 - 4.90" Diameter)

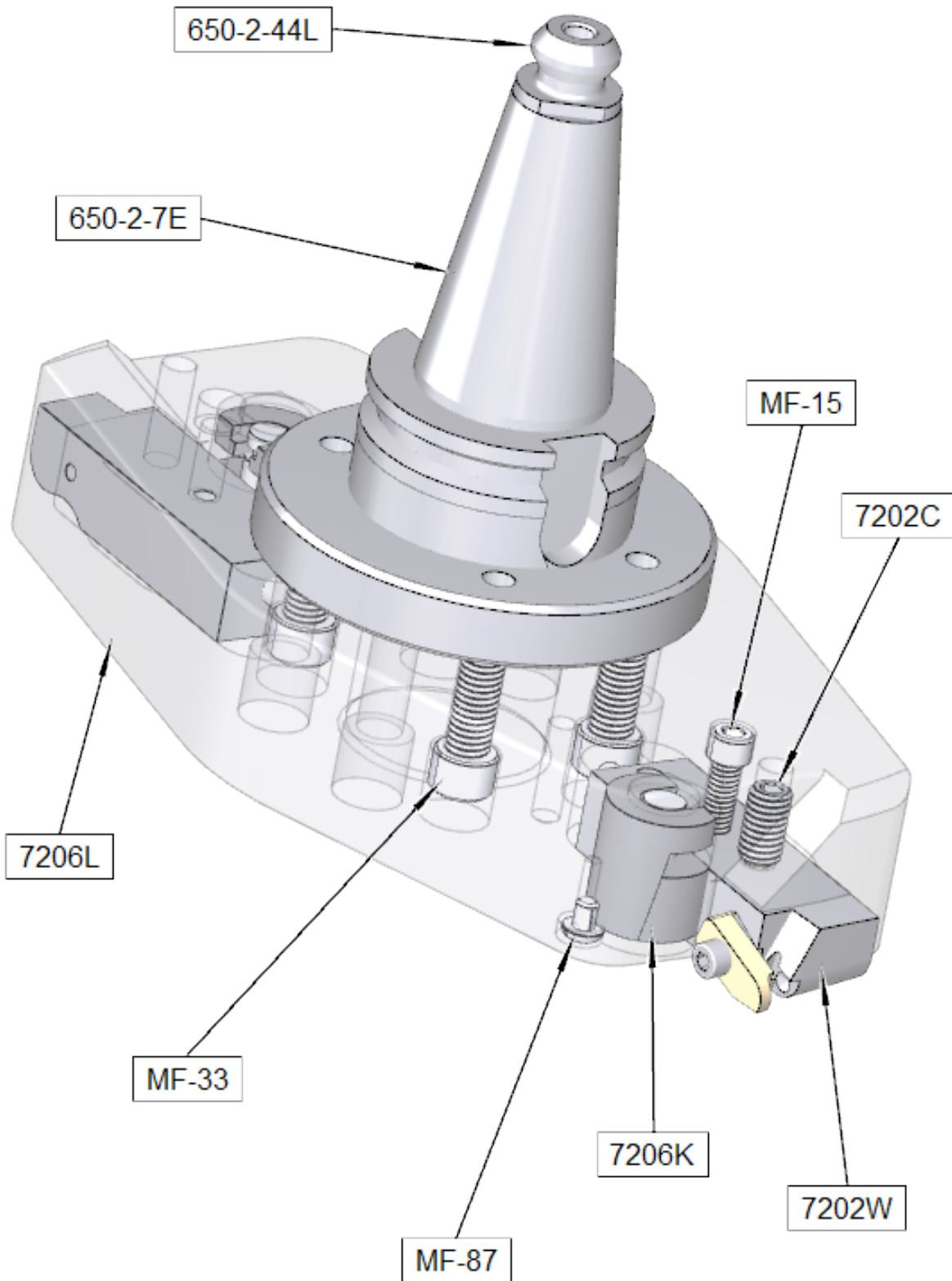


Inserts for Cutterhead Tooling

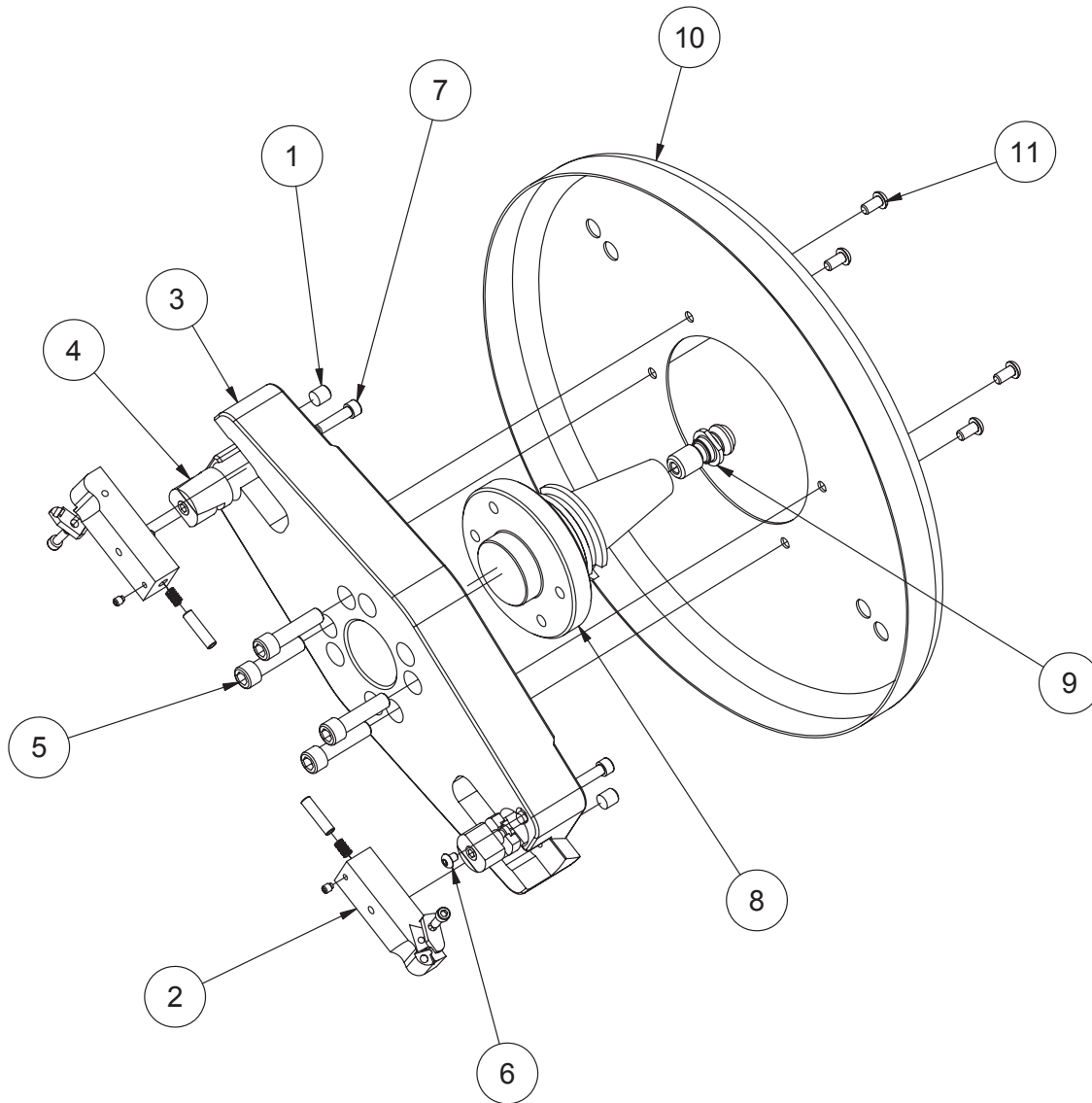
<p>RT211 Triangular Insert 1/4" (6.35mm) 1/64" (.397mm) radius, 1/4" triangular Insert holders only, general purpose and sleeving</p> 	<p>RT212 Triangular Insert 1/4" (6.35mm) 1/32" (.787mm) radius, 1/4" triangular Insert holders only, general purpose and sleeving</p> 	<p>RT321 Triangular Insert Positive rake, 3/8" (9.525mm) 1/64" (.397mm) radius, general purpose and sleeving</p> 
<p>RT322 Triangular Insert Positive rake, 3/8" (9.525mm) 1/32" (.787mm) radius, general purpose and sleeving</p> 	<p>RT321F Triangular Insert Positive rake, 3/8" 1/64" Radius, Precision Counterboring</p> 	<p>RT322F Triangular Insert Positive rake, 3/8" 1/32" Radius, Precision Counterboring</p> 
<p>RS322 Square Insert Negative rake, 1/32" (.787mm) radius, 3/8" (9.525mm) IC, black ceramic coated for high speed oversize thru boring</p> 		

SURFACING TOOLING

650-2-8E Surfacing Cutterhead Parts




650-2-8F Surfacing Cutterhead Parts



650-2-8F 14" FLYCUTTER ASSEMBLY			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	7202C	Hexagon Socket Set Screw - Oval Point
2	2	7202W	TOOL HOLDER ASSEMBLY, FLY CUTTER
3	1	7206G	MILLING CUTTERHEAD, 14" DIA. WITH 3/4 x 1 TOOL HOLDER
4	2	7206K	L' LOCK
5	4	Mf-33	Socket Head Cap screw 3/8 - 16 UNC - 1 1/2
6	2	Mf-87	Socket Button Head Cap Screw 10 - 24 x 1/4
7	2	MF-15	S.H.C.S. 1/4 - 20 UNC - 1
8	1	650-2-7E	ADAPTER, 10 & 14 INCH FLYCUTTER - CAT 40
9	1	650-2-44L	CAT40 RETENTION KNOB
10	1	650-2-8D	Shroud, surfacing cutterhead
11	4	MF-90	Socket Button Head 1/4 - 20 x 1/2

Inserts for Surfacing Cutterhead

<p>6303B CBN Insert, Round Double-Sided, 3/8" (9.525mm) IC, for Cutting Cast Iron</p> 	<p>6303M PCD Insert, Round 3/8" (9.525mm) IC, for Cutting Aluminum</p> 	<p>6303K Coated Carbide Insert, Round 3/8" (9.525mm) IC, for General Purpose Use</p> 
<p>6303S CBN Insert, Round 3/8" (9.525mm) IC, for Cutting Aluminum Blocks with Liners</p> 	<p>6303U CBN Round Insert Single Sided, 3/8" IC. For hard cast iron</p> 	

