



Tool Products

# OPERATOR'S MANUAL

INCLUDING: OPERATION, INSTALLATION & MAINTENANCE

## LEAD SCREW TAPPER

SECTION M 104

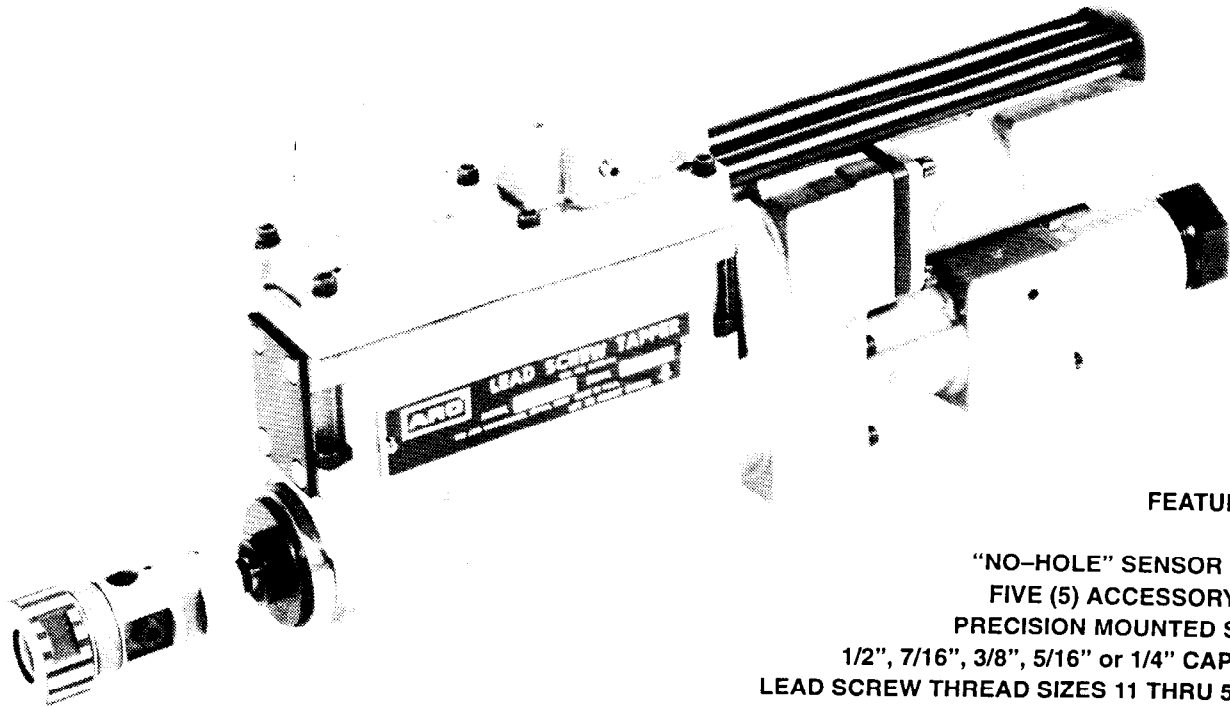
MANUAL 32

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Models: 8655-B(-)(-), 8656-B(-)(-),  
8657-B(-)(-), 8658-B(-)(-)  
and 8659-B(-)(-).



### FEATURES:

- "NO-HOLE" SENSOR SYSTEM
- FIVE (5) ACCESSORY PORTS
- PRECISION MOUNTED SPINDLE
- 1/2", 7/16", 3/8", 5/16" or 1/4" CAPACITIES
- LEAD SCREW THREAD SIZES 11 THRU 56 PITCH
- METRIC THREAD SIZES AVAILABLE
- 3/16" (MIN.) TO 2" (MAX.) STROKE ADJUSTMENT
- THREE (3) BASIC SECTIONS FOR EASY MAINTENANCE
- 175, 325, 600, 1300, 2400 R.P.M. FREE SPEEDS AVAILABLE
- PRODUCES ACCURATE THREADS IN PRE-DRILLED MATERIAL

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For additional Maintenance/Repair information, Form 1631-2 (English) is available at \$5.00 each. Send request to The ARO Corporation, One Aro Center, Bryan, Ohio 43506, Attn: "Sales Training".

**IMPORTANT: READ THIS MANUAL CAREFULLY BEFORE INSTALLING, OPERATING OR SERVICING THIS EQUIPMENT.**

For parts and service information, contact your local ARO distributor, or the Customer Service Dept. of the Ingersoll-Rand Distribution Center, White House, TN at PH: (615) 672-0321, FAX: (615) 672-0801.

ARO Tool Products

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**PROFESSIONAL TOOLS**

# GENERAL DESCRIPTION AND OPERATION

The tapping cycle is started by manually actuating and releasing "START" valve at the tool. The start valve must be held long enough to allow the stop signal valve to close (page 9); about one (1) second duration for most applications.

**NOTE:** For very low spindle speeds with medium to fine pitch lead screw, the signal duration may need to be increased beyond one second. For very high spindle speeds and short stroke settings, the signal duration may need to be decreased and positively controlled – consult factory in this case.

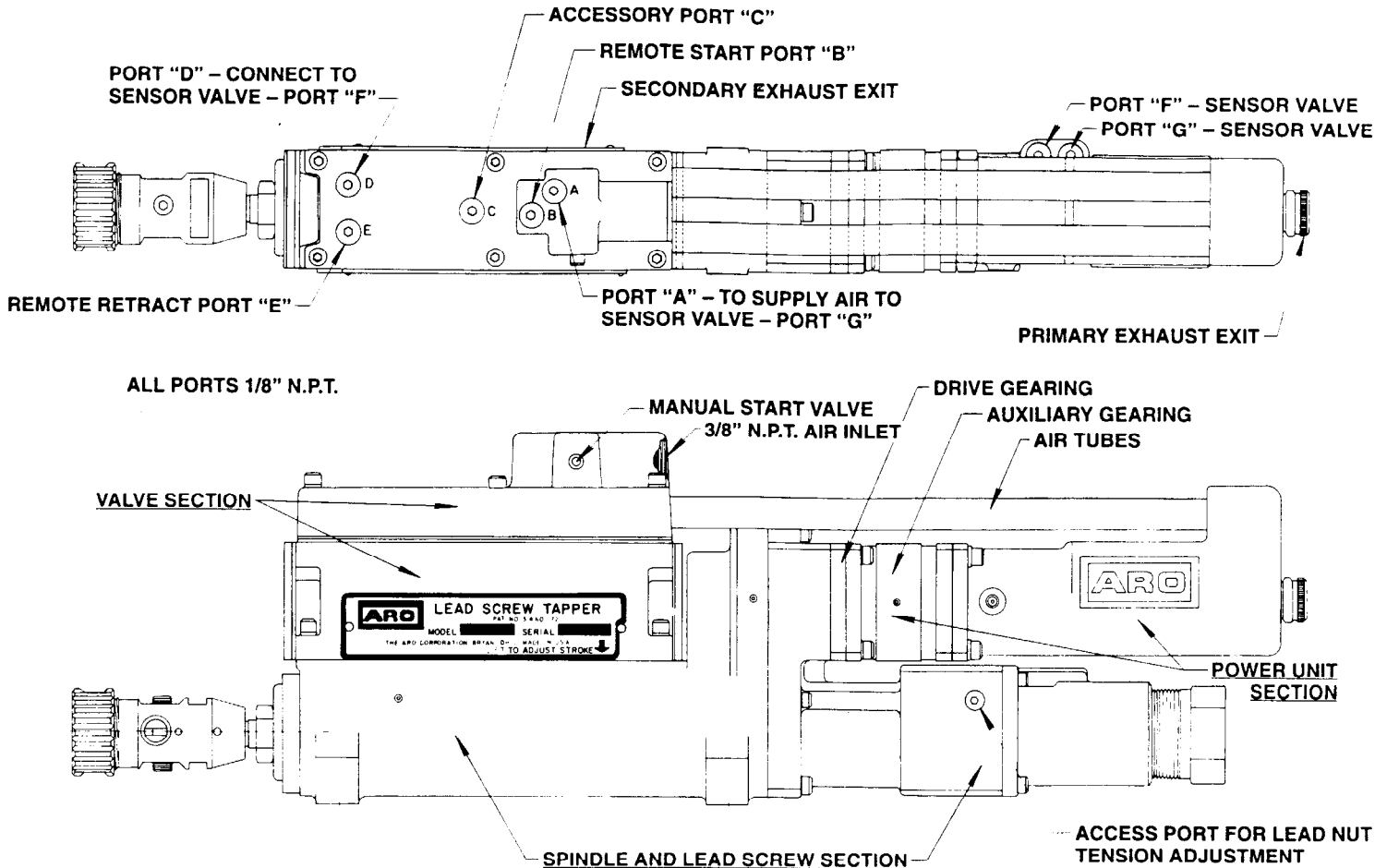
The unit will advance the tap to a pre-set depth and automatically retract to the initial position whereupon the unit will stop with all air

to the unit shut-off. To aid set-up procedure, "RETRACT" and "STOP" may be manually initiated at the tool by actuating one of two trip tabs located inside the nameplate cover. Swing cover up for for access (page 4).