TOOLING FOR LIFTER BORE MACHINING

650-2-60B Lifter Bore Tooling Kit Components

650-2-60C



650-2-60D



650-2-60K



650-2-60J



650-2-20C



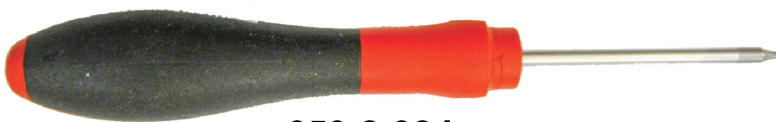
650-2-20L



650-2-44A



650-2-32J



650-2-60E



650-2-60F



650-2-60H



650-2-60G



650-2-60L



650-2-32U

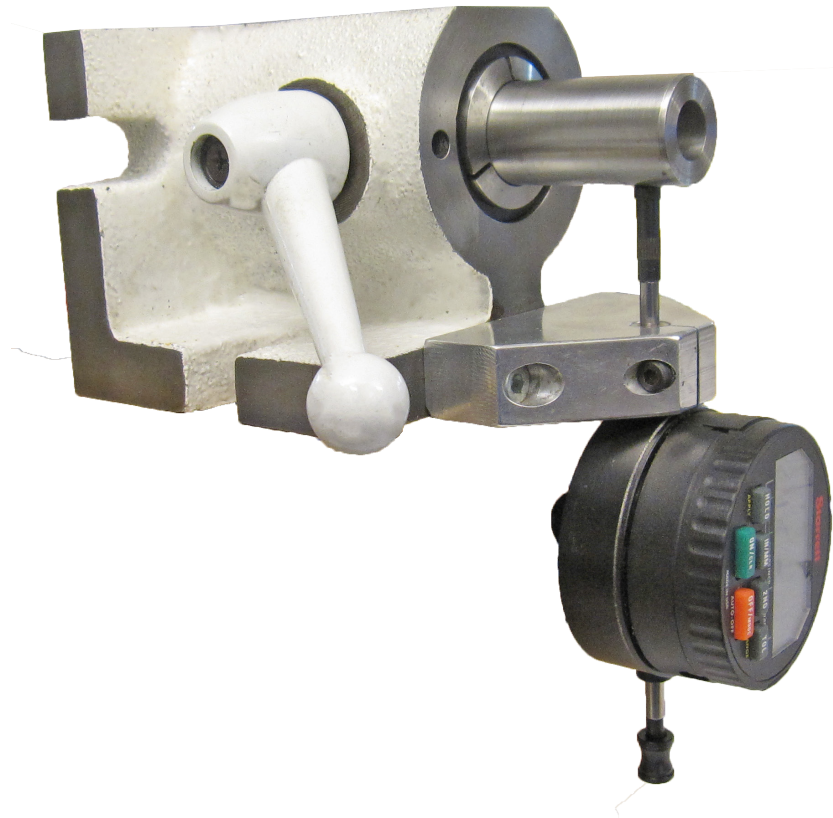


511-29-12F



650-2-60N Setting Fixture

Sold only as complete assembly



**650-2-60G Insert for 0.750 - 0.900
diameter cartridge**

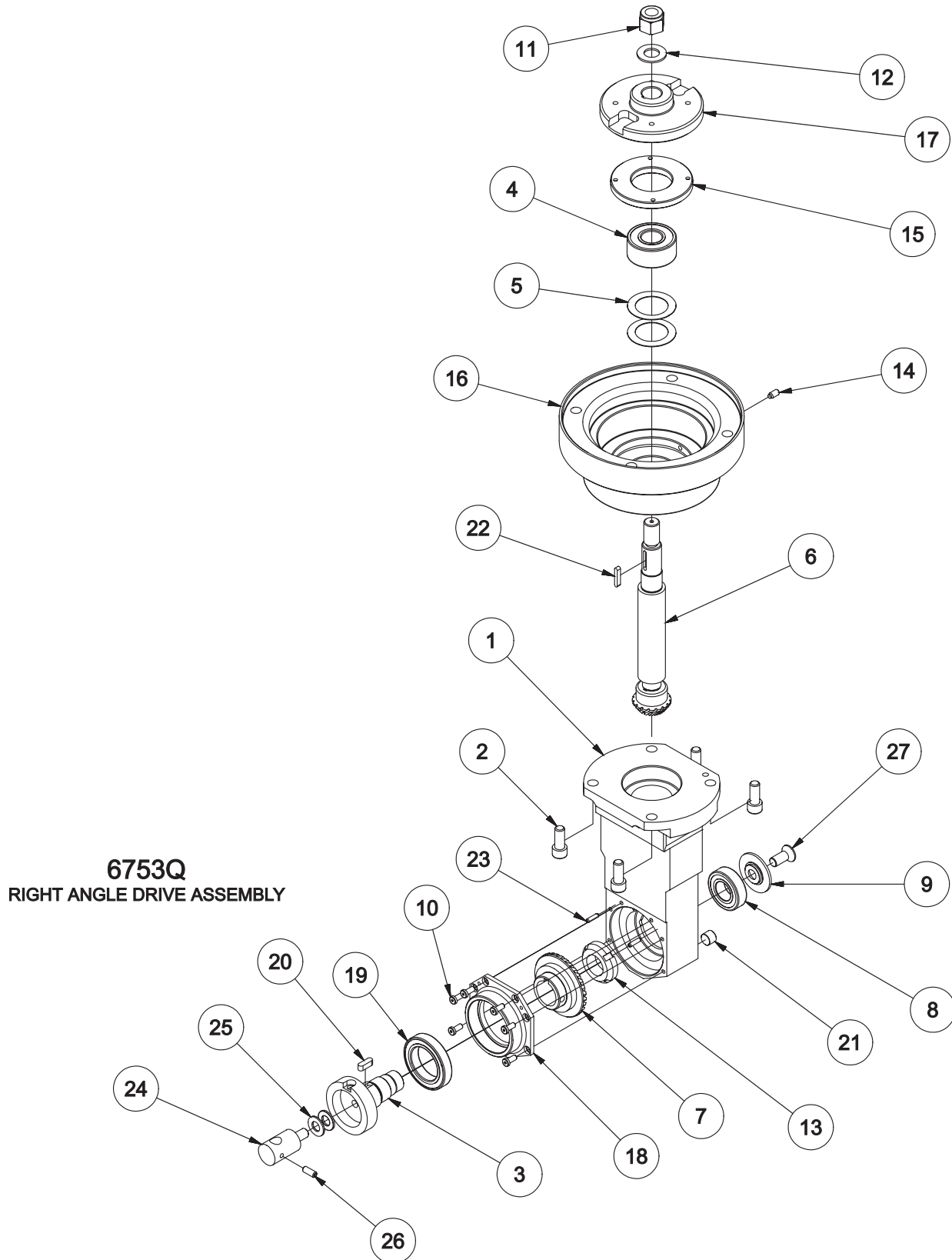


**650-2-60H Insert for 0.920 - 1.180
diameter cartridge**

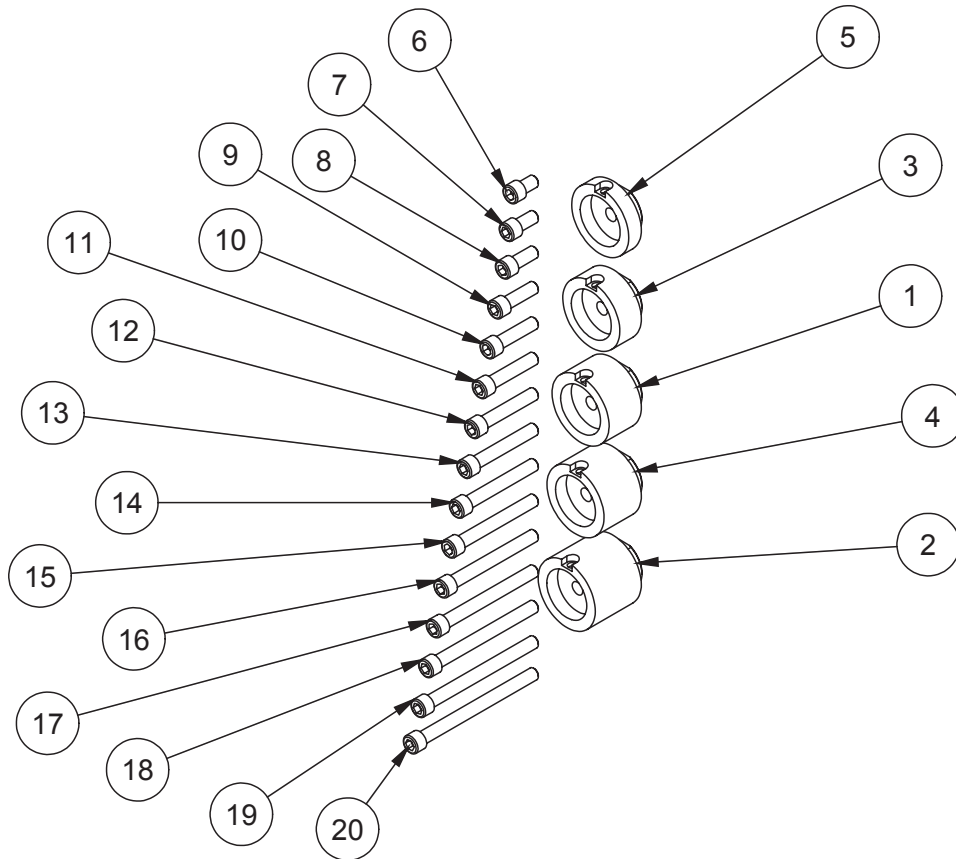


MAIN LINE BORE TOOLING

6753Q Main Line Bore 90 Degree Right Angle Drive Assembly Parts



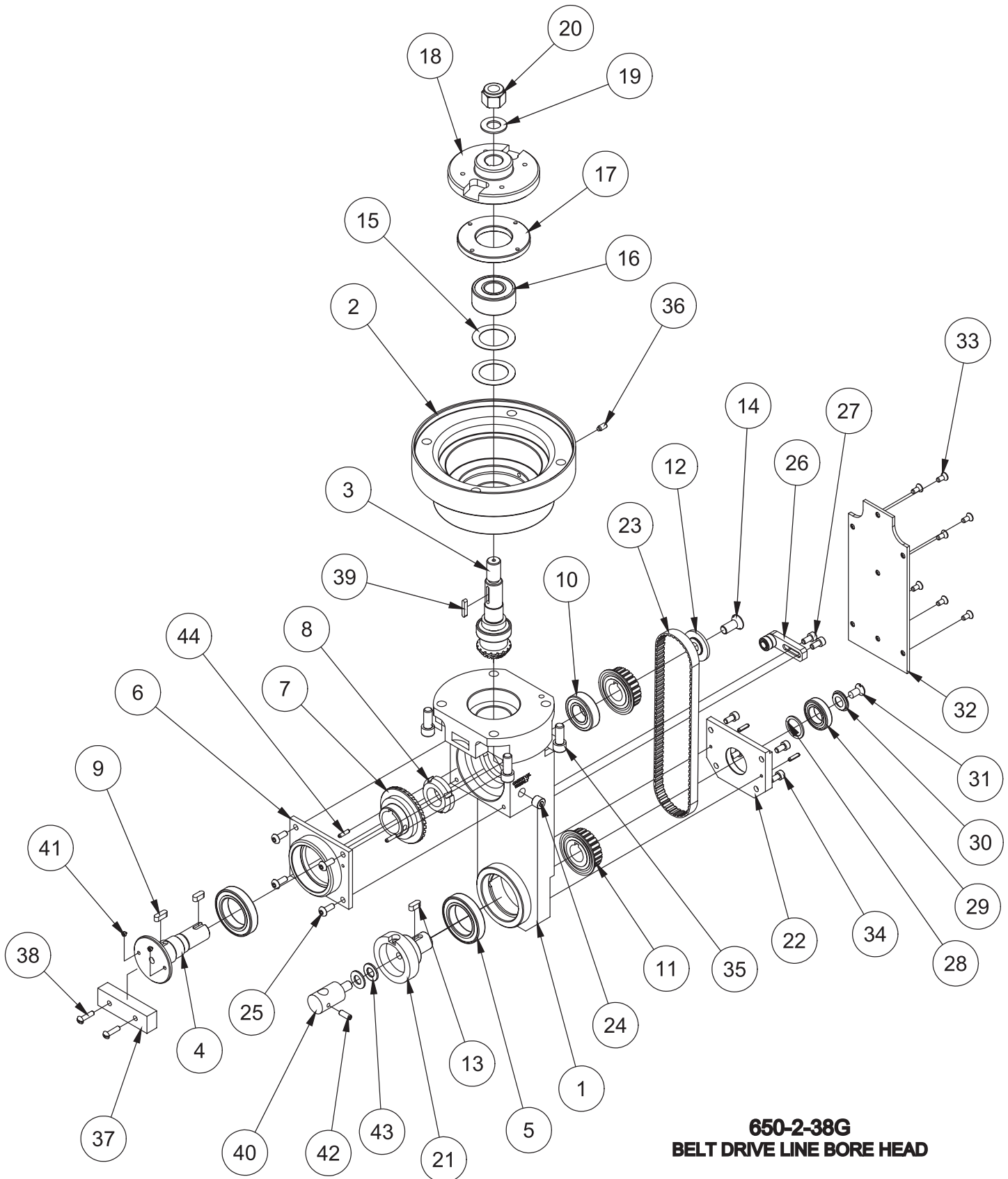
6753Q RIGHT ANGLE DRIVE ASSEMBLY			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	6773C	HOUSING, GEAR LINE BORE HEAD
2	4	MF-22	5/16-18UNC x 3/4" LG. S.H.C.S.
3	1	650-2-42	SHAFT, HORIZONTAL PRECISION R.A.D.
4	1	502-9-32	Bearing, Ball MRC 5203SBKFF
5	2	6007A	Bellville Spring, BS203
6	1	6775A	PINION AND SHAFT ASSEMBLY - R.A.D.
7	1	6766W	RING GEAR REWORK - F60 SMALL 90 DEG. R.A.D.
8	1	6753E	Bearing, NDH Z99L03
9	1	6766F	End Cap
10	6	6774E	Hexagon Socket Head Cap Screw
11	1	MF-186	1/2-13 Nylock Nut
12	1	100-19	Washer
13	1	6705B	BEARING LOCK NUT
14	1	100-82-2A	10-24UNC BRASS TIPPED SOCKET SET SCREW
15	1	6772A	Nut, Bearing Line Bore Head
16	1	6770G	HUB, MOUNTING
17	1	6771B	DRIVER, F60 LINE BORE HEAD
18	1	6774D	COVER, BEARING RETAINER - R.A.D.
19	1	502-9-72C	OUTER BALL BEARING, R.A.D.
20	1	650-2-18M	KEY, HORIZONTAL SHAFT, R.A.D.
21	1	MF-233	Countersunk Hex-Head Plug 1/8
22	1	6753V	KEY (MICARTA), PINION - 90 DEGREE HEAD
23	2	MF-217	1/8 x 1/2 Roll Pin
24	1	502-9-9S	INDICATOR MOUNT, R.A.D.
25	2	MF-177	SAE FLAT WASHER 5/16"
26	1	MF-58A	10-24UNC x 1/2" LG. SOCKET FLAT POINT SET SCREW
27	1	6774K	5/16-24UNF x 3/4" LG. HEX SOCKET FLAT HEAD SCREW



CUTTERHEAD SPACER SET - LINE BORE HEAD

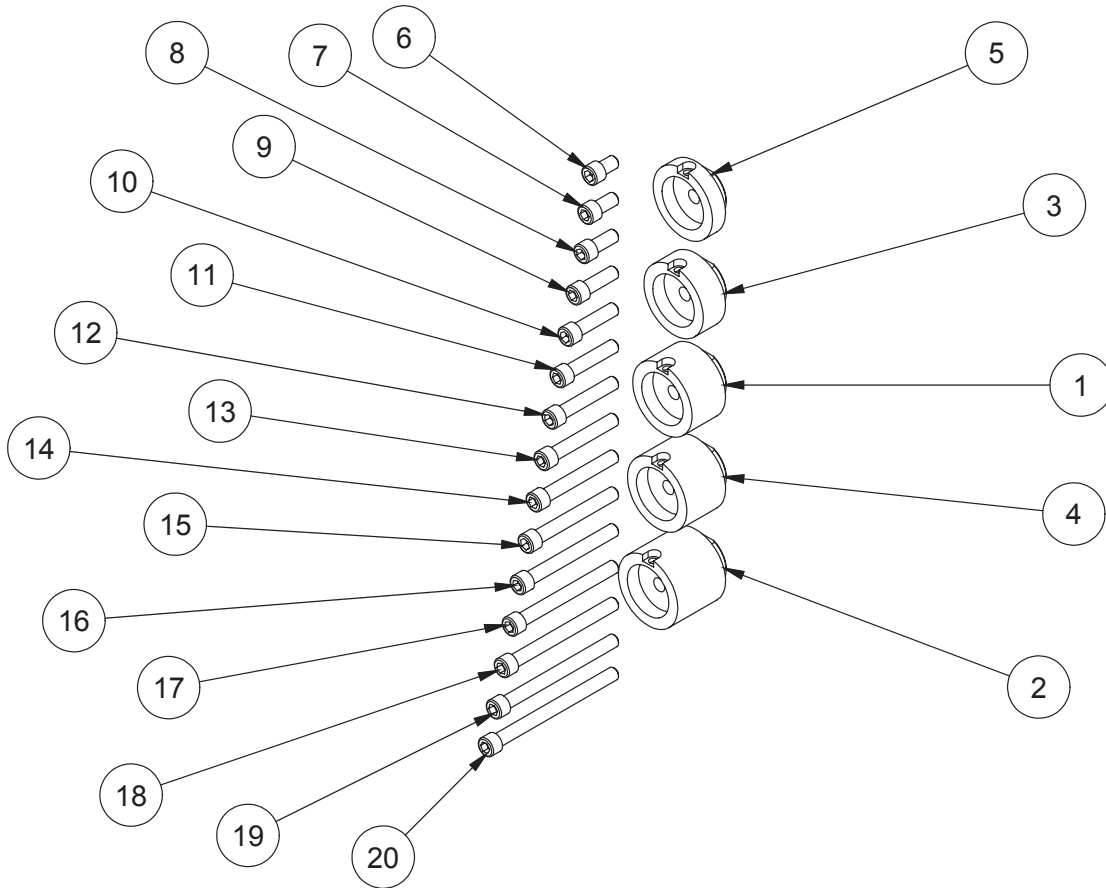
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-2-43	1.05 SPACER
2	1	650-2-43A	SPACER - 1.50" LONG
3	1	650-2-43B	SPACER - .70" LONG
4	1	650-2-43D	SPACER - 1.215" LONG
5	1	650-2-43E	SPACER - .41" LONG
6	1	MF21A	S.H.C.S. 5/16 - 18 UNC - 1/2
7	1	MF-21	S.H.C.S. 5/16 - 18 UNC - 5/8
8	1	MF-22	S.H.C.S. 5/16 - 18 UNC - 3/4
9	1	MF-23	S.H.C.S. 5/16 - 18 UNC - 1
10	1	MF-24	S.H.C.S. 5/16 - 18 UNC - 1-1/4
11	1	MF-25	S.H.C.S. 5/16 - 18 UNC - 1 1/2
12	1	Mf-26	S.H.C.S. 5/16 - 18 UNC - 1-3/4
13	1	MF-27	S.H.C.S. 5/16 - 18 UNC - 2
14	1	MF-27C	S.H.C.S. 5/16 - 18 UNC - 2-1/4
15	1	MF-27A	S.H.C.S. 5/16 - 18 UNC - 2 1/2
16	1	MF-28	S.H.C.S. 5/16 - 18 UNC - 2 3/4
17	1	MF-28E	S.H.C.S. 5/16 - 18 UNC - 3
18	1	MF-28F	S.H.C.S. 5/16 - 18 UNC - 3-1/4
19	1	MF-28A	S.H.C.S. 5/16 - 18 UNC - 3-1/2
20	1	MF-28G	S.H.C.S. 5/16 - 18 UNC - 3-3/4

650-2-38G Special Belt Drive 90 Degree Right Angle Drive Assembly Parts



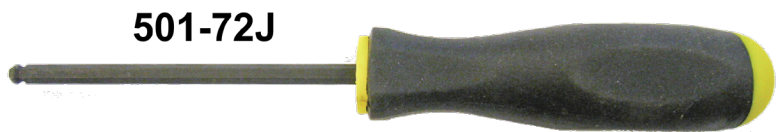
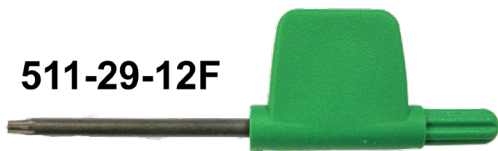
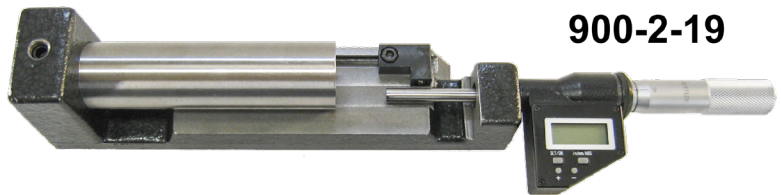
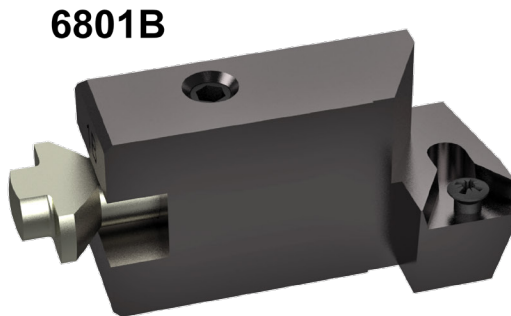
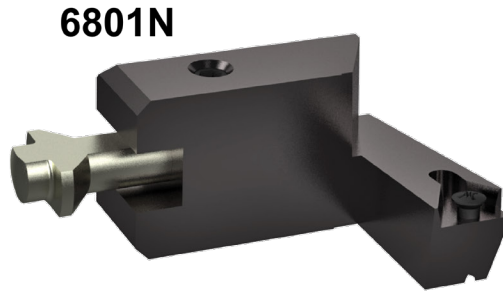
**650-2-38G
BELT DRIVE LINE BORE HEAD**

650-2-38G BELT DRIVE RIGHT ANGLE DRIVE			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-2-38B	HOUSING, RIGHT ANGLE DRIVE BELT DRIVE
2	1	6770G	HUB, MOUNTING
3	1	650-2-37X	PINION & SHAFT ASSEMBLY BELT DRIVE LINE BORE HEAD
4	1	650-2-37D	SHAFT, HORIZONTAL UPPER - BELT DRIVE LINE BORE HEAD
5	2	502-9-72C	OUTER BALL BEARING, RIGHT ANGLE LINE BORING HEAD
6	1	650-2-37C	BEARING COVER, BELT DRIVE RIGHT ANGLE DRIVE
7	1	6766W	RING GEAR REWORK
8	1	6705B	BEARING LOCK NUT
9	1	650-2-18M	KEY, HORIZONTAL SHAFT, R.A.D.
10	1	6753E	Bearing, NDH Z99L03
11	2	650-2-37G	PULLEY (REWORK), BELT DRIVE R.A.D.
12	1	650-2-37E	ENDCAP, UPPER PULLEY RETAINER - BELT DRIVE LINE BORE HEAD
13	2	650-2-37U	MICARTA KEY, BELT DRIVE LINE BORE HEAD
14	1	6774K	HEX SOCKET FLATHEAD SCREW 5/16-24UNF x 3/4"
15	2	6007A	Bellville Spring, BS203
16	1	502-9-32	Bearing, Ball MRC 5203SBKFF
17	1	6772A	Nut, Bearing Line Bore Head
18	1	6771B	DRIVER, LINE BORE HEAD
19	1	100-19	Washer
20	1	MF-186	1/2-13 Nylock Nut
21	1	650-2-42B	Horizontal Shaft
22	1	650-2-37L	LOWER BEARING RETAINER - BELT DRIVE LINE BORE HEAD
23	1	650-2-38D	TIMING BELT, BELT DRIVE LINE BORE HEAD
24	1	MF-233	1/8-27NPT PIPE PLUG
25	4	Mf-88A	Socket Button Head Cap Screw 10 - 24 x 1/2
26	1	650-2-37P	BELT TENSIONER ASSY, BELT DRIVE LINE BORE HEAD
27	2	MF-4	10-24UNC x 3/8" LG. S.H.C.S.
28	1	650-2-37V	SPACER, LOWER PULLEY - BELT DRIVE LINE BORE HEAD
29	1	650-2-37J	BEARING, BELT DRIVE LINE BOER HEAD
30	1	650-2-37K	END CAP, LOWER - BELT DRIVE LINE BORE HEAD
31	1	650-2-37Z	1/4-28UNF x 1/2" SLOTTED FLATHEAD SCREW
32	1	650-2-38C	BELT COVER, BELT DRIVE LINE BORE HEAD
33	7	MF-76	Socket Flat Head 8-32 UNC x 0.375
34	4	MF-4	S.H.C.S. 10 - 24 UNC - 3/8
35	4	MF-22	S.H.C.S. 5/16 - 18 UNC - 3/4
36	1	100-82-2A	Brass tipped 10-24 Socket Set Screw
37	1	650-2-38a	RETAINING TOOL - BELT DRIVE R.A.D.
38	2	MF-105	ROUND HEAD MACHINE SCREW 8-32 x 5/8"
39	1	6753V	KEY (MICARTA), PINION - 90 DEGREE HEAD
40	1	502-9-9S	INDICATOR MOUNT, R.A.D.
41	2	MF-49	8-32UNC x 1/8" LONG SOCKET SET SCREW
42	1	MF-58A	10-24UNC x 1/2" LG. SOCKET FLAT POINT SET SCREW
43	2	MF-177	SAE FLAT WASHER 5/16"
44	4	MF-217	1/8 x 1/2 Roll Pin



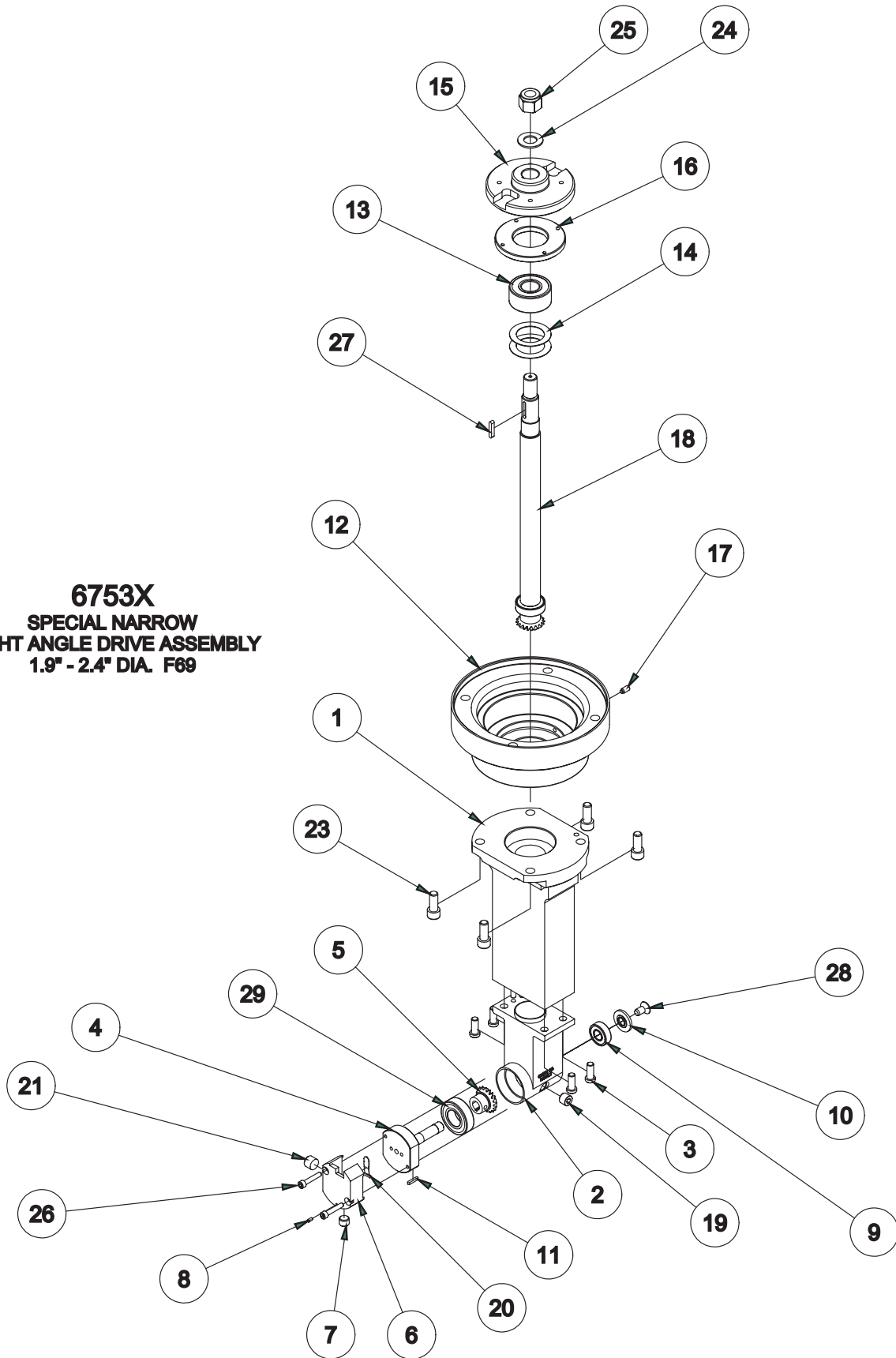
CUTTERHEAD SPACER SET - BELT DRIVE LINE BORE HEAD			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-2-43	1.05 SPACER
2	1	650-2-43A	SPACER - 1.50" LONG
3	1	650-2-43B	SPACER - .70" LONG
4	1	650-2-43D	SPACER - 1.215" LONG
5	1	650-2-43E	SPACER - .41" LONG
6	1	MF21A	Hexagon Socket Head Cap Screw
7	1	MF-21	S.H.C.S. 5/16 - 18 UNC - 5/8
8	1	MF-22	S.H.C.S. 5/16 - 18 UNC - 3/4
9	1	MF-23	Hexagon Socket Head Cap Screw
10	1	MF-24	Hexagon Socket Head Cap Screw
11	1	MF-25	S.H.C.S. 5/16 - 18 UNC - 1 1/2
12	1	Mf-26	Hexagon Socket Head Cap Screw
13	1	MF-27	S.H.C.S. 5/16 - 18 UNC - 2
14	1	MF-27C	S.H.C.S. 5/16 - 18 UNC - 2-1/4
15	1	MF-27A	S.H.C.S. 5/16 - 18 UNC - 2 1/2
16	1	MF-28	S.H.C.S. 5/16 - 18 UNC - 2 3/4
17	1	MF-28E	S.H.C.S. 5/16 - 18 UNC - 3
18	1	MF-28F	S.H.C.S. 5/16 - 18 UNC - 3-1/4
19	1	MF-28A	S.H.C.S. 5/16 - 18 UNC - 3-1/2
20	1	MF-28G	S.H.C.S. 5/16 - 18 UNC - 3-3/4

6753Y Narrow Right Angle Drive Assembly Components



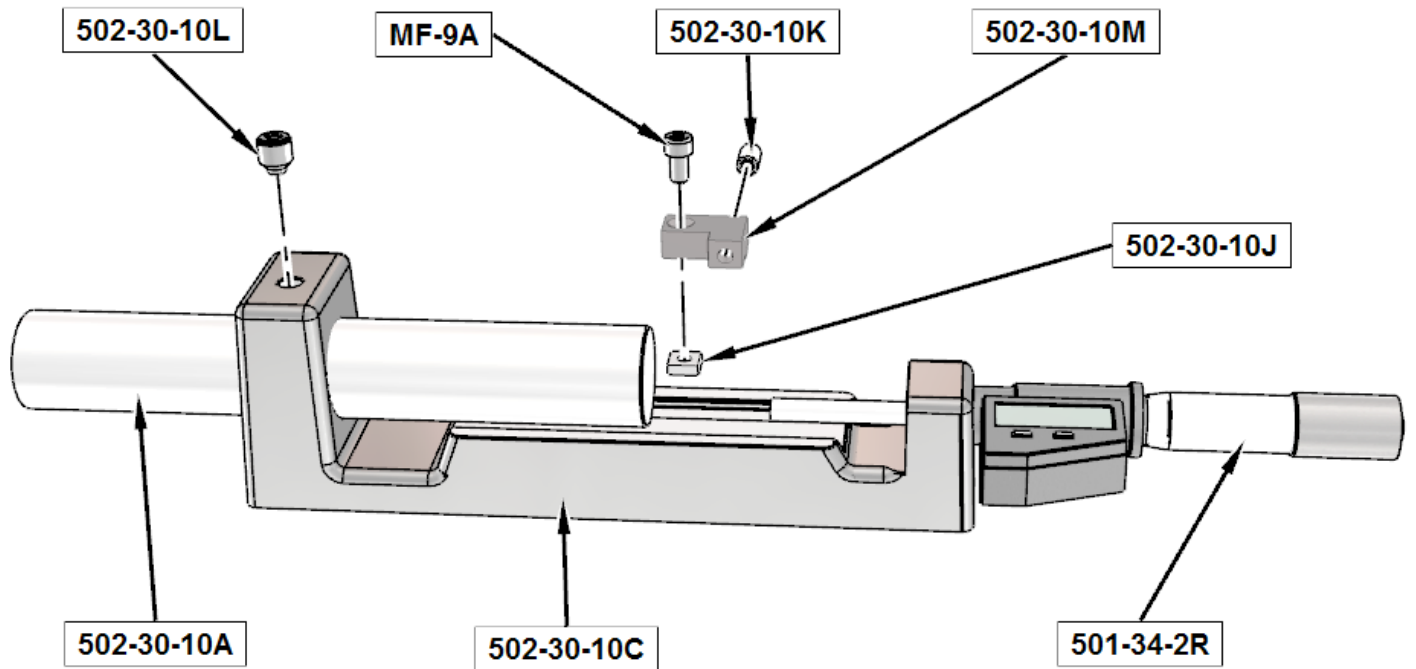
6753X Parts

6753X
SPECIAL NARROW
RIGHT ANGLE DRIVE ASSEMBLY
1.9" - 2.4" DIA. F69



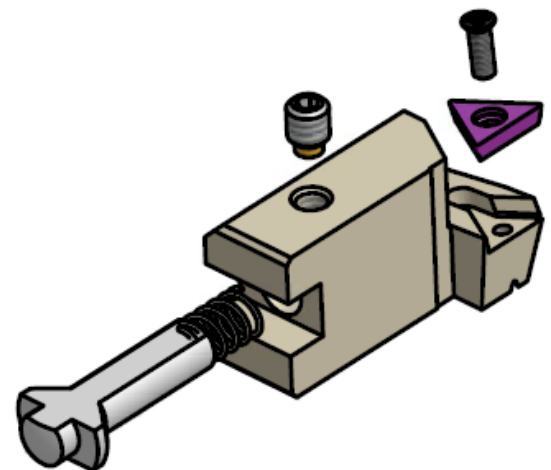
6753X SPECIAL RIGHT ANGLE DRIVE ASSEMBLY			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-2-19X	Upper Housing, Right Angle Drive Narrow
2	1	650-2-19Y	LOWER HOUSING
3	4	650-4-18	Low Head Cap Screw, 1/4-20 x 5/8
4	1	650-2-19J	Shaft, Horizontal
5	1	650-2-19R	RING GEAR (REWORK) F65 LINE BORE HEAD (NARROW)
6	1	650-2-19H	Cutter Head Cap
7	1	502-2-85B	Index Screw
8	1	650-2-6A	4-40 brass tipped set screw
9	1	650-2-19L	Bearing
10	1	650-2-19S	Cover Rear, End Cap
11	1	650-2-19W	Key
12	1	6770G	HUB, MOUNTING
13	1	502-9-32	Bearing, Ball
14	2	6007A	Bellville Spring
15	1	6771B	DRIVER, LINE BORE HEAD
16	1	6772A	Nut, Bearing Line Bore Head
17	1	100-82-2A	Brass tipped 10-24 Socket Set Screw
18	1	650-2-19Z	Assembly, Vertical shaft
19	1	MF-233	Countersunk Hex-Head Plug 1/8-27 NPT
20	1	100-1B	Tool Lock Spring
21	1	501-70G	SCREW, TOOL HOLDER LOCK ASSEMBLY
23	4	MF-22	S.H.C.S. 5/16 - 18 UNC - 3/4
24	1	100-19	Washer
25	1	MF-186	1/2-13 Nylock Nut
26	2	MF-3A	8-32UNC x 7/8" LG. S.H.C.S.
27	1	6753V	KEY (MICARTA), PINION - 90 DEGREE HEAD
28	1	MF-82	1/4-20UNC x 1/2" LG. SOCKET FLAT HEAD SCREW
29	1	6753E	BALL BEARING

900-2-19 Parts



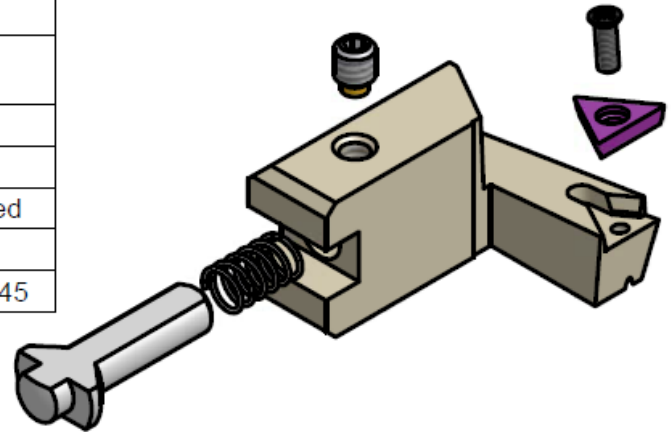
6801B Parts

6801B Tool Holder Assembly			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	6800B	Tool Cartridge
2	1	100-82-3B	Adjusting Pin
3	1	100-82-2	Set Screw, brass tipped
4	1	100-82-1	Spring
5	1	511-29-12E	Insert Screw, m2.5 x .45