**WARNING:** Do not use fingers to manually actuate trip tabs – use a blade type screwdriver or similar tool.

The ARO Lead Screw Tapper may be used in a single unit application or a multiple unit application.

The maximum stroke length of unit is 2". Maximum stroke length of unit with dual spindle head is 1-1/4".



The three basic sections of the Lead Screw Tapper are arranged for efficient maintenance. The following is a brief description of the sections and their functions.

**VALVE SECTION** is composed of a two-way and a four-way spool valve, both being a two position, double pilot pressure operated type.

The tap function is manually actuated by the operator while the "RETRACT" and "STOP" functions are automatically actuated by the tool. The start valve must be depressed with a short duration of dwell when starting a cycle from the automatically stopped position. Hold valve down only so long as necessary to properly start the advance (1 second). "RETRACT" and "STOP" trip tabs need only be depressed briefly to achieve proper response.

Located between and piloting within the "RETRACT" and "STOP" valves is actuator (40521-1) with the two trip tabs (40523-1) pilot-

ing on the actuator with set screws provided to hold a positive setting between either trip tab and the actuator (page 4). It is the purpose of the adjustable trip tabs to provide contact with the bracket on the traversing spindle drive and properly actuate the "RETRACT" and "STOP" valves to achieve the proper mode. The "START" and "RETRACT" functions may be manually operated at the tool or remotely operated through remote inlet ports using recommended tubing, fittings and valves (see page 19 for remote control hook-up).

Each time the "START" valve is depressed, the unit will start in the advancing (forward) mode.

To start in the retract mode when the unit has been stopped in mid-stroke, depress and hold retract tab to the left and press the "START" valve and release retract tab after retraction commences (see warning note above).

Also contained in the valve section are five (5) 1/8" NPT ports for accessory purposes. The ports and their functions are listed as follows:

PORT "A" – provides constant line pressure. This port is used to connect air supply to the "no-hole" sensor valve, port "G" (page 20). **Do not** use this port to supply another unit.

PORT "B" – use for remote start input (page 19).

PORT "C" is pressurized during the advance and retract cycles and is not pressurized when the unit is stopped. This port can be used to control a valve for coolant, cycle completion, etc. (page 21).

PORT "D" is used to connect port "F" of the "no-hole" sensor valve to the retract valve in the valve housing (page 20).

PORT "E" – use for remote retract input (page 19).

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SPINDLE AND LEAD SCREW SECTION has provisions for primary mounting and houses the spur gear drive train, lead screw shaft, lead screw assembly, main drive spindle and sleeve and a "no-hole" sensor valve located in rear housing (45443), see page 20.

The spindle is mounted in a precision sleeve by a pair of ball bearings and a precision roller bearing.

The spindle sleeve is mounted within two precision finished bronze bushings contained in the spindle housing. The spindle is connected to the lead screw shaft thru a rigid, no-back-lash coupling. The spindle is free to rotate but axially retained in the sleeve by the ball bearings. The lead screw shaft is driven thru a sliding

spline connection with a final gear of the three spur gear system. Feed is accomplished by connecting the lead screw to the rotating lead screw shaft by means of another rigid, no-back-lash coupling. The lead nut within the lead screw housing has provisions for tension adjustment with the lead screw. The tension adjustment provision is accessible from the outside of the lead screw housing by removing pipe plug (Y227-2-L). The lead screw and nut assembly is easily accessible from the rear of the tool by removing three (3) screws (Y154-53) and housing (45443) and may be changed to provide another pitch in 10 minutes or less (see page 5).

The non-interchangeable spur gear system is easily accessible for maintenance.

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POWER UNIT SECTION is comprised of a reversible motor assembly and housing and bolt-on type planetary gearing. The "2200" series motor develops .60 horsepower at approximately half of free speed. The torque and free speed developed is com-

mensurate with the planetary gear reduction of a specific model. The planetary gearing is accessible and completely interchangeable for easy change of tapping speed. A typical change of speeds may be accomplished in 15 minutes or less (see page 12).

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MOUNTING the unit is accomplished with 5/16"-18 bolts or cap screws from the underside of the fixture. Keyways are provided in the units two mounting feet (page 27) and it is recommended that

keys be used for alignment of the unit to the fixture. Keys (45060) – .500" wide x .375" thick x 1.000" long – are available as optional equipment.

# SET-UP PROCEDURE

**SET-UP PROCEDURE:** The ARO Lead Screw Tapper is adaptable to many applications. Its maximum stroke of 2" can be reduced to a minimum stroke of 3/16" by adjusting the "RETRACT" and "STOP" trip tabs, located beneath the nameplate door. Any stroke setting of less than 2" can be positioned at any point within the 2" length by properly setting the trip tabs.

When shipped from the factory, the spindle is in its full retracted position with the internal sleeve bracket addressing the "STOP" trip tab and the inside edge of the trip tab directly under the zero (0) index line on the gauge plate (step 1). The unit is thus properly calibrated for stroke indication. In this position, the unit should remain stopped when air is admitted to the main air inlet.

**IMPORTANT NOTE:** Adjustment of the trip tabs should be made **BEFORE** connecting air pressure to the tool or with the air supply line to the tool shut off and exhausted (drained) of compressed air.

Prior to setting the stop trip tab, the spindle will have to be advanced at least 1/4" in order to allow moving the stop tab to the left (trip bracket 41235 must be moved away from trip tab). To accomplish this, rotate chuck until trip bracket has moved sufficiently forward to allow the stop trip tab to be moved to the desired position.

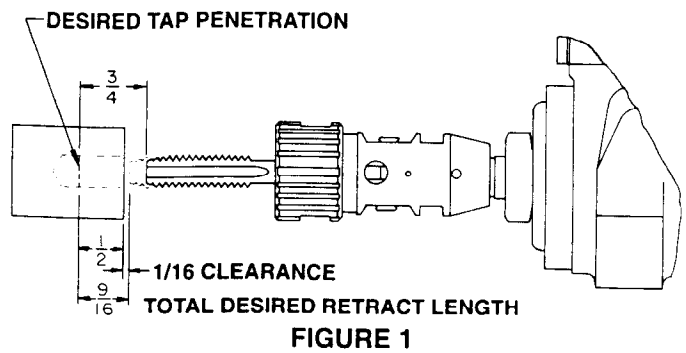
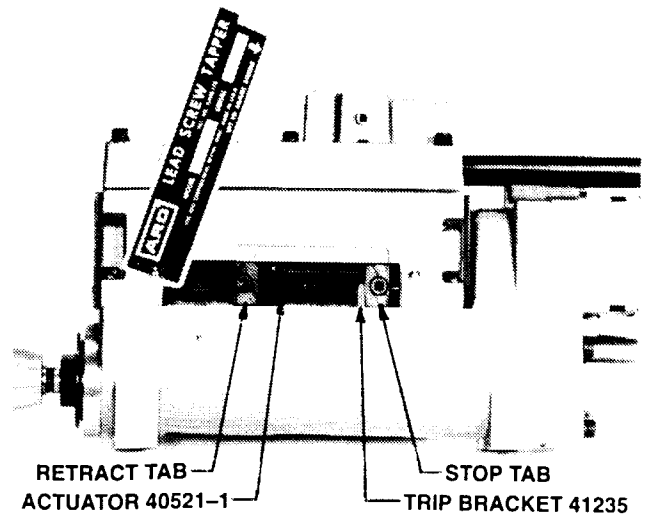
The purpose of setting the stop trip is to prevent excessive "cutting of air" during the advance cycle, decreasing cycle time and increasing production.

The following example of set-up (figure 1) is given to explain the setting of the "RETRACT" and "STOP" trip tabs.