6801N Parts

6801N Tool Holder Assembly, 1/4 IC triangle, Pos rake			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	6800N	Tool Cartridge offset
2	1	100-82-1	Spring
3	1	100-82-2	Set Screw, brass tipped
4	1	100-82-3B	Adjusting Pin
5	1	511-29-12E	Insert Screw, m2.5 x .45



650-2-39B Line Boring Cutterhead Package Components

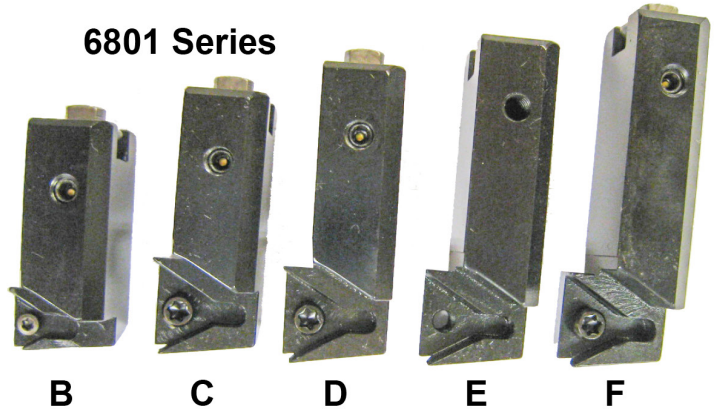


650-2-39F

RT321F



6801 Series



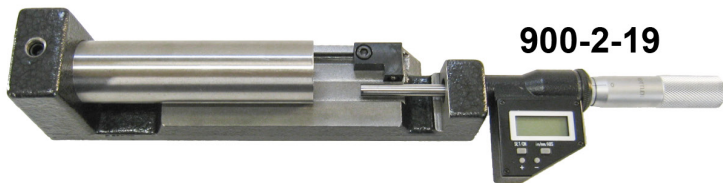
B

C

D

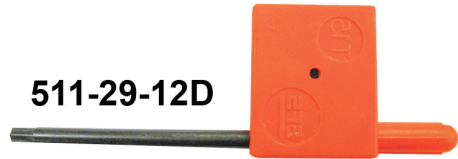
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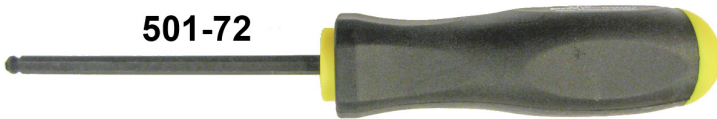


900-2-19

511-29-12D



501-72



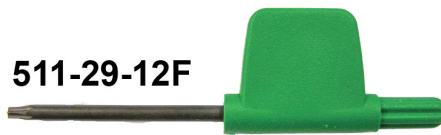
T7D



RT322F



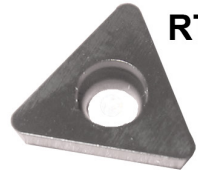
511-29-12F



RT211



RT212



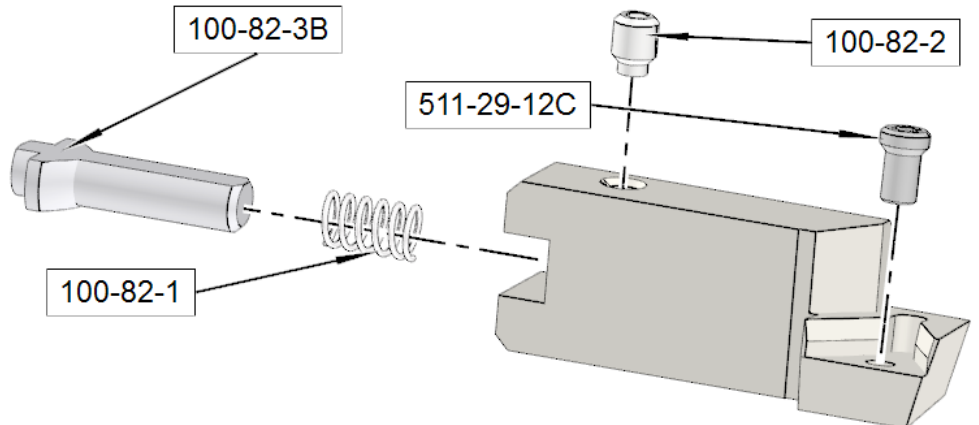
RT321



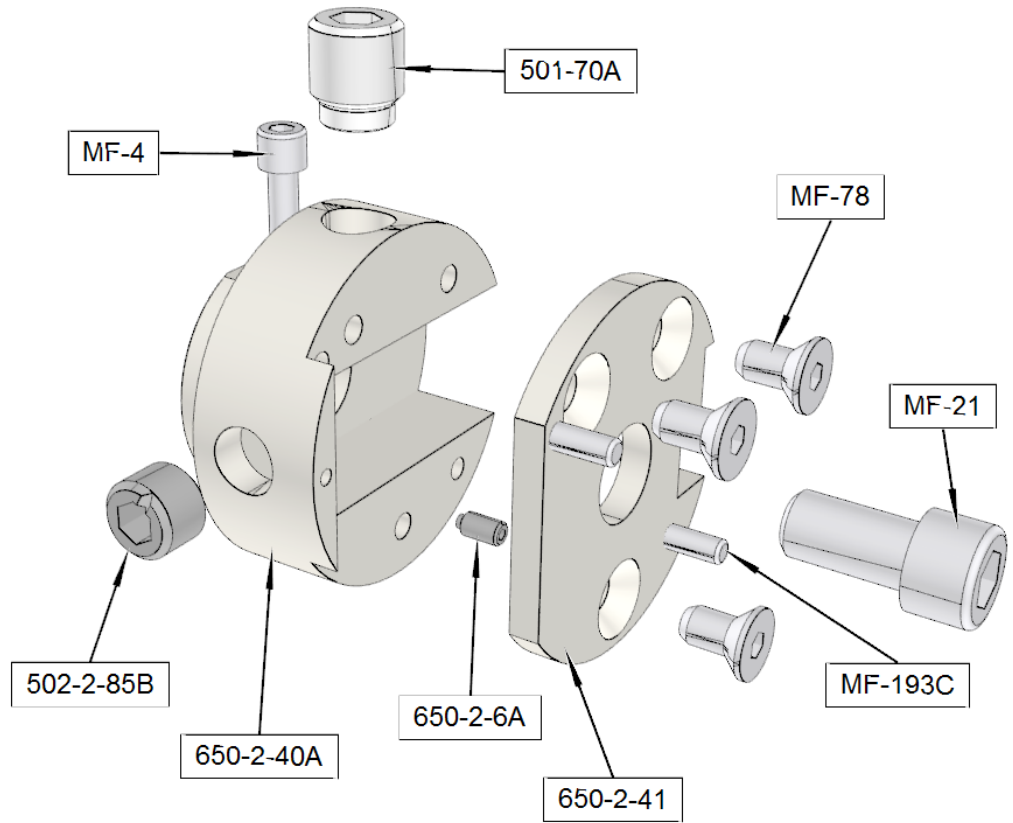
RT322



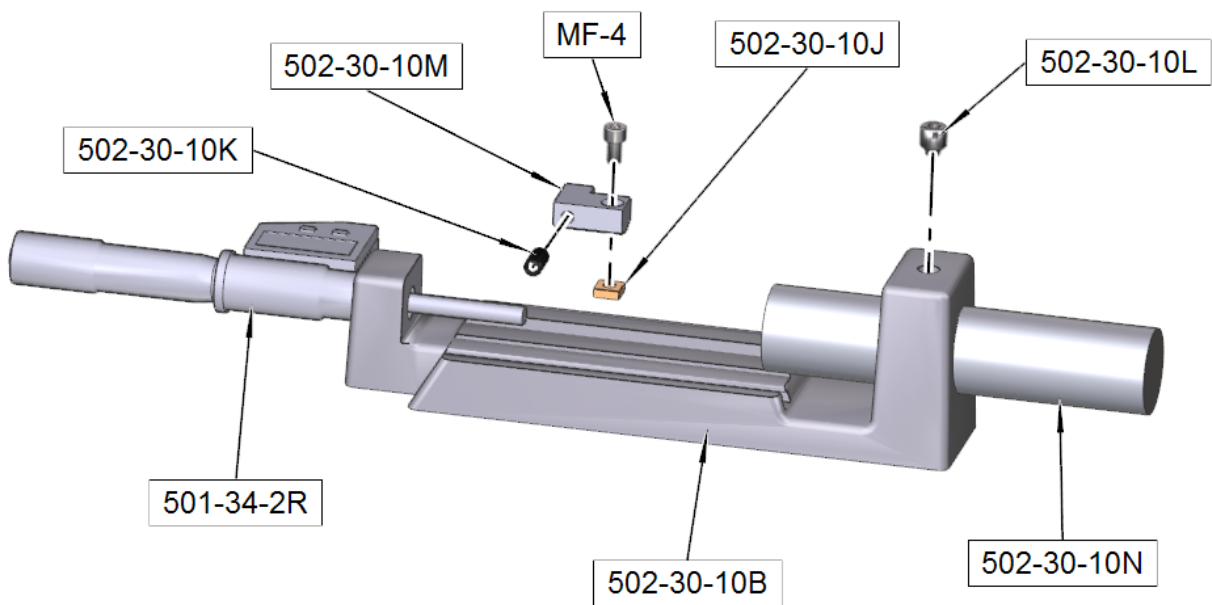
6801 Series Insert Holder Parts



650-2-39F Cutterhead Parts

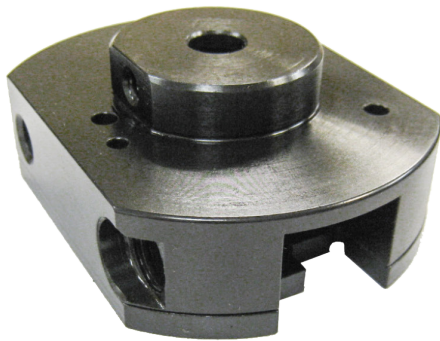


900-2-19 Micrometer Parts

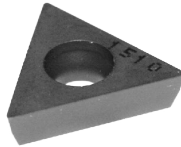


650-2-39C Cutterhead Package Components

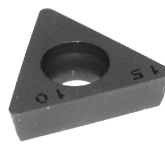
650-2-39G



RT321



RT322



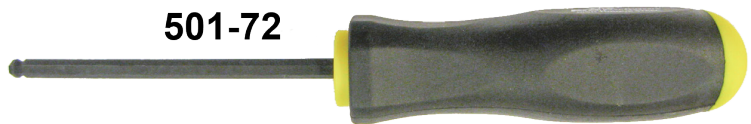
RT321F



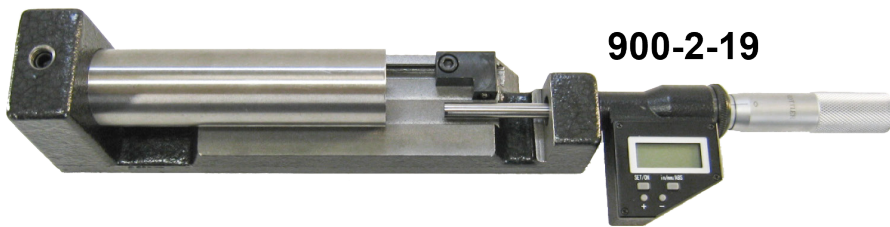
RT322F



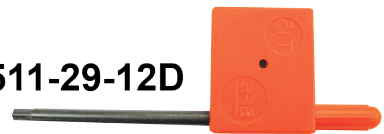
501-72



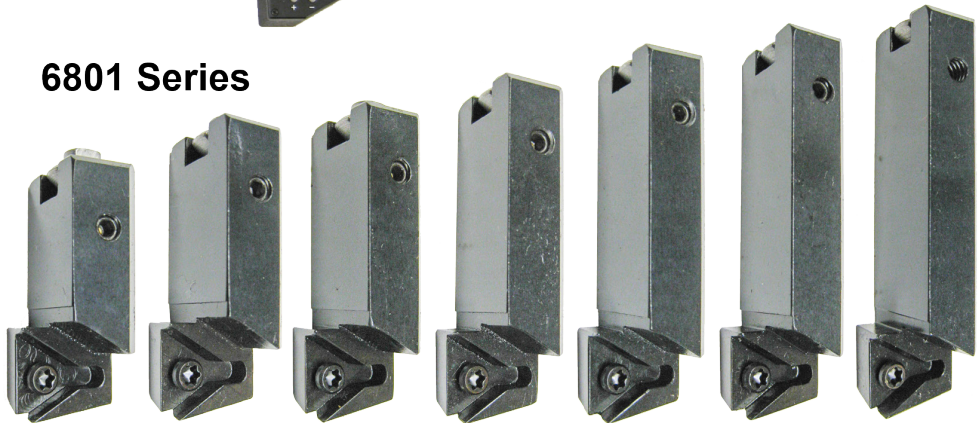
900-2-19



511-29-12D



6801 Series



C

D

E

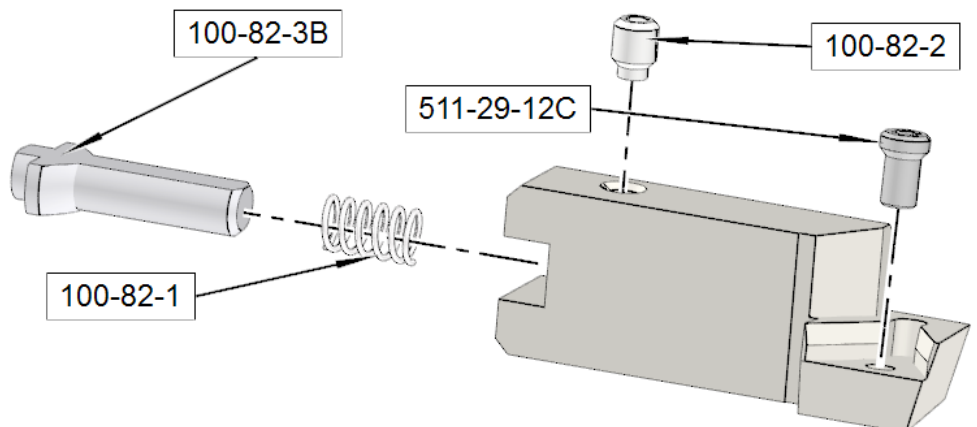
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G

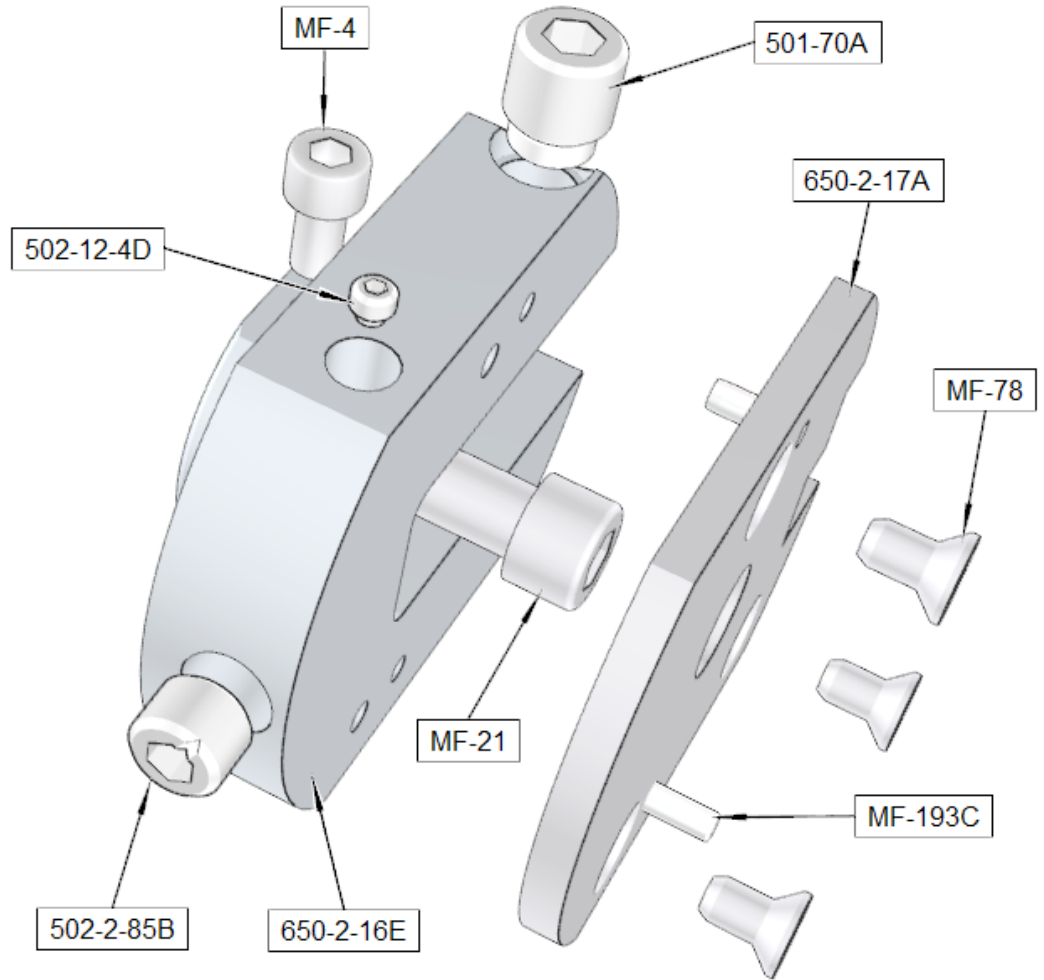
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J

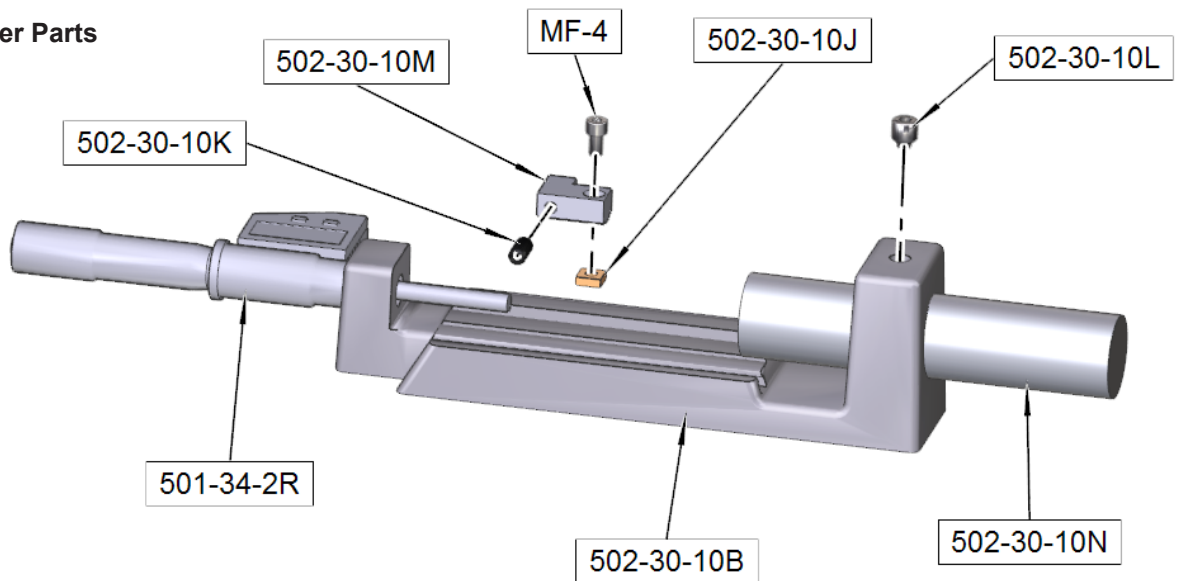
6801 Series Insert Holder Parts



650-2-39G Cutterhead Parts

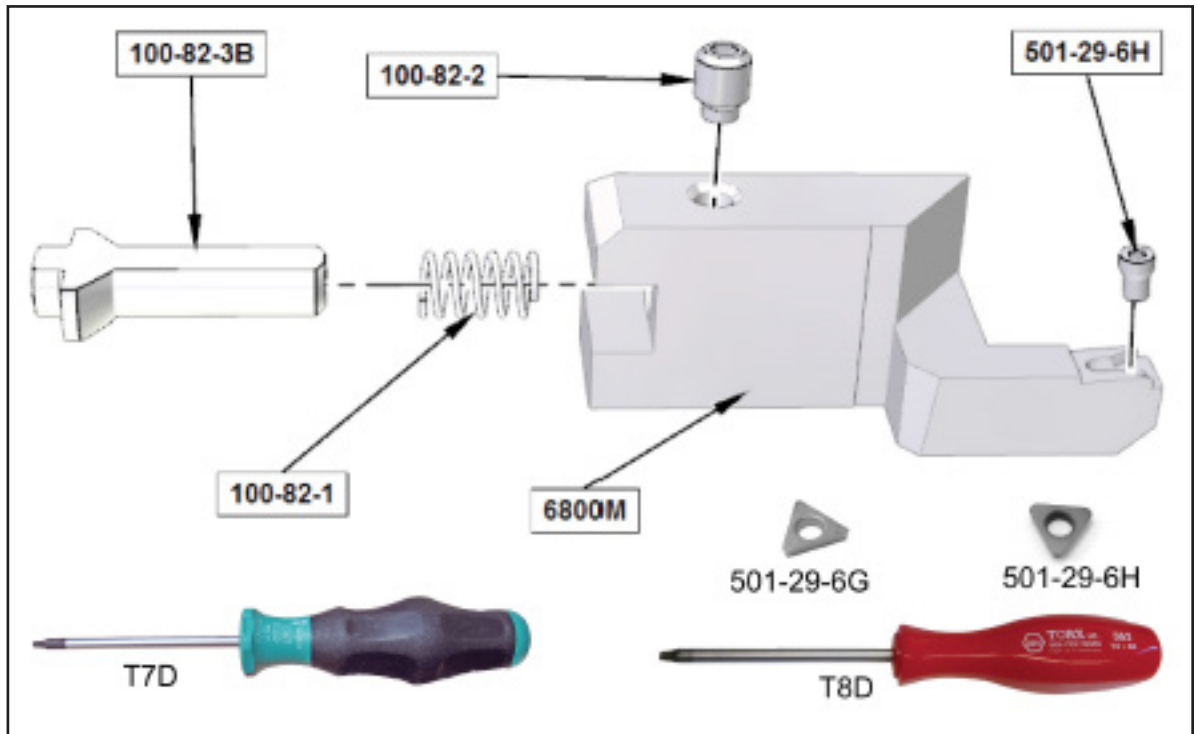


900-2-19 Micrometer Parts

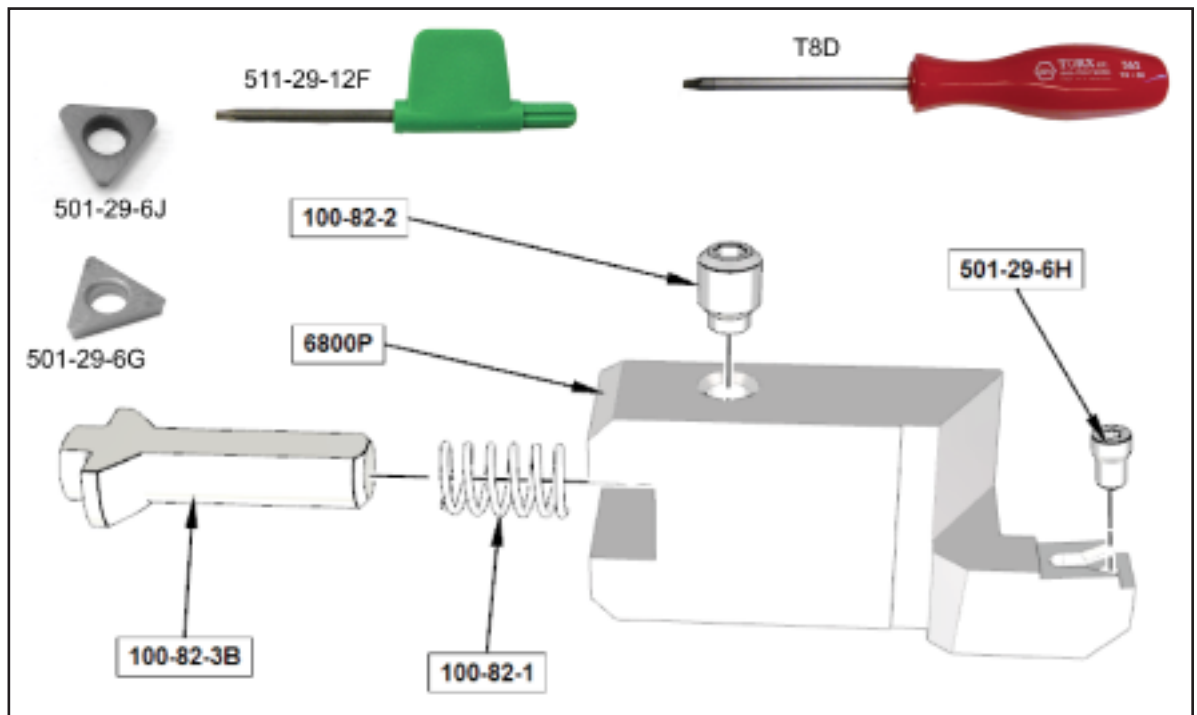


SPECIAL MAIN LINE BORING THRUST FACING TOOL

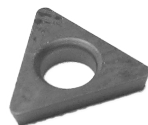
6801M Insert
Holder Package
Components



6801P Insert
Holder Package
Components



501-29-6G Triangular Insert

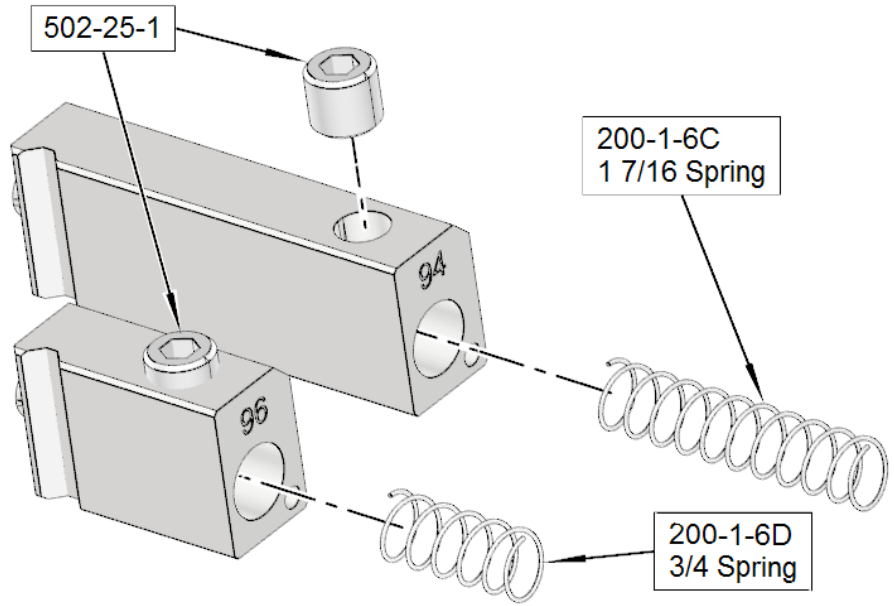


501-29-6H Insert Screw



SPECIAL MAIN LINE BORING CHAMFERING TOOL

199 Series Tool Holder Parts



501-33E Tool bit, 45-Degree Chamfer

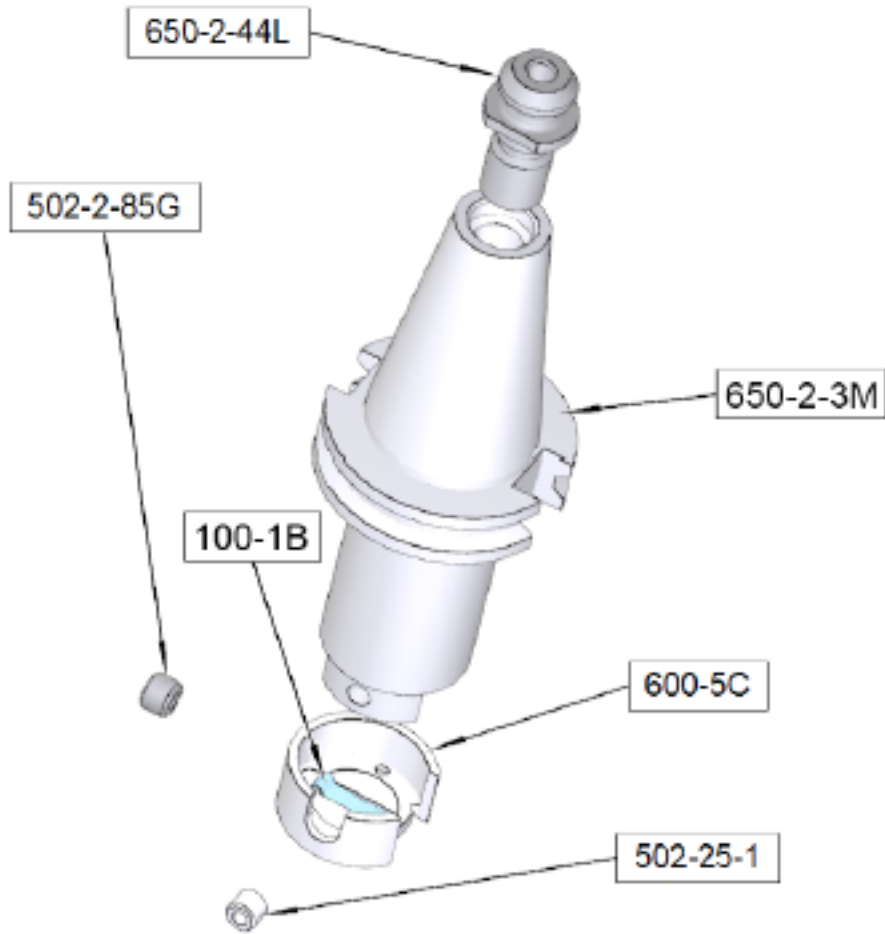


CAM LINE BORING TOOLING

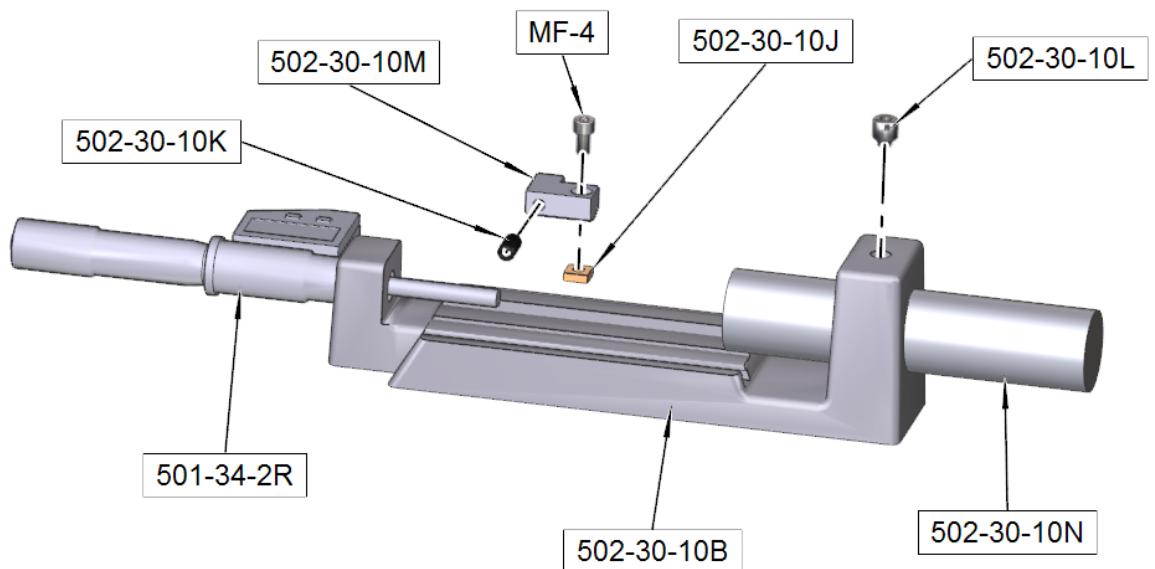
650-3-43T Cam Line Bore Tooling Package Parts