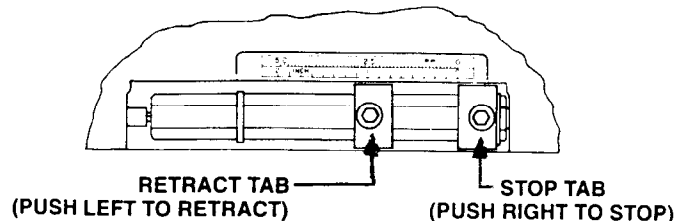
1. Determine the distance between the tap and the desired tap penetration into the workpiece (3/4" in illustration). Loosen set screw in retract trip tab one (1) turn and slide tab so the inside edge of the tab is aligned with the 3/4" mark on the index scale. Tighten set screw (step 1).
2. To determine the distance necessary to retract the tap to sufficiently clear the workpiece (9/16" in illustration), subtract a constant of 1/16" from the 9/16" ( $9/16" - 1/16" = 1/2"$ ). Subtract the remainder (1/2") from the previously set desired tap penetration (3/4") to yield 1/4" ( $3/4" - 1/2" = 1/4"$ ). Loosen set screw one turn in stop trip tab and slide tab so the inside edge of tab is aligned with the 1/4" mark on the index scale (step 2). Subtraction of the constant 1/16" is necessary to allow for the spindle over-running the set stop position by 1/16".

Once set, the depth control will consistently repeat within .005", assuming stable air pressure is maintained (90 p.s.i.g.) at the air inlet.

**BEFORE STARTING** tool, be sure pitch of tap and lead screw match. Thread pitch is etched on both the lead screw and lead screw nut.

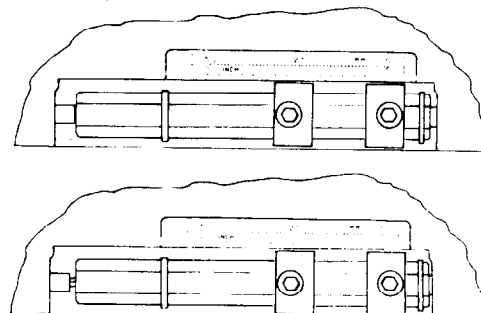


STEP 1



POSITION OF TRIP TABS AFTER UNIT HAS BEEN ADVANCED AND STOPPED, SHOWING 1/16" OVERRIDE

STEP 2



POSITION OF TRIP TABS AFTER COMPLETE CYCLE AND WITH 1/16" OVERRIDE

FIGURE 2

The following items must be given proper consideration to correctly apply the ARO Lead Screw Tapper.

1. Accuracy of positioning the tap drilled hole with the tapper (X, Y and Z axis).
2. Speed at which the material should be tapped (S.F.M., see page 29)
3. Size and diameter variation of the hole to be tapped (% of effective thread height).
4. Length – diameter – pitch ratio of thru or blind hole – chip size – amount of chips – compaction of chips in hole bottom – chip load on flutes.
5. Coolant or no coolant used – chip flushing and friction of tap to material (see page 29).
6. Cutting face angle of tap per material (see page 29).

Under favorable conditions, the rated capacity of a given model tapper may be exceeded.

Where the position of the tap drilled hole is held reasonably close with the tapper (X – Y position), the standard tap chuck is recommended for the application.

Where the X – Y position of the tap drilled hole varies too greatly to maintain proper cutting conditions, a floating collet holder is recommended. The collet holder has floating capability of .030" T.I.R. parallel float to compensate for hole shift. This floating holder will also compensate for about .004" maximum hole angularity. Floating holder and collets used with holders are listed under "ACCESSORIES", page 22.

It is essential, during the operation of the unit, to have the stroke adjustment cover door (nameplate) closed to prevent contamination entry (cutting oil, chips, etc.) into the spindle sleeve area. Coolant or cutting oil flow should never be directed to the region of the cover door.

Lead screw and nut may be changed without disturbing any other section of the tool. Disconnect tool from air supply or shut off air supply to tool and exhaust (drain) air line to tool of compressed air before continuing further. Disconnect tubing from sensor valve ports. Remove three (3) screws (Y154-53) and washers (Y14-10), housing (45443), spring (49533) and spacer (44848). Using a wrench on flats at rear of shaft (40516-1), rotate shaft clockwise, advancing drive spindle approximately 1/4", or until trip bracket (41235) is no longer in contact with trip tab (40523-1).

**CAUTION:** If the tool is mounted in a vertical or near vertical position, block the chuck end of drive spindle to prevent the spindle from dropping down when lead screw and nut are removed. Remove two (2) set screws (45445) from lead screw (41258-).

**NOTE:** Small end of tapered hole in shaft (40516-1) is identified by an "X" stamped on one side of flats at end of shaft. Insert a punch thru lead screw at side identified with "X" and lightly tap punch to remove taper pin (45446). After removal of taper pin, pull on lead screw to remove lead screw and nut assembly (45453-).

## REASSEMBLY

Assemble lead screw and nut assembly to shaft (40516-1), aligning holes in lead screw with tapered hole in shaft. Assemble taper pin (45446) – small end first – thru lead screw and shaft from the side opposite the "X" identification mark on the shaft and assemble one set screw (45445) into the same hole in lead screw, tightening the set screw against taper pin, forcing the pin into lock position. Torque the set screw to 40 in. lbs. Assemble the other set screw (45445) in the opposite side of lead screw and torque to 35 in. lbs.

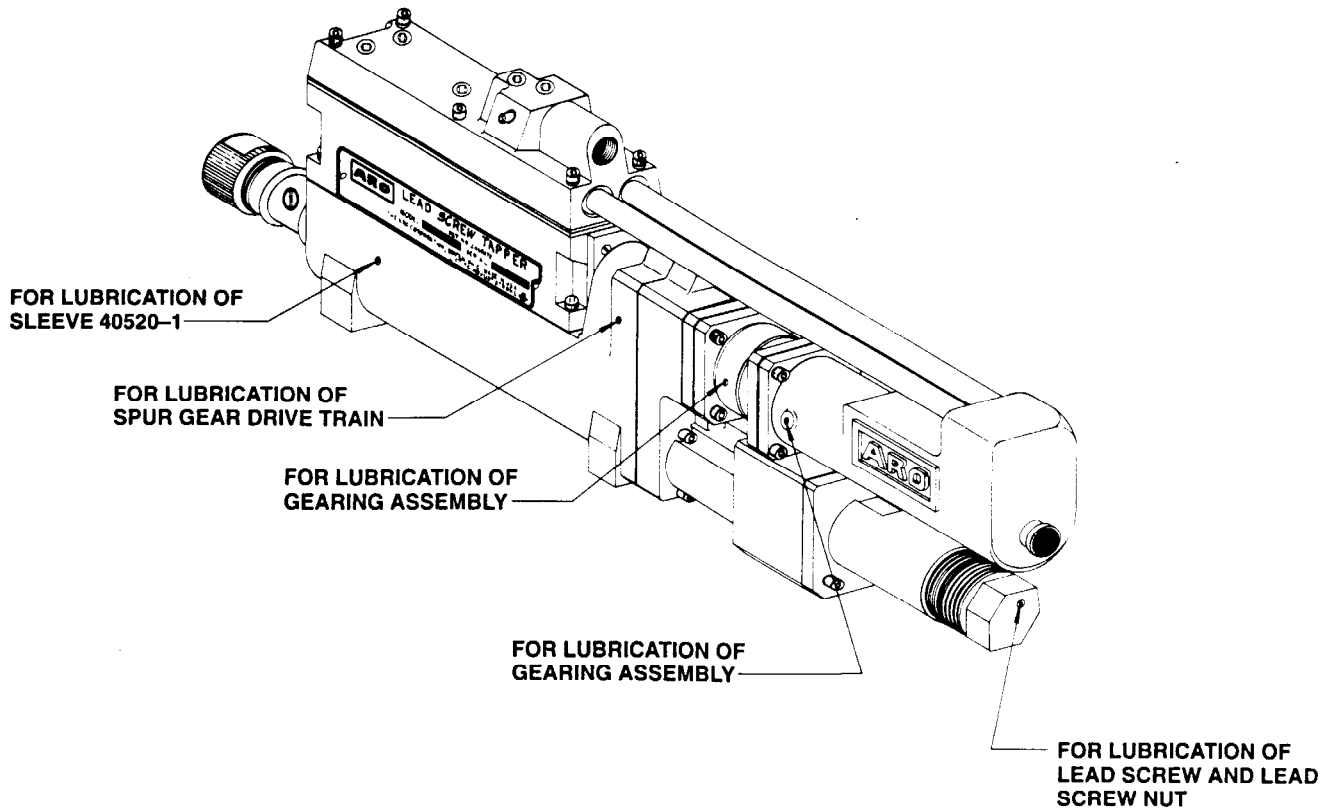
Remove block from chuck end of spindle if used, and rotate shaft (40516-1) if necessary to insure lead screw nut is properly positioned into housing (40508-2), slot in lead nut aligned with dowel pin in housing. Insure lead screw and nut area contains proper amount of grease (see "Air and Lube Requirements", page 6), assemble spacer (44848), spring (49533) and housing assembly (45452) and adjustment nut (45444) and secure with washers (Y14-10) and screws (Y154-53).