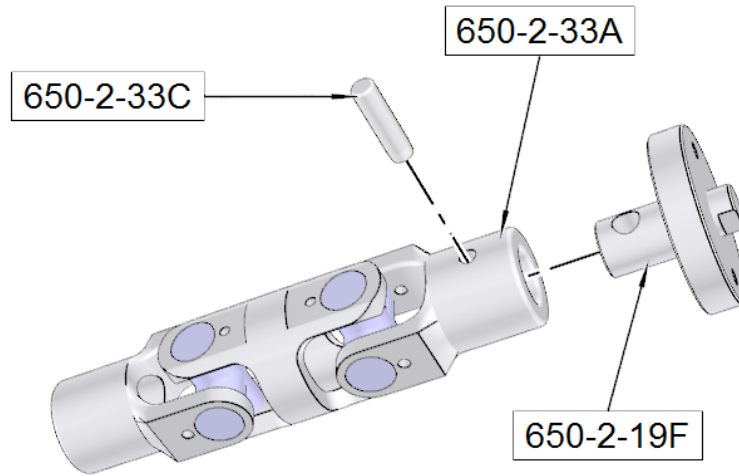
650-3-3R Cutter Head Assembly Parts



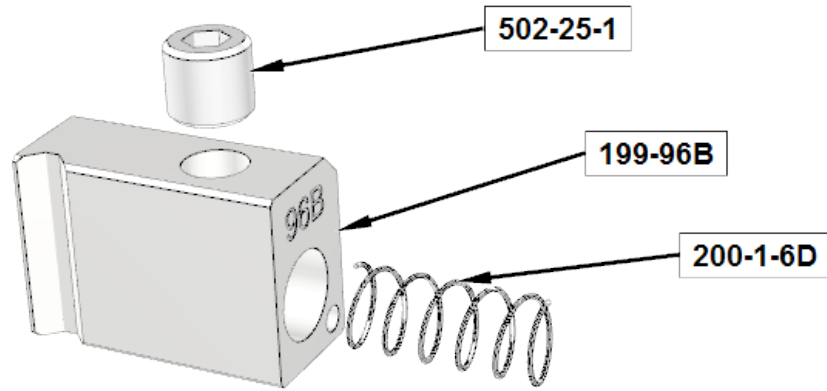
900-2-19 Micrometer Parts



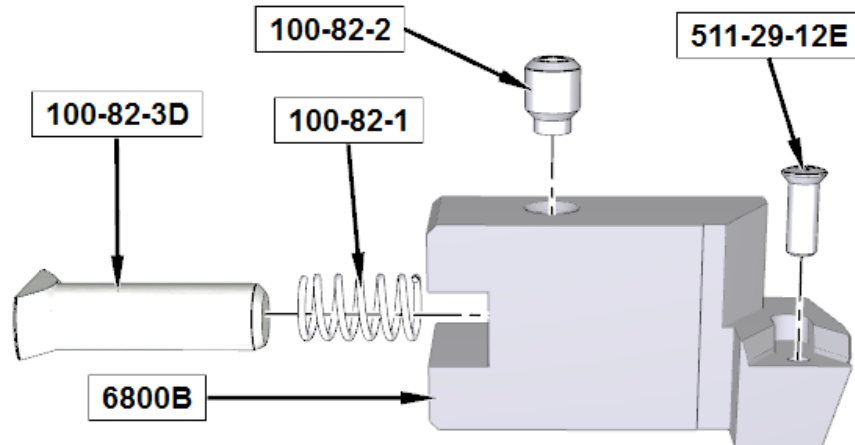
650-2-19G Universal Drive Parts



199-96B Tool Holder Parts



6802B Insert Holder Parts



CAM LINE BAR BUSHINGS

- If customer requires sizes other than listed below, rottler will manufacture the required size.
- Customer must provide the size, including tolerance, of the housing bore/s the bushing will be used in.
- Rottler will use this information to design the actual bushing.
- Bushings are machined smaller than housing bore.
- Sold in pairs.

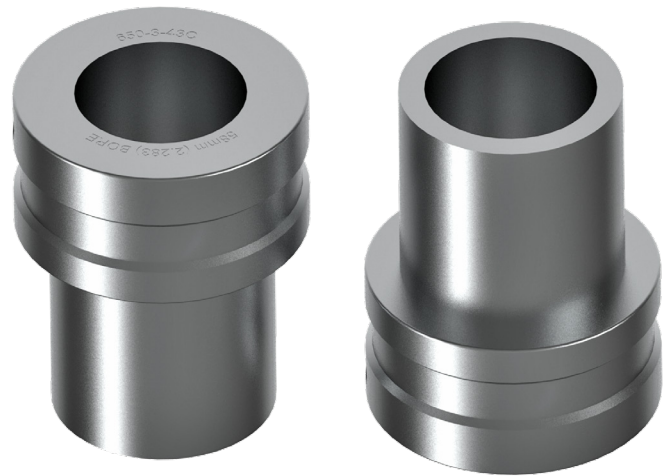
650-3-43B Bushing - 63mm (2.480" +/- .0007)

(Sold in pairs)



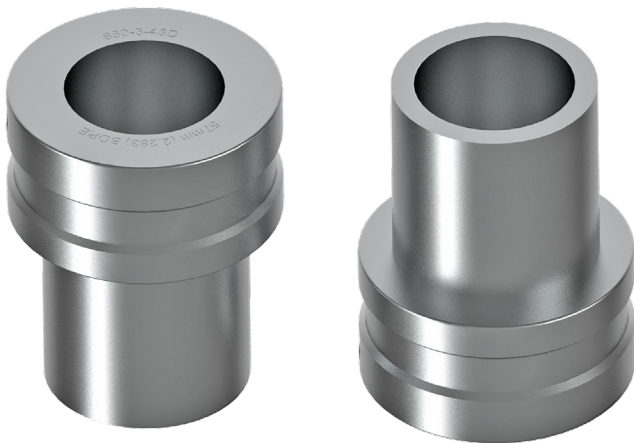
650-3-43C Bushing - 58mm (2.282" +/- .0007)

(Sold in pairs)



650-3-43D Bushing - (2.250" +/- .0007)

(Sold in pairs)



650-3-43E Bushing - (2.790" +/- .0007)

(Sold in pairs)



650-3-43F Bushing - (2.309" +/- .0007)

(Sold in pairs)



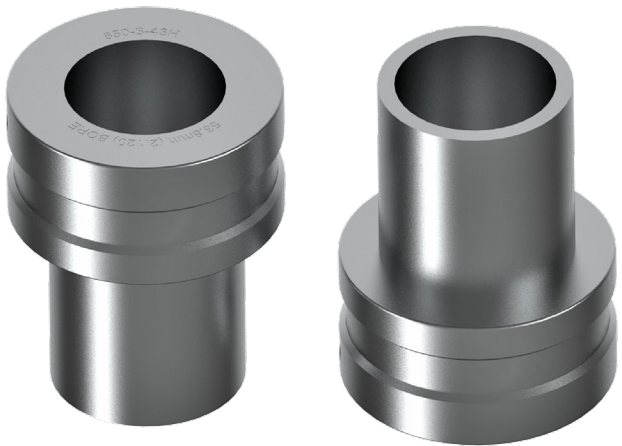
650-3-43G Bushing - (2.500" +/- .0007)

(Sold in pairs)



650-3-43H Bushing - (2.120" +/- .0007)

(Sold in pairs)



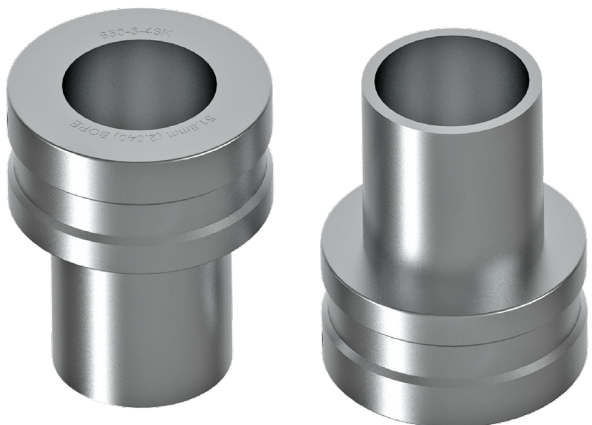
650-3-43J Bushing - (2.030" +/- .0007)

(Sold in pairs)



650-3-43K Bushing - (2.040" +/- .0015)

(Sold in pairs)



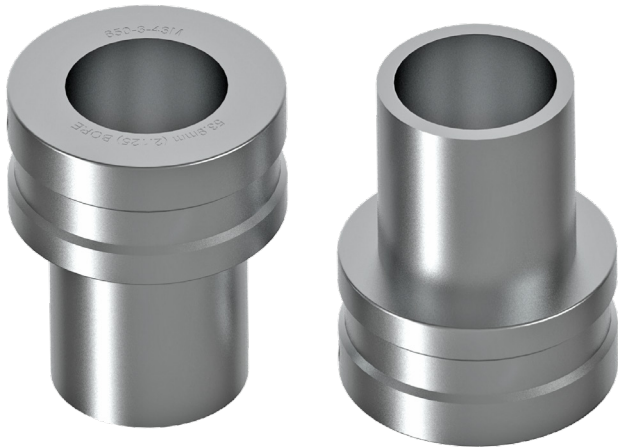
650-3-43L Bushing - (2.400" +/- .0007)

(Sold in pairs)



650-3-43M Bushing - (2.125" +/- .0007)

(Sold in pairs)



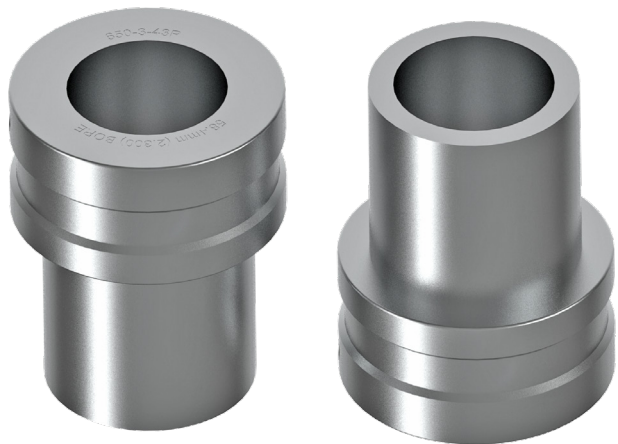
650-3-43N Bushing - (2.150" +/- .0007)

(Sold in pairs)



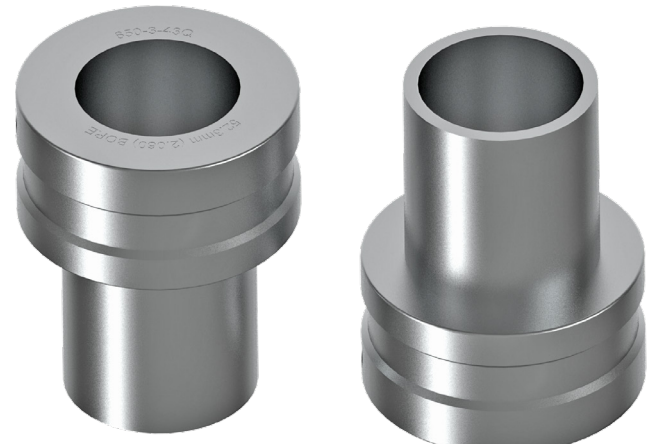
650-3-43P Bushing - (2.300" +/- .0007)

(Sold in pairs)



650-3-43Q Bushing - (2.060" +/- .0007)

(Sold in pairs)



650-3-43R Bushing - (2.6733" +/- .0007)

(Sold in pairs)



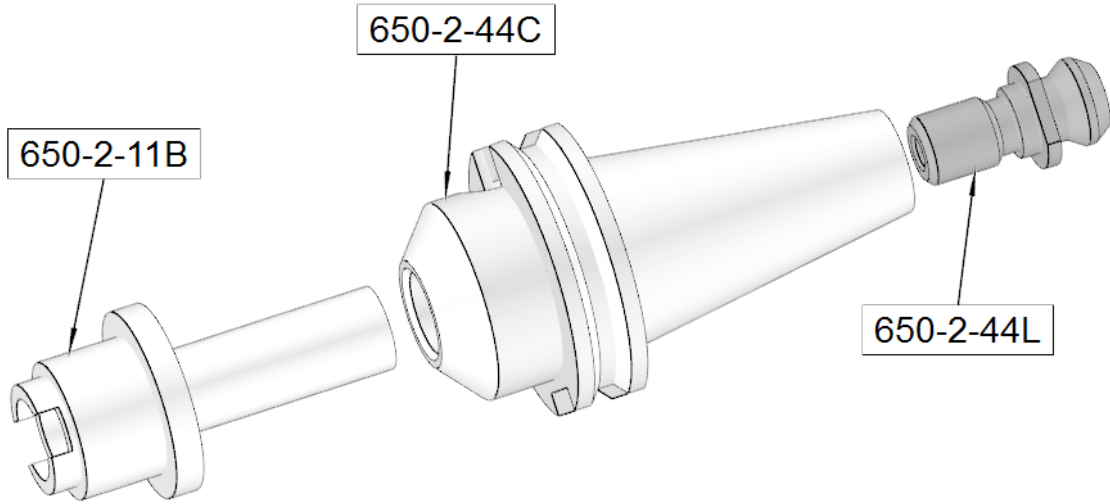
650-3-43S Bushing - (2.0450 +/- .0007)

(Sold in pairs)



THREAD TAPPING TOOLING

650-2-11K Quick Change Tap Holder Cartridge Assembly Parts



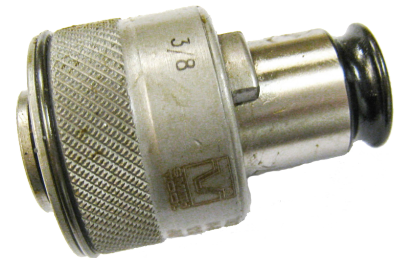
650-2-11C Torque Control Tap Holder for 1/4" (6.35mm) taps



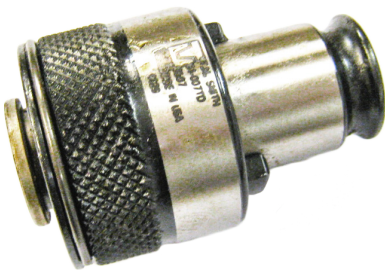
650-2-11D Torque Control Tap Holder for 5/16" (7.95mm) taps



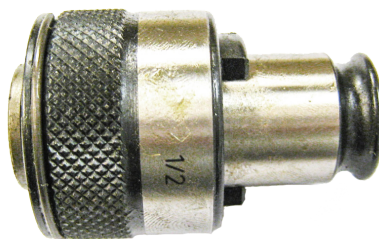
650-2-11E Torque Control Tap Holder for 3/8" (9.525mm) taps



650-2-11F Torque Control Tap Holder for 7/16" (11.13mm) taps



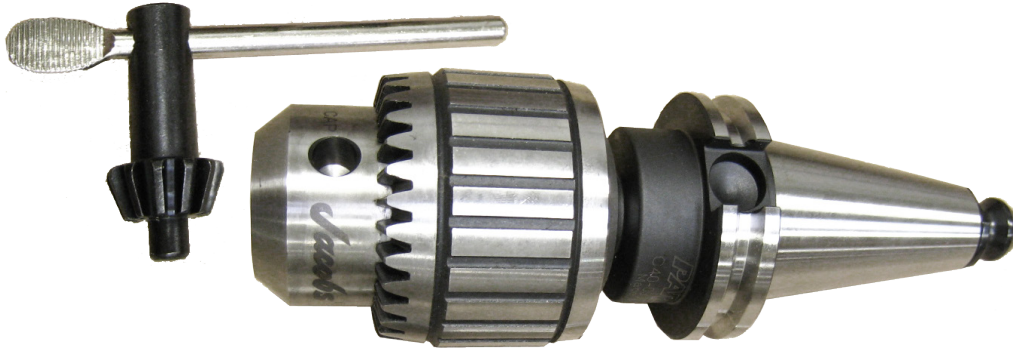
650-2-11G Torque Control Tap Holder for 1/2" (12.70mm) taps



DRILL TOOLING

650-2-44M Precision Drill Chuck Assembly

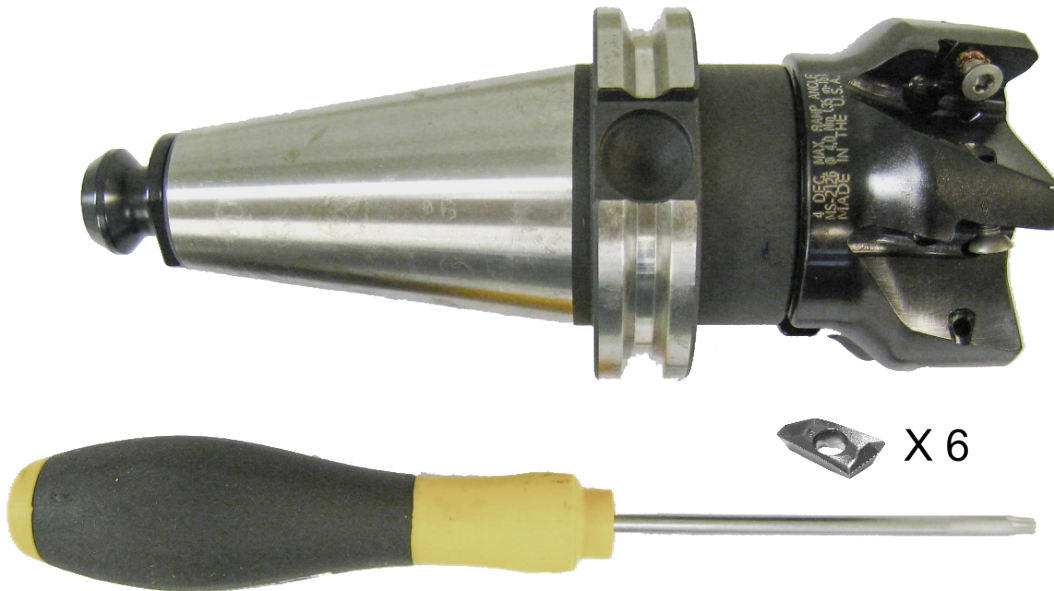
Sold only as complete assembly

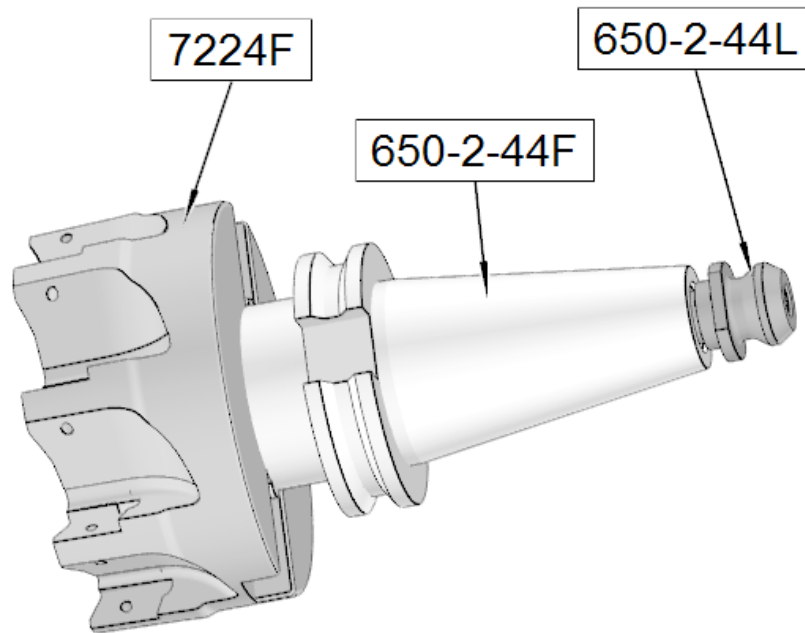


SHELL MILL ASSEMBLIES

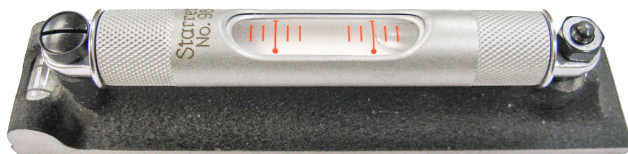
650-2-44N 2 1/2" (63.50mm) Shell Mill Assembly

Sold only as complete assembly

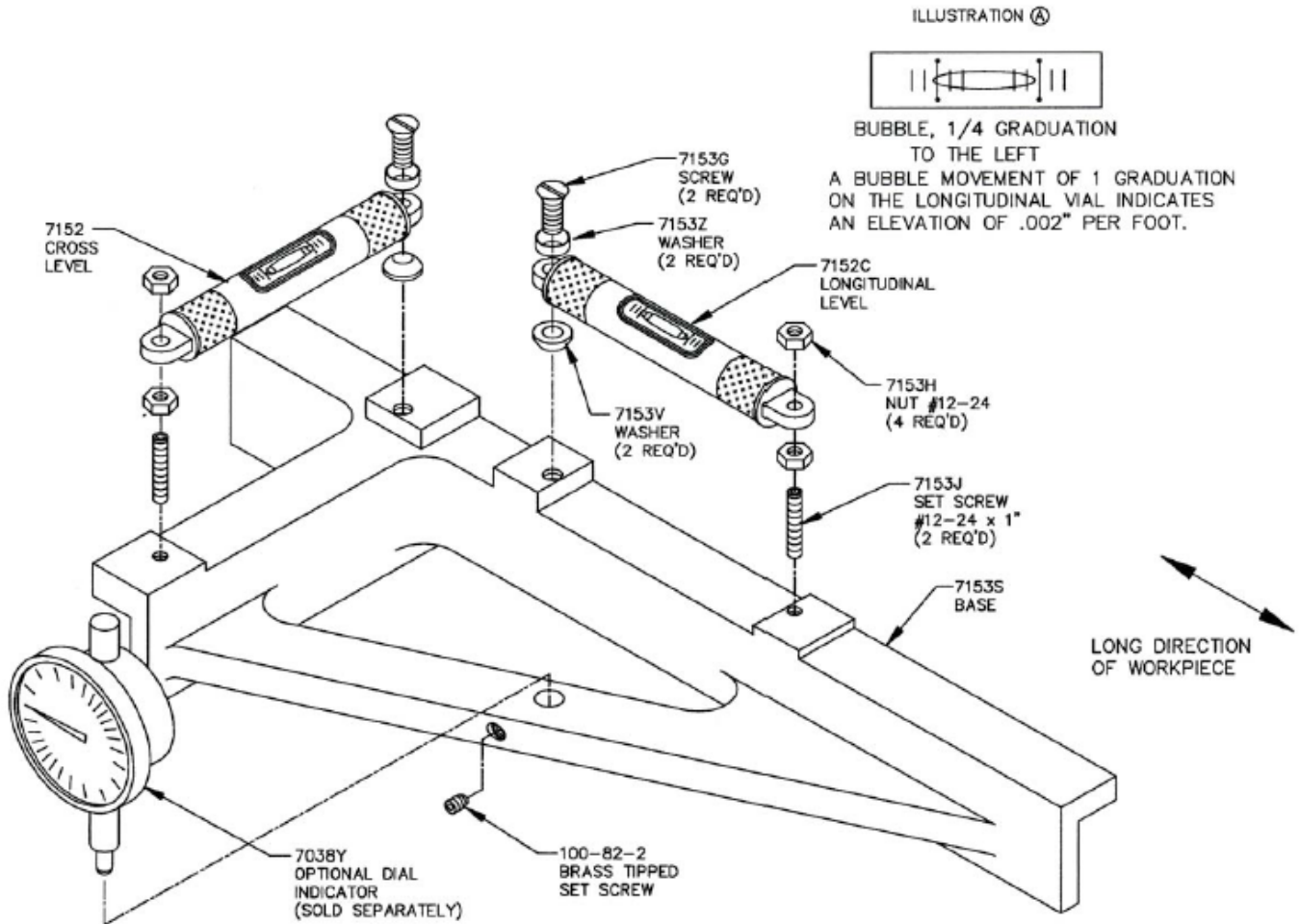


650-2-44P 4" (101.60mm) Shell Mill Assembly**GAGES AND INDICATORS****650-3-38 Level-for Intake and Exhaust Manifolds**

Sold only as complete assembly.



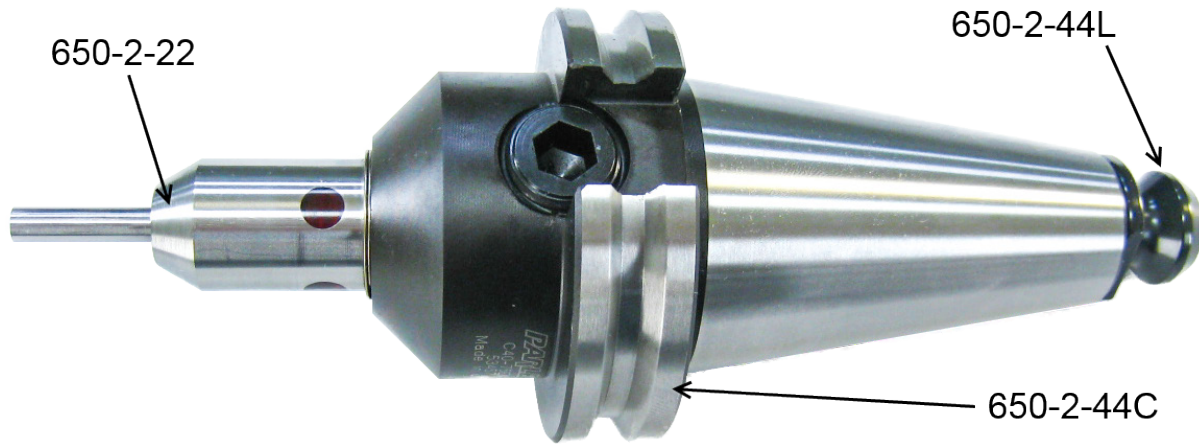
7152A Dual Axis Level Assembly Parts



7152A - OPTIONAL DUAL
AXIS LEVEL ASSEMBLY

NOTE: 7152A ASSEMBLY DOES NOT INCLUDE 7038Y DIAL INDICATOR

650-2-44Q Three Dimensional Electronic Position Finder Parts



502-9-9S Indicator Mount

Angled for small diameter main line bores



502-9-9A Mechanical Run Out Indicator

General Purpose (.001 Resolution)

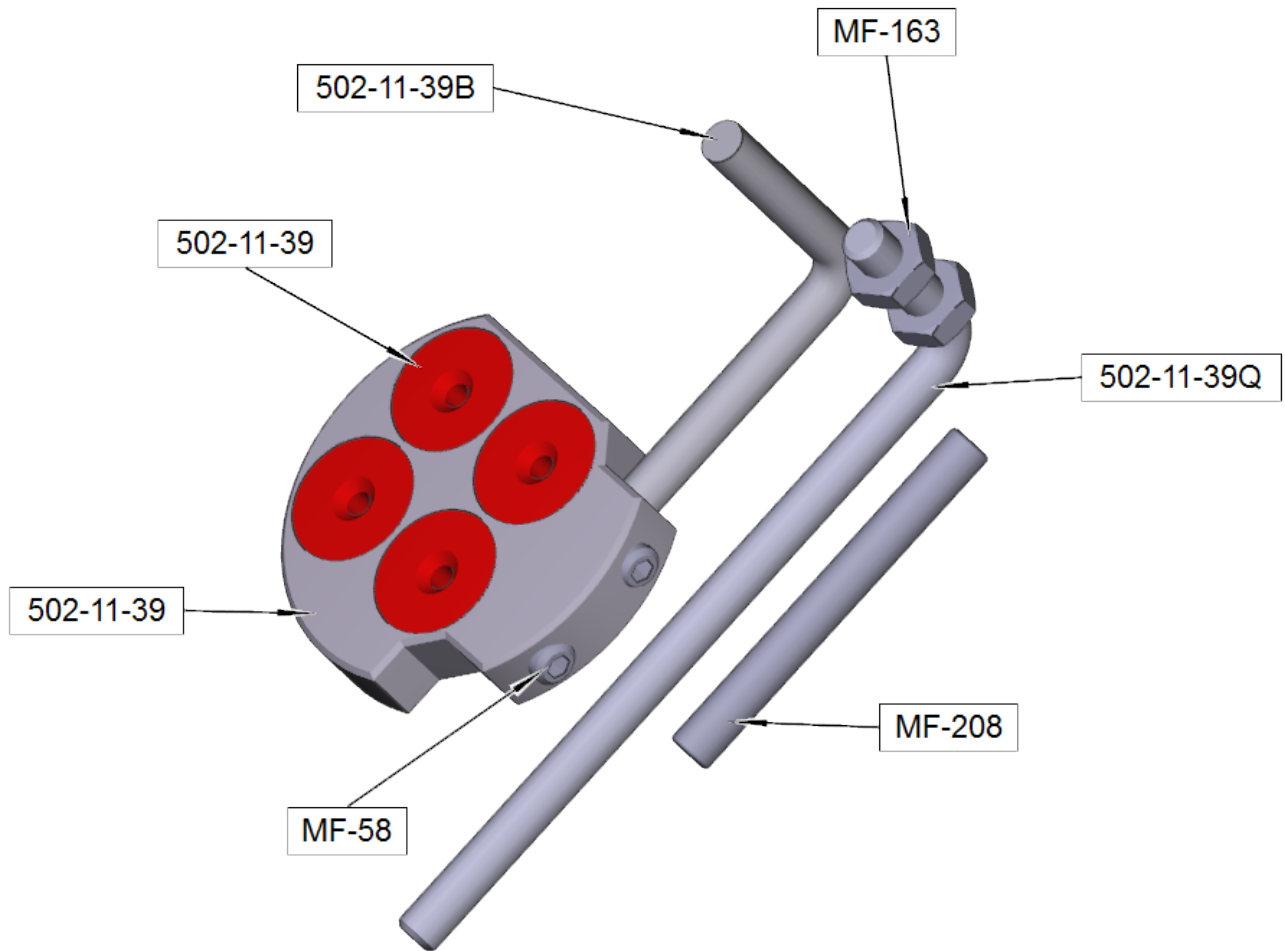


502-11-39D Mechanical Run Out Indicator

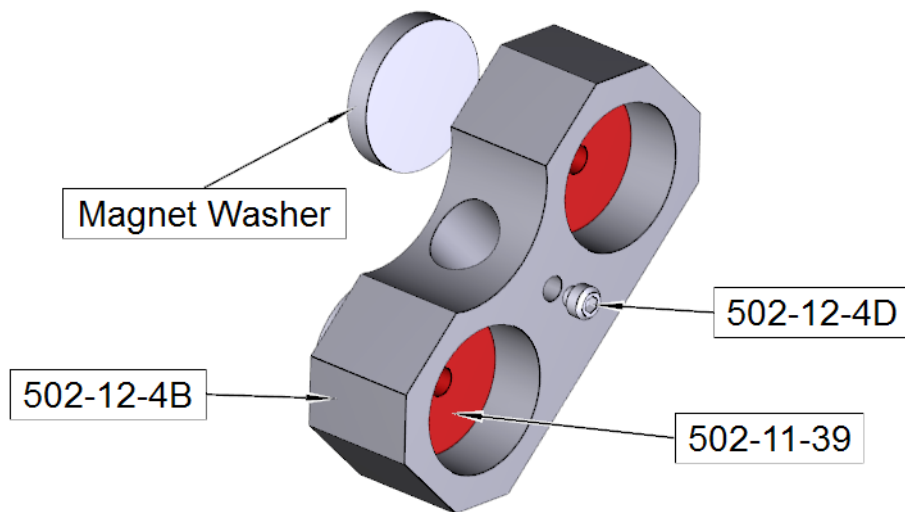
For Precision Bore Adjustment (.0001 Resolution)