### LEAD NUT TENSION ADJUSTMENT:

Remove pipe plug located at the side of lead screw housing (40508-2). Set trip tabs so the unit will cycle with a minimum of 1" stroke length. Operate the unit and, using an allen type wrench, slowly tighten adjustment screw until load is noted on motor (motor noise decreases slightly).

Remote control of start and retract functions is achieved by introducing air pressure into the proper remote control port (see pages 2 and 19). The unit is equipped with built-in check valves to assure free flow to the tool but checks the signal from leaving the tool thru the remote control line.

# AIR AND LUBE REQUIREMENTS



## LUBRICATION POINTS (GREASE FITTING LOCATIONS)

**NOTE: MUST ALWAYS BE 1/2 TO 2/3 FULL OF GREASE**

Air pressure of 90 p.s.i.g. (6.2 bars) at the air inlet of the tool is required for maximum motor efficiency. An air regulator should be installed to maintain this pressure when the tool is in operation. ARO will not guarantee directional response when the pressure drops below 60 pounds (operating) at the air inlet of the tool, or an oiler/filter is not used.

Filtered and oiled air will allow the tool to operate more efficiently and yield a longer life to operating parts and mechanisms. A line filter capable of filtering particles larger than 50 microns should be used with a line oiler.

A Filter/Regulator/Lubricator (F.R.L.) assembly is recommended for use with this air tool. The capacity of the individual Filter-Regulator-Lubricator is adequate to provide clean (40 micron), oiled and regulated air for the tool. See page 18 for recommended F-R-L systems.

**RECOMMENDED HOSE SIZE:** See page 18 for recommended power air inlet systems.

Inject grease (40036-1) – 2 to 3 strokes – thru all grease fittings after each 40 hours of operation, or as experience indicates. Cavity of housing (45443) and cavity of adjusting nut (45444) should be kept 1/2 to 2/3 full of grease (40036-1). When assembling lead screw and lead nut to tool, lubricate internal threads of lead nut and threads on lead screw liberally with grease (40036-1) and fill cavities of housing and adjusting nut from 1/2 to 2/3 full.

### RECOMMENDED LUBRICANTS:

**MOTOR:** Spindle oil 29665, 1 qt. (.9 liter) or equivalent type 1 light oil. Consult manufacturer of air line lubricator used to insure equivalent oil used is compatible with construction of lubricator bowl.

**LEAD SCREW, GEARS, BEARINGS, ETC.:** Grease 40036-1, 1 lb. (.45 kg) container, or equivalent grade containing molybdenum disulfides.

**"O" RING:** Lubricant 36460, 4 oz. (113 g) tube.

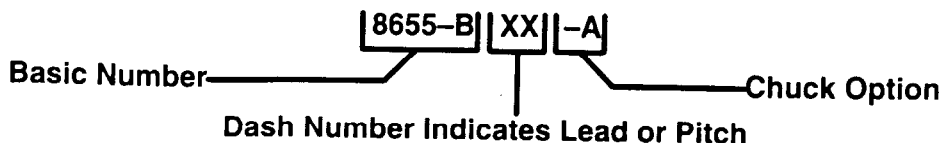
PART NUMBER	WHERE USED	DESCRIPTION
29665	AIR MOTOR	A HIGH QUALITY LIGHT TURBINE OR SPINDLE OIL, RUST INHIBITED, WITH A VISCOSITY OF 100-150 S.U.S. AT 100° F. OIL IS COMPATIBLE WITH POLYCARBONATE TYPE AIR LINE LUBRICATOR BOWLS.
40036-1	GEARS & BEARINGS	A HIGH QUALITY "EP" EXTREME PRESSURE MOLYBDENUM GREASE SUITABLE FOR CLUTCH APPLICATIONS, NLGI NO. 1, FREE OF CORROSIVE MATTER AND FILLERS, WITH A VISCOSITY OF 500-700 S.U.S. AT 100° F.
36460	"O" RINGS & LIP SEALS	A STRINGY LUBRICANT FOR RUBBER SEALS, WITH GOOD ADHESIVE QUALITIES.

# MODEL IDENTIFICATION

M104

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Model numbers are comprised of the basic model number, thread pitch or lead of the lead screw and American or Metric thread as shown in the following:



The basic difference in the Lead Screw Tapper models is in the combination of gearing assemblies (gear ratio) which determines the rated free speed (r.p.m.) of the tool as shown in the table below.

MODELS	CAPACITY		R.P.M.	GEARING		AIR TUBE (2 REQ'D)
	AMERICAN	METRIC		AUXILIARY	DRIVE	
8655-BXX-A	1/2"	14 mm	175	40834	41371	41219-5
8656-BXX-A	7/16"	12 mm	325	40833	41371	41219-5
8657-BXX-A	3/8"	10 mm	600	40833	41370	41219-5
8658-BXX-A	5/16"	8 mm	1,300		41371	41219-4
8659-BXX-A	1/4"	7 mm	2,400		41370	41219-4

The complete model number, which includes the numbers indicating the pitch or lead of the lead screw, is shown in the table below. Where model numbers are omitted from the table, the lead screw is not compatible with the rated free speed of the tool. The complete lead screw and nut assembly, as furnished with a particular model, is also shown in the table. See page 22 for parts breakdown of lead screw and nut assembly.

175 R.P.M. * 55 FT LBS	325 R.P.M. * 28 FT LBS	600 R.P.M. * 15 FT LBS	1,300 R.P.M. * 7 FT LBS	2,400 R.P.M. * 4 FT LBS	LEAD SCREW & NUT ASSEMBLY	PITCH
<b>MODELS WITH METRIC THREAD LEAD SCREW</b>						
		8657-B1-A	8658-B1-A	8659-B1-A	45785-40	.40
		8657-B2-A	8658-B2-A	8659-B2-A	45785-45	.45
		8657-B3-A	8658-B3-A	8659-B3-A	45785-50	.50
	8656-B4-A	8657-B4-A	8658-B4-A	8659-B4-A	45785-60	.60
	8656-B5-A	8657-B5-A	8658-B5-A	8659-B5-A	45785-70	.70
8655-B6-A	8656-B6-A	8657-B6-A	8658-B6-A	8659-B6-A	45785-75	.75
8655-B7-A	8656-B7-A	8657-B7-A	8658-B7-A	8659-B7-A	45785-80	.80
8655-B8-A	8656-B8-A	8657-B8-A	8658-B8-A	8659-B8-A	45785-100	1.00
8655-B9-A	8656-B9-A	8657-B9-A	8658-B9-A		45785-125	1.25
8655-B10-A	8656-B10-A	8657-B10-A	8658-B10-A		45785-150	1.50
<b>MODELS WITH AMERICAN THREAD LEAD SCREW</b>						
8655-B11-A	8656-B11-A	8657-B11-A			45453-11	11
8655-B12-A	8656-B12-A	8657-B12-A			45453-12	12
8655-B13-A	8656-B13-A	8657-B13-A	8658-B13-A		45453-13	13
8655-B14-A	8656-B14-A	8657-B14-A	8658-B14-A		45453-14	14
8655-B16-A	8656-B16-A	8657-B16-A	8658-B16-A		45453-16	16
8655-B18-A	8656-B18-A	8657-B18-A	8658-B18-A		45453-18	18
8655-B20-A	8656-B20-A	8657-B20-A	8658-B20-A		45453-20	20
8655-B24-A	8656-B24-A	8657-B24-A	8658-B24-A	8659-B24-A	45453-24	24
8655-B27-A	8656-B27-A	8657-B27-A	8658-B27-A	8659-B27-A	45453-27	27
8655-B28-A	8656-B28-A	8657-B28-A	8658-B28-A	8659-B28-A	45453-28	28
8655-B32-A	8656-B32-A	8657-B32-A	8658-B32-A	8659-B32-A	45453-32	32
8655-B36-A	8656-B36-A	8657-B36-A	8658-B36-A	8659-B36-A	45453-36	36
8655-B40-A	8656-B40-A	8657-B40-A	8658-B40-A	8659-B40-A	45453-40	40
8655-B44-A	8656-B44-A	8657-B44-A	8658-B44-A	8659-B44-A	45453-44	44
8655-B48-A	8656-B48-A	8657-B48-A	8658-B48-A	8659-B48-A	45453-48	48
8655-B56-A	8656-B56-A	8657-B56-A	8658-B56-A	8659-B56-A	45453-56	56

\*STALL TORQUE

# MAINTENANCE

Disconnect air supply from the tool or shut off air supply and exhaust (drain) line of compressed air BEFORE performing maintenance or service to tool.