502-12-4 Magnetic Base Parts



502-12-4A Magnetic Indicator Holder Assembly Parts



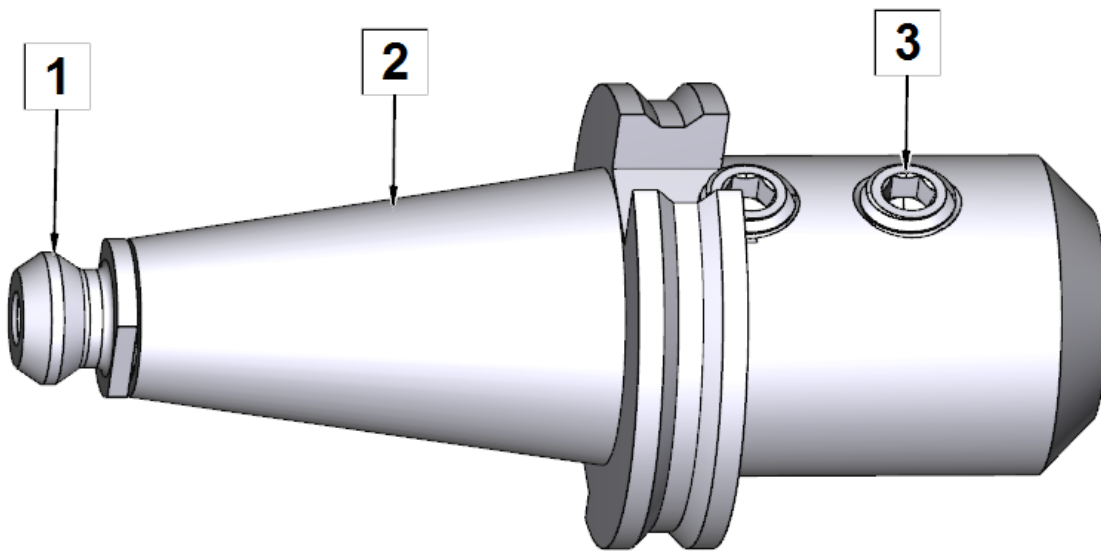
TOOLING FOR CRANKSHAFT STROKER CLEARANCE / NOTCHING

650-2-45H Roughing End Mill

1" (25.4mm) diameter X 8 1/2" (216mm) long for block stoker clearance



650-2-44A End Mill Adapter Parts



ITEM	PART #	DESCRIPTION
1	650-2-44L	CAT 40 RETENTION KNOB
2	650-2-44A	END MILL ADAPTER-1" COMPLETE WITH 650-2-44L RETENTION KNOB CAT 40 TAPER
3	MF-85	SOCKET FLAT HEAD SCREW 3/8-16 X 3/4"

TOOLING FOR SPLAYED 4 BOLT MAIN CAP MACHINING

650-2-53 Splayed 4 Bolt Main Cap Machining Tooling Package Components



650-2-44J



650-2-11F



650-2-53B



650-2-11K



650-2-44M



650-2-44N



650-2-53C



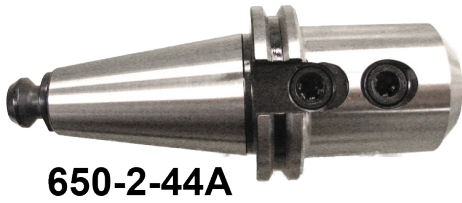
650-2-53A



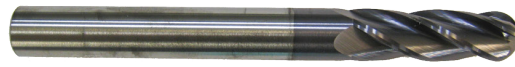
650-2-53D

BLOCK LIGHTENING TOOLING PACKAGES

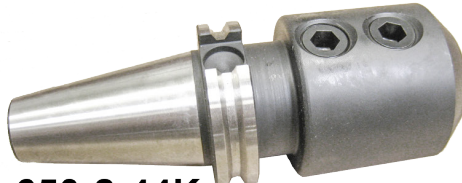
650-2-44W Block Lightening Tooling Package for Dart Small Block Chev Components



650-2-44A



650-2-44T



650-2-44K



650-2-45A



650-2-44S



650-2-45C



650-2-44U



650-2-44V



650-3-14R



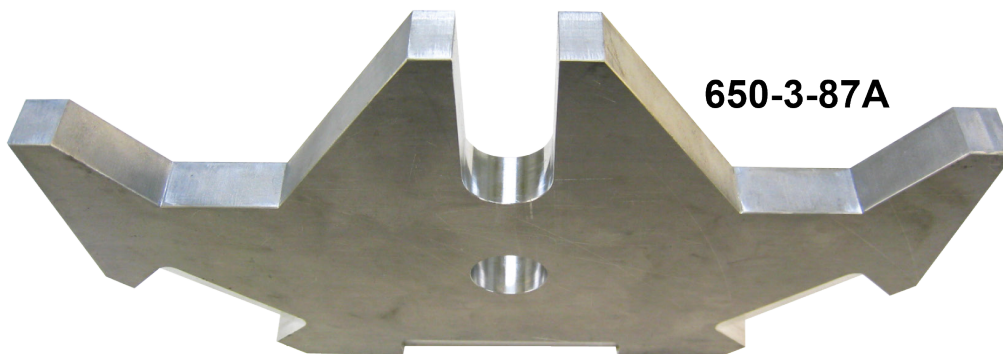
650-2-45D



650-2-45B

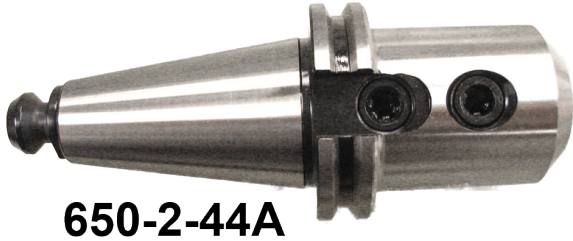


650-3-69

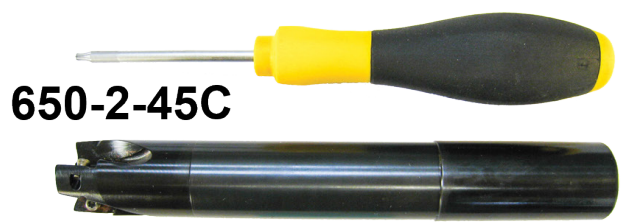


650-3-87A

650-2-44X Block Lightening Tooling Package for World Products Small Block Chev Components



650-2-44A



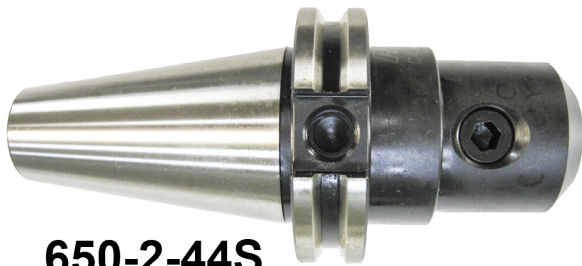
650-2-45C



650-2-44K



650-2-45A



650-2-44S



650-2-44T



650-2-44V



650-3-14



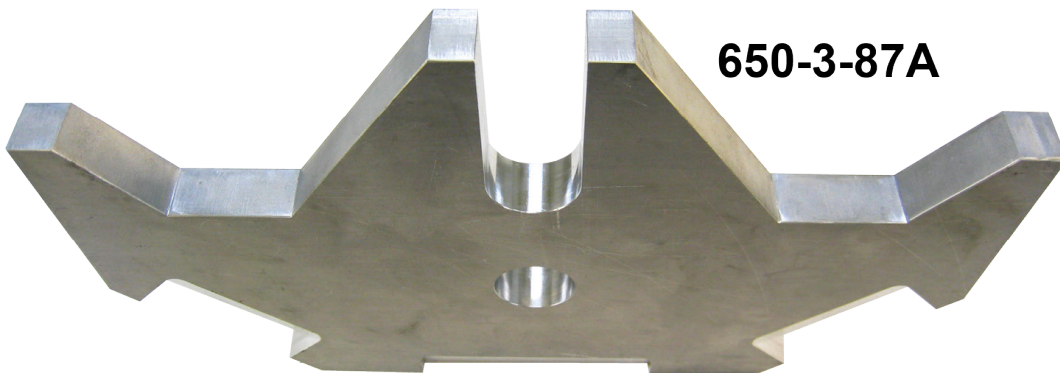
650-3-39



650-2-44U



650-2-45D

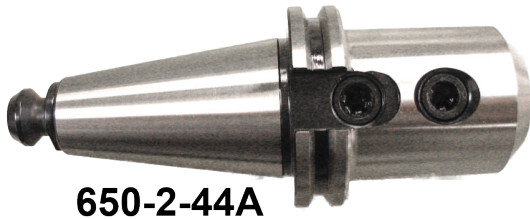


650-3-87A

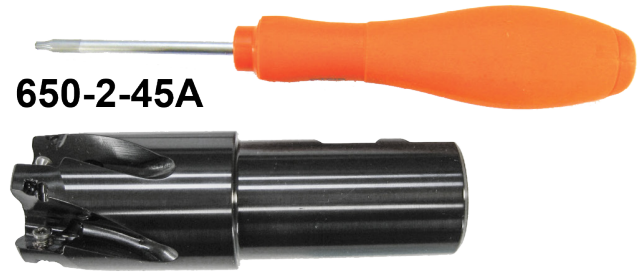


650-2-45B

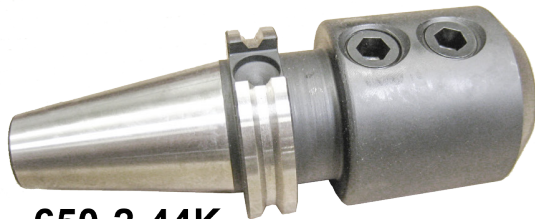
650-2-45J Block Lightning Tooling Package (CAT40 Taper) for Big Block Chevy Components



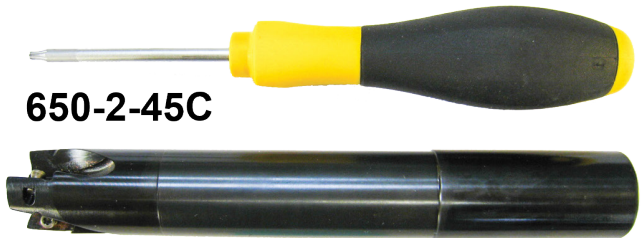
650-2-44A



650-2-45A



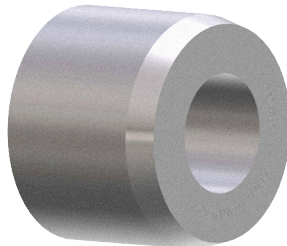
650-2-44K



650-2-45C



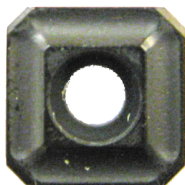
650-3-14P



650-3-69B



650-2-45L



650-2-45N



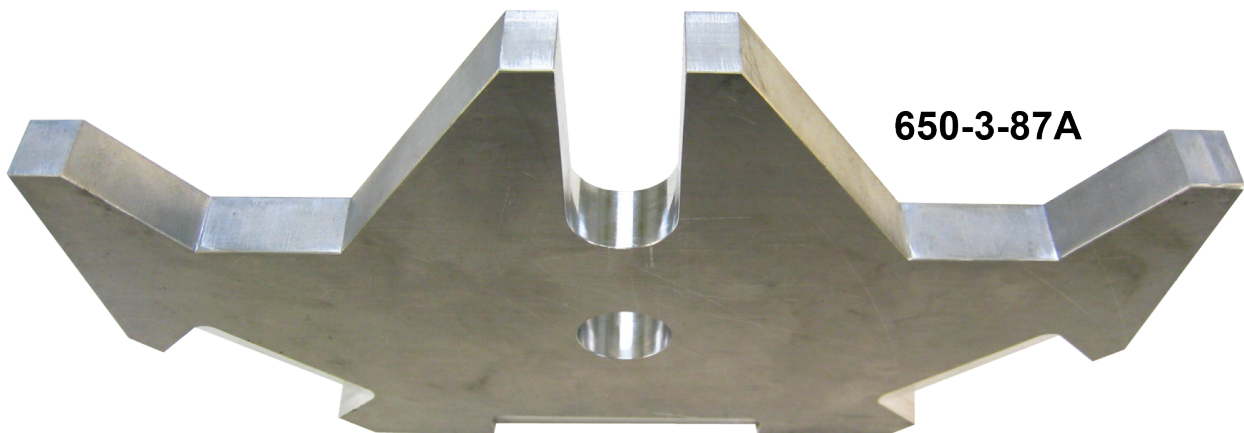
650-2-45M



650-2-45B

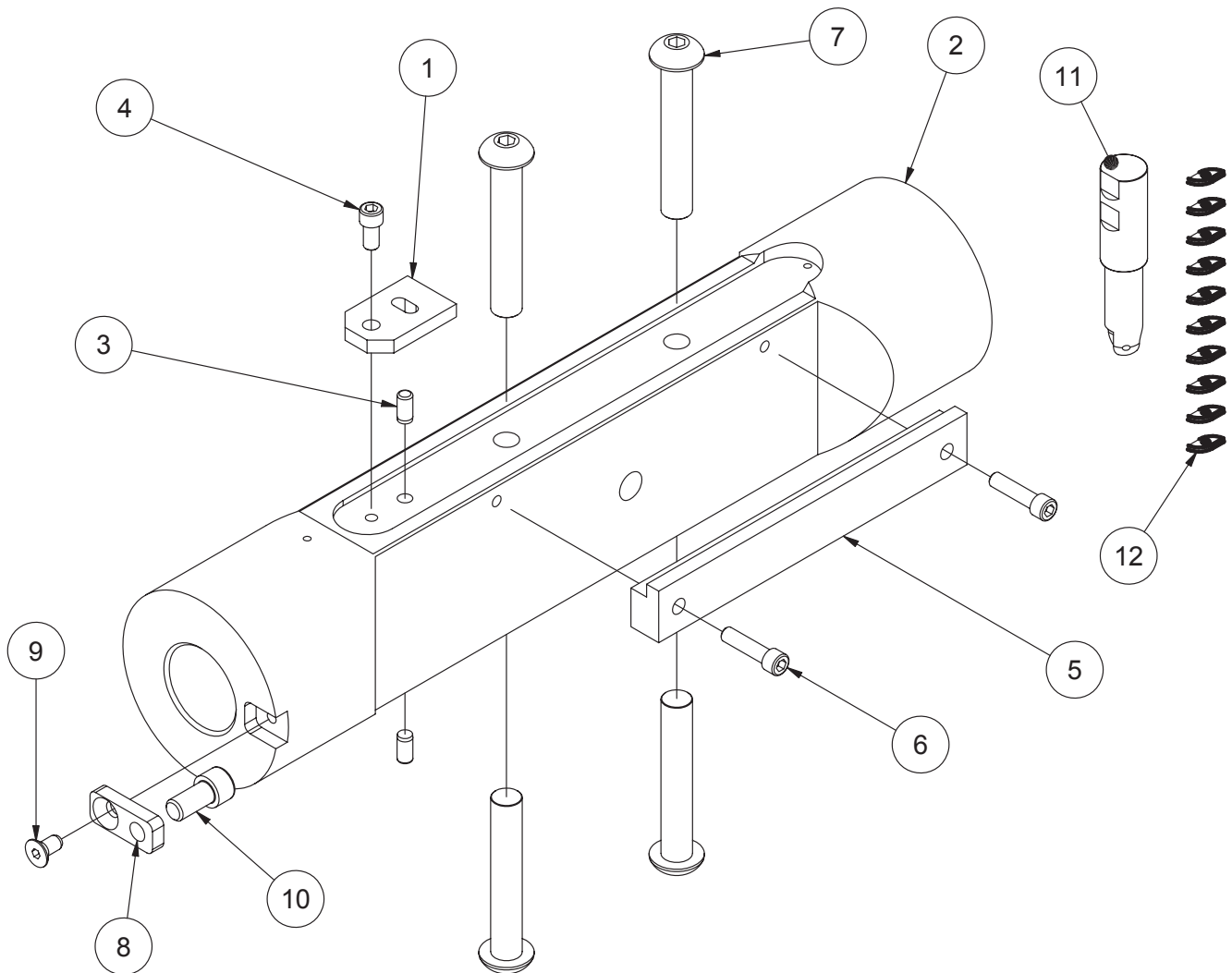


650-2-45D



650-3-87A

650-2-45Q Big Block Main Cap Lightening Fixture Assembly Parts



650-2-45Q MAIN BEARING CAP LIGHTENING FIXTURE ASSEMBLY			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-2-45S	SPACER PLATE, MAIN BEARING CAP LIGHTENING FIXTURE
2	1	650-2-45R	FIXTURE, MAIN BEARING CAP LIGHTENING
3	2	MF-202	1/4 x 1/2 Dowel Pin
4	1	MF-12	S.H.C.S. 1/4 - 20 UNC - 1/2
5	1	650-2-45T	LOCATOR, REAR MAIN BEARING CAP - MAIN BEARING CAP LIGHTENING FIXTURE
6	2	MF-15	S.H.C.S. 1/4 - 20 UNC - 1
7	4	650-2-45W	BUTTON HEAD SCREW 1/2-13UNC x 3" LG.
8	1	650-2-45X	DRIVER, MAIN BEARING CAP LIGHTENING FIXTURE
9	1	MF-82	Socket Flat Head 1/4-20 UNC x 0.5
10	1	Mf-30	S.H.C.S. 3/8 - 16 UNC - 3/4
11	1	650-2-45Y	SOFTWARE PACKAGE - MAIN BEARING CAP LIGHTENING
11	1	650-2-45U	INDEXABLE BALL NOSE ENDMILL
12	10	650-2-45V	CARBIDE INSERT - BALL NOSE ENDMILL