Tool maintenance and repair should be performed by authorized, trained, competent personnel. Maintenance and repair records should be maintained on all tools. Insure tool is receiving adequate lubrication, as failure to lubricate can create operating conditions resulting in excessive wear. Insure that the air supply lines and connectors are of the proper size to provide a sufficient quantity of air to the tool.

Air tools are made of precision parts and should be handled with reasonable care when servicing. Excessive pressure exerted by a holding device may cause distortion of a part. Apply pressure evenly when disassembling or assembling parts which have a press fit. When removing or installing bearings, apply pressure to the bearing race that will be the press fit to the mating part; if this is not practiced, Brinelling of the bearing races may occur, making replacement necessary. It is important that the correct tools and fixtures are used when servicing this air tool.

Disassembly should be done on a clean work bench with a clean cloth spread to prevent the loss of small parts. After disassembly is completed, all parts should be thoroughly washed in a clean solvent, blown dry with air and inspected for wear levels, abuse and contamination. Double sealed or shielded bearings should never be placed in a solvent unless a good method of relubricating the bearing is available. Open bearings may be washed but should not be allowed to spin while being blown dry. When replacement parts are necessary, consult the drawing containing the part.

Before reassembling, lubricate parts where required. Use ARO 33153 grease, or equivalent, in bearings. Use ARO 36460 "O" ring lube for "O" ring assembly. When assembling "O" rings or parts adjacent to "O" rings, care must be exercised to prevent damage to the rubber sealing surfaces. A small amount of grease will usually hold steel balls and other small parts in place while assembling.

When ordering parts, be sure to list **part number**, **part name**, **model number** and **serial number** of tool. Use only genuine ARO replacement parts.

## DISASSEMBLY AND REASSEMBLY OF TOOL

Disconnect air supply from the tool or shut off the air supply and exhaust (drain) line of compressed air BEFORE performing maintenance or service to the tool.

Before starting to disassemble or reassemble this tool (any part or completely), be sure to read "Maintenance Section".

To minimize the possibility of parts damage, and for convenience, the steps for disassembly or reassembly listed on the following pages are recommended.

Listed below are the three (3) basic sections of the tool and instructions for removing them.

### VALVE SECTION

Remove three (3) screws (Y154-53), housing assembly (45452), spring (49533) and spacer (44848) from the rear of the tool. Place a suitable wrench on flats of shaft (40516-1) and rotate shaft clockwise until bracket (41235) has advanced far enough forward so it no longer contacts stop trip tab (40523-1). If only the valve section is being removed from the tool at this time, replace spacer (44848), spring (49533) and housing (45452) and secure with

screws (Y154-53). Remove four (4) screws (Y154-54) and washers (Y14-10). Lift valve section to clear bracket (41235) and pull forward carefully to disengage air tubes (41219-). If air tubes remain with valve section, pull carefully to remove.

### POWER UNIT SECTION

Remove four (4) screws (Y154-55) and washers (Y14-10) and pull motor and gearing section from housing section. If the unit is equipped with both drive and auxiliary gearing, remove four (4) screws (Y154-52) and washers (Y14-10) and pull gearing from motor section. Grasp end of rotor and pull to remove motor assembly from housing.

### SPINDLE AND LEAD SCREW SECTION

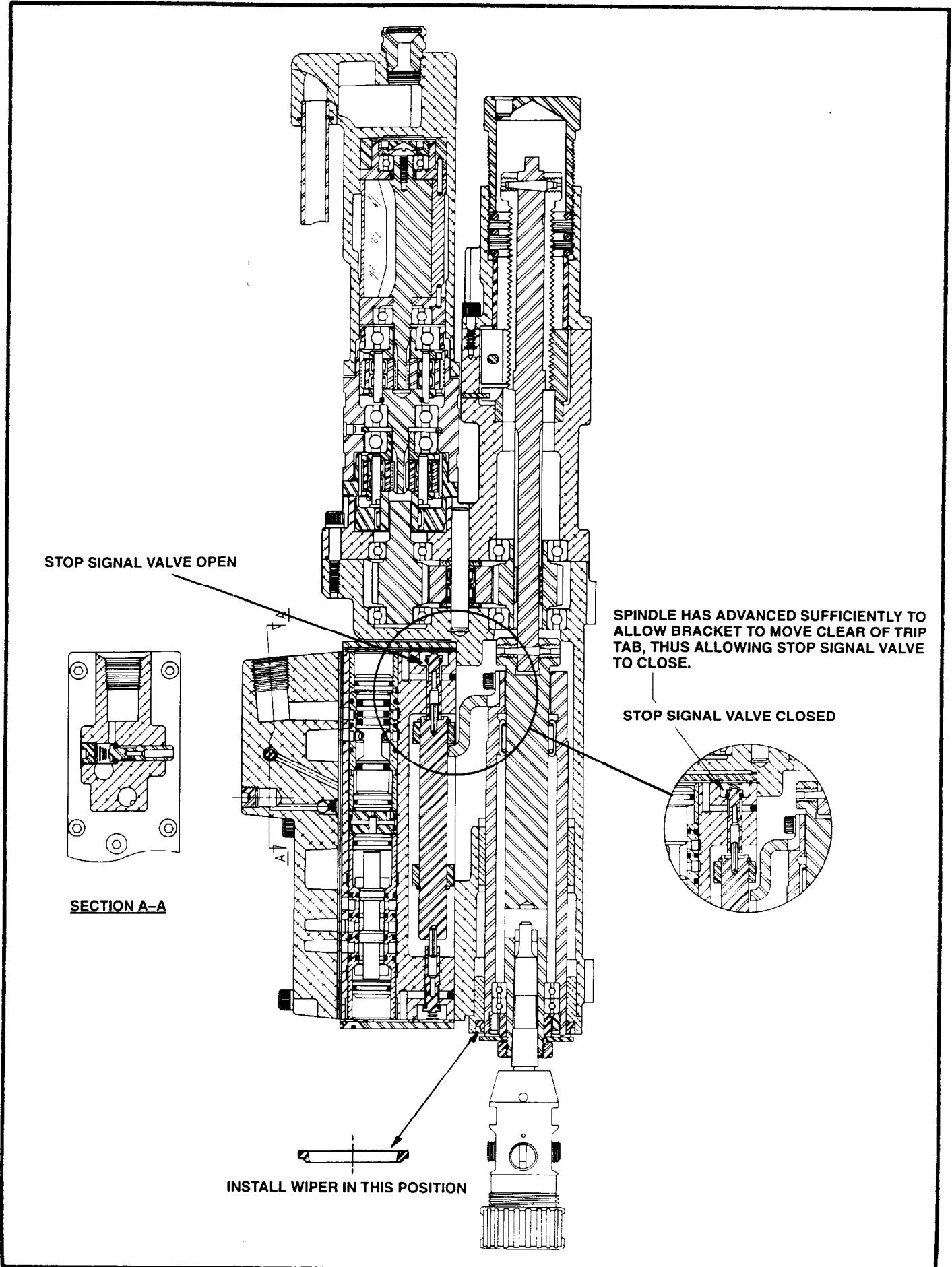
The lead screw and nut assembly (45453-) can be serviced without removing the tool from the fixture mounting. To remove from or reassemble to tool, see "Lead Screw and Nut" on page 5.

For complete disassembly of a particular section, refer to the appropriate section contained in the following pages.



# TYPICAL CROSS SECTION OF TOOL

M104  
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# VALVE SECTION

## DISASSEMBLY

To remove manifold (42432-1), remove six (6) cap screws (Y154-57) and four (4) washers (Y14-10). NOTE: Springs (31125) and balls (44967) are loose parts and may drop out. To remove valve stem (40522) and spring (31125), remove pipe plug (Y227-2-L). NOTE: Gaskets (40524 and 45459) should be replaced with new gaskets if manifold is removed from valve housing.

To remove valve pistons and/or components from valve housing (40511-1); remove screws (Y132-107-C), valve plates (40525-1) and gaskets (41222-1).

**CAUTION:** Exercise reasonable care when disassembling or assembling valve parts, so as not to cause damage to outside diameter of bushings, pistons, valves or bore diameters of bushings or housing.

Remove end pistons (41213) using a number 8-32 machine screw threaded into threads of piston. Pull out to remove. Tap end of housing lightly with a soft face hammer until bushing extends from housing enough to grasp with fingers and remove bushing with valve stem and other piston. Remove valve stem and piston from bushing.

Using a non-metallic rod (1/4" max. dia.), press spacer (41234) and other bushing, valve stem and piston out opposite end of housing. NOTE: Replace all "O" rings with new "O" rings when reassembling.

To remove actuator and pin assembly; remove springs (39452), move actuator to the extreme left and remove valve stem (40522) from left side of housing. Slide actuator to extreme right and remove other valve stem (40522) from that end of housing. Actuator and pin assembly can now be removed from housing. To remove trip tabs; remove retaining ring (Y145-18) from actuator, loosen screw (45457) and slide trip tab off actuator.

To remove screen (41266), remove screws (Y8-243-C) and plate (41246-1).

## REASSEMBLY

It is recommended "O" rings be replaced with new "O" rings when reassembling. Lubricate all "O" rings with 36460 lubricant and coat pistons and valve stems with 29665 spindle oil when assembling.

Assemble valve stem (40522), with "O" ring (Y325-7) and spring (31125), to manifold and secure with pipe plug (Y227-2-L). Assemble balls (44967) and springs (31125) to manifold. Assemble "O" rings (Y325-14) to manifold.

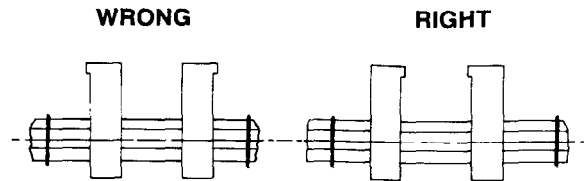
Assemble "O" rings (Y325-17) to spacer (41234) and assemble to housing with large hole in spacer facing towards front end of housing (see cross section below).

Assemble "O" rings (40284 and Y325-17) to bushings (41214-1 and 41215). Assemble "O" rings (Y325-15) to pistons (41213). Assemble "O" rings (15066) to valve (41217-1).

Assemble valve (41217-1) and pistons (41213) to bushing (41214-1) and assemble bushing to housing. NOTE: See cross section view below for correct installed position of bushing, piston and valve stem.

Assemble valve stem (41216) and pistons (41213) to bushing (41215) and assemble bushing to housing. NOTE: Align slots in bushing with exhaust holes in housing as shown in auxiliary view on page 11. Assemble pistons as shown in cross section view below.

Assemble trip tabs (40523-1), with spacers (41572), to actuator (see correct assembled position below) and secure with screws (45457). Assemble retaining rings (Y145-18) to actuator. Position actuator in housing and assemble valves (40522), with "O" rings (Y325-7), to housing and pins of actuator, securing actuator in housing.



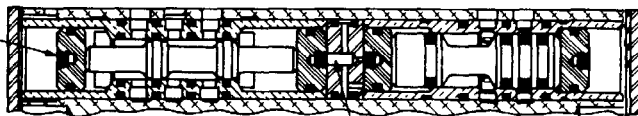
**BOTTOM VIEW OF TRIP TABS SHOWING CORRECT ASSEMBLED POSITION.**

Assemble springs (39452), gaskets (41222-1), spacer (46496) and valve plates (40525-1) to housing and secure with screws (Y132-107-C). NOTE: Torque screws to 45 - 55 in. lbs.

When assembling the valve section to tool, be sure bracket (41235), page 17, is positioned between the two trip tabs and air tubes are properly aligned. Secure valve section to spindle housing with cap screws (Y154-54) and washers (Y14-10).

## CROSS SECTION THRU VALVES

**ASSEMBLE PISTONS WITH THREADED HOLE POSITIONED AS SHOWN**

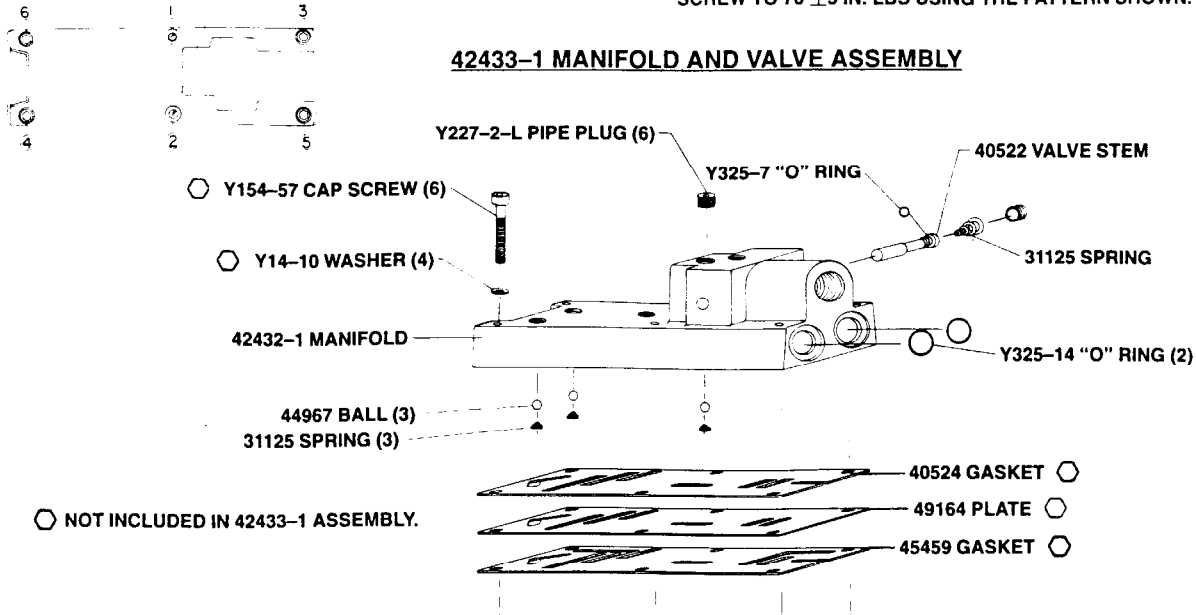


**ASSEMBLE WITH LARGE HOLE AS SHOWN**

DO NOT USE WASHERS  
ON 2 CENTER SCREWS.

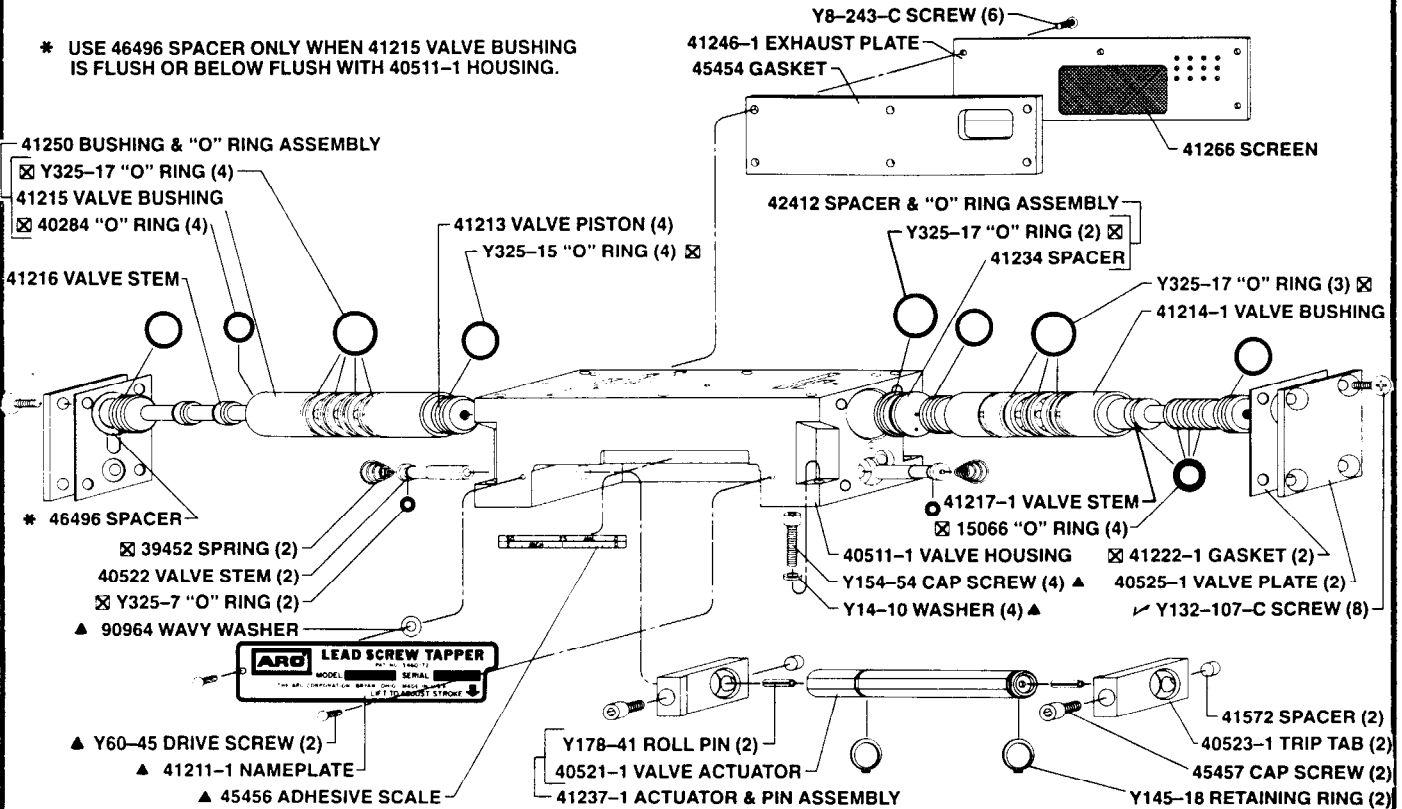
WHEN ASSEMBLING 40524 AND 45459 GASKETS AND 49164 PLATE BETWEEN 42433-1 AND 42164-1 ASSEMBLIES, TORQUE THE SIX Y154-57 SCREWS DOWN EVENLY TO ABOUT 50 IN. LBS. FURTHER TIGHTEN EACH SCREW TO 70 ± 5 IN. LBS USING THE PATTERN SHOWN.

## 42433-1 MANIFOLD AND VALVE ASSEMBLY



41440-1 CONTROL VALVE ASSEMBLY INCLUDES: 42433-1 AND 42164-1 ASSEMBLIES.

\* USE 46496 SPACER ONLY WHEN 41215 VALVE BUSHING IS FLUSH OR BELOW FLUSH WITH 40511-1 HOUSING.

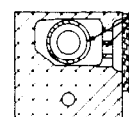


## 42164-1 HOUSING AND VALVE ASSEMBLY

▲ NOT INCLUDED IN 42164-1 ASSEMBLY.

✓ TORQUE TO 45 - 55 IN. LBS.

PARTS MARKED THIS ☒ ARE INCLUDED IN SERVICE KIT NUMBER 45782, SEE PAGE 22.



ASSEMBLE BUSHING 41215 WITH SLOTS FACING EXHAUST HOLES IN HOUSING.

AUXILIARY VIEW SHOWING CORRECT ORIENTED POSITION OF SLOTS IN BUSHING WITH EXHAUST HOLES IN HOUSING.

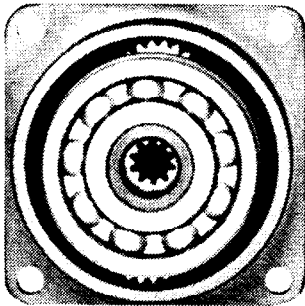
# POWER UNIT SECTION GEARING INTERCHANGE CHART

A CHANGE OF 41219-( ) AIR TUBES IS REQUIRED WHEN CONVERTING FROM SINGLE GEARING TO DOUBLE GEARING OR VICE VERSA.

PRESENT SPEED	DESIRED SPEED OF TAPPER									
	175 R.P.M.		325 R.P.M.		600 R.P.M.		1,300 R.P.M.		2,400 R.P.M.	
	REMOVE	ADD	REMOVE	ADD	REMOVE	ADD	REMOVE	ADD	REMOVE	ADD
175 R.P.M.	X	X	40834	40833	40834 AND 41371	40833 AND 41370	40834		40834 AND 41371	41370
325 R.P.M.	40833	40834	X	X	41371	41370	40833		40833 AND 41371	41370
600 R.P.M.	40833 AND 41370	40834 AND 41371	41370	41371	X	X	40833 AND 41370	41371	40833	
1,300 R.P.M.		40834		40833	41371	40833 AND 41370	X	X	41371	41370
2400 R.P.M.	41370	40834 AND 41371	41370	40833 AND 41371		40833	41370	41371	X	X

## GEARING ASSEMBLY IDENTIFICATION BY SIGHT

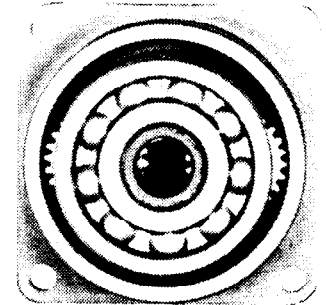
BY SIGHTING THE REAR OF THE GEARING ASSEMBLY, IT CAN BE DETERMINED IF AN ASSEMBLY HAS A SUN DRIVE GEAR OR NOT.



WITH SUN GEAR

GEARING WITH SUN GEAR		GEARING WITHOUT SUN GEAR	
DRIVE	AUXILIARY	DRIVE	AUXILIARY
41370	40833	41371	40834

### DRIVE GEARING



WITHOUT SUN GEAR

### DISASSEMBLY

To remove the power unit from the tool, follow the instructions on page 8, under "Power Unit Section".

Grasp the ring gear in one hand and tap the drive end of the spindle with a soft face hammer; spindle and components will loosen from ring gear.

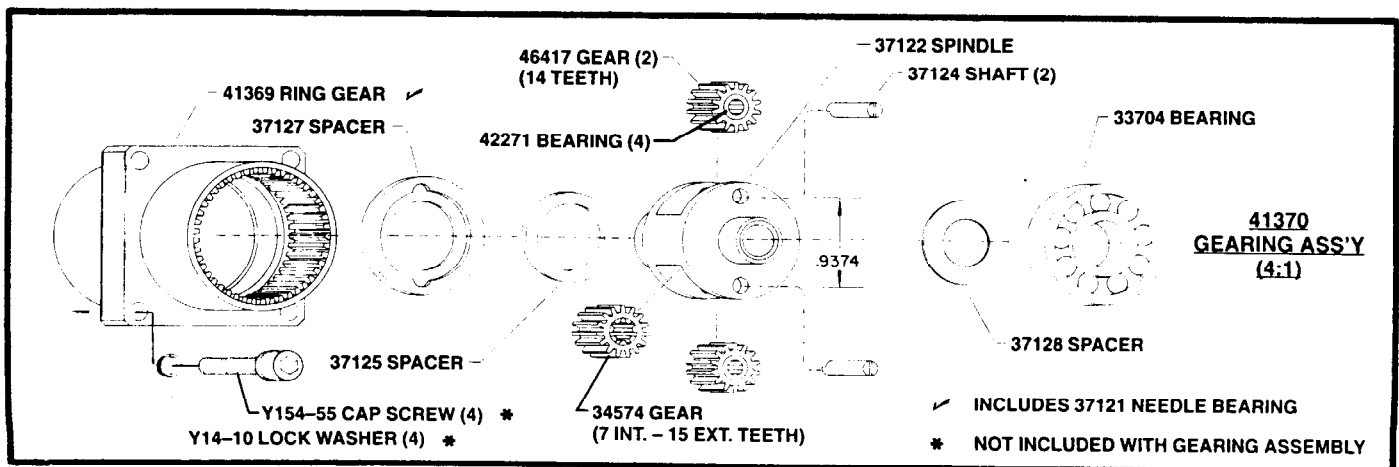
Gearing should not be disassembled further unless it is necessary to replace a part, as Brinelling of the bearing races may occur, making replacement necessary.

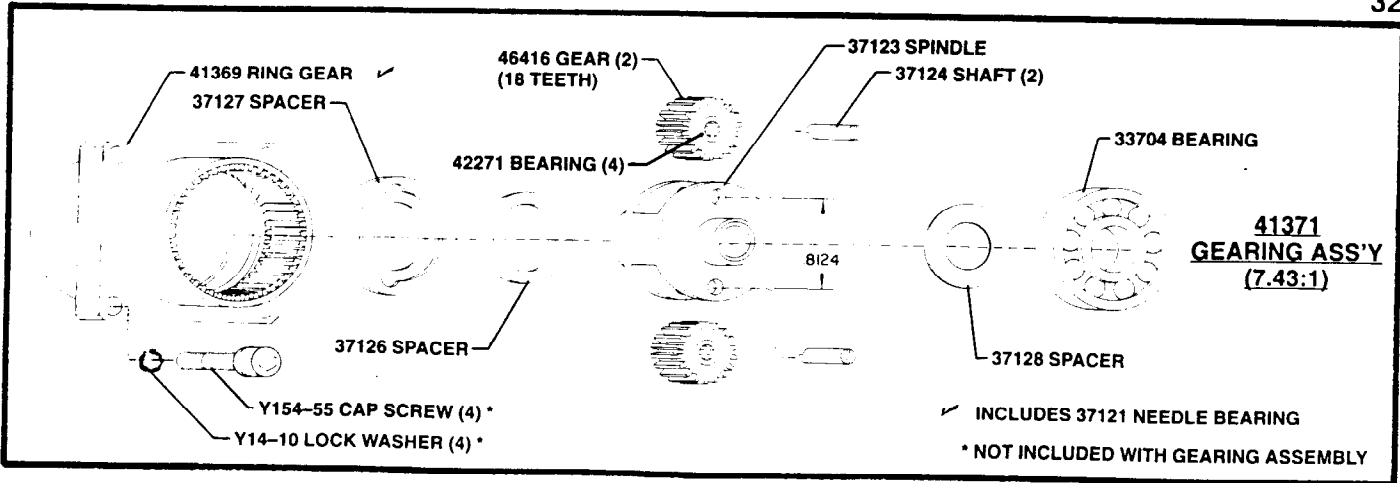
To further disassemble, remove bearing (33704) and spacer (37128), allowing removal of shafts retaining gears and bearings.

### REASSEMBLY

NOTE: Pack bearings and lubricate gears liberally with 40036-1 grease, or equivalent, during assembly. Gearing assembly should contain approximately 1/4 oz. of grease.

Assemble spacer (37126 or 37125) and gears to spindle and secure with shafts, aligning notch in ends of shafts with spacer (37126 or 37125). Assemble spacer (37128) and bearing (33704) to spindle. Assemble spacer (37127) to spindle, aligning grooves in spacer with shafts. Assemble spindle and components to ring gear.





## AUXILIARY GEARING

### DISASSEMBLY

Grasp ring gear in one hand and tap drive end of spindle with a soft face hammer; spindle and components will loosen from ring gear.

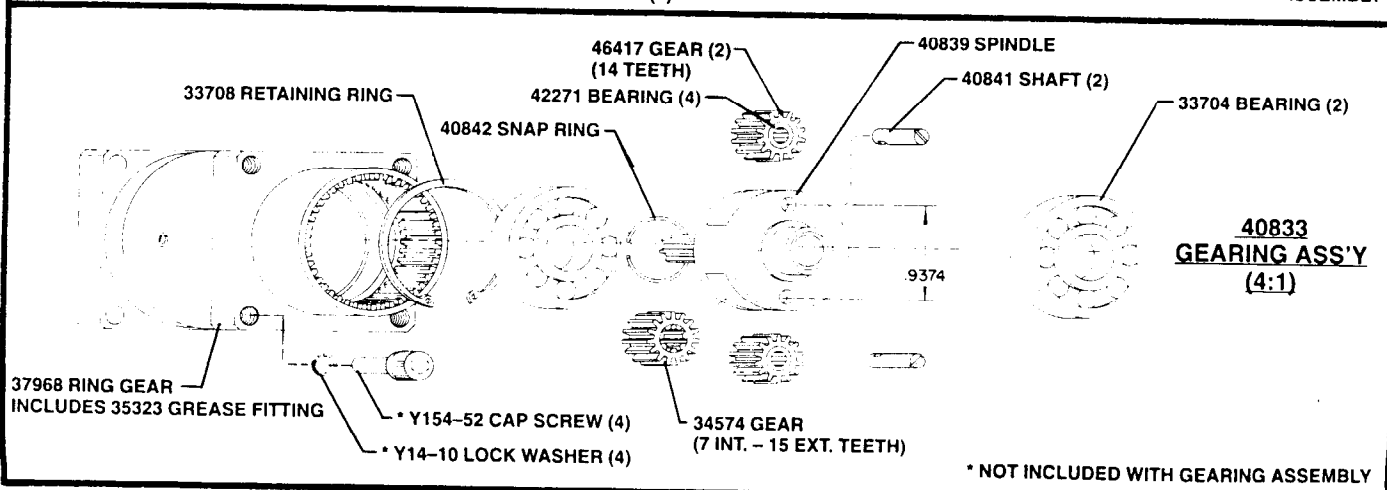
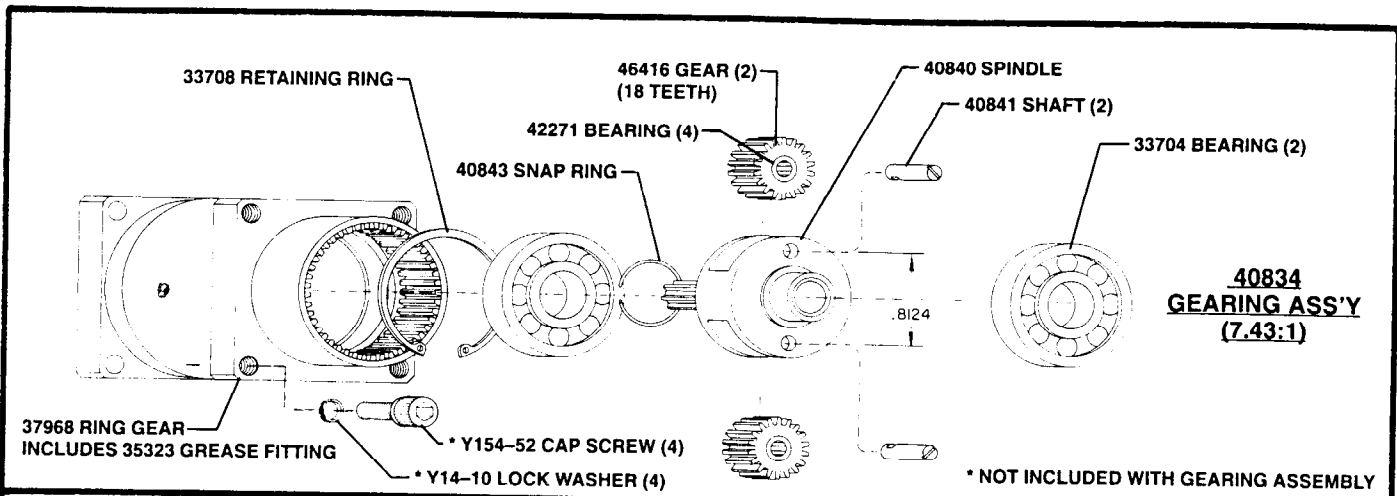
Gearing should not be disassembled further unless it is necessary to replace a part, as Brinelling of the bearing race may occur, making replacement necessary.

To further disassemble, remove bearings (33704), rotate snap ring (40842 or 40843) so the open portion of the ring will allow the removal of shaft and remove shaft releasing gear. Repeat for removal of opposite shaft and gear.

### REASSEMBLY

NOTE: Pack bearings and lubricate gears liberally with 40036-1 grease, or equivalent, during assembly. Gearing assembly should contain approximately 1/4 oz. of grease.

Assemble snap ring (40842 or 40843) to spindle, aligning open portion of ring with one shaft hole in spindle. Assemble gear and shaft to spindle. Rotate snap ring and assemble opposite gear and shaft. Rotate snap ring to secure both shafts in place. Assemble bearings (33704) to spindle. Assemble spindle, with components, to ring gear, being sure ring gear contains retaining ring (33708) before replacing spindle and components.



# POWER UNIT SECTION

## MOTOR ASSEMBLY

### DISASSEMBLY

Remove nut (33694) and sems fastener (33700). Grasp cylinder in one hand and tap splined end of rotor with a soft face hammer; motor will come apart.

### REASSEMBLY

Pack bearings with 40036-1 grease, or equivalent, and coat i.d. of cylinder with 29665 spindle oil upon assembling.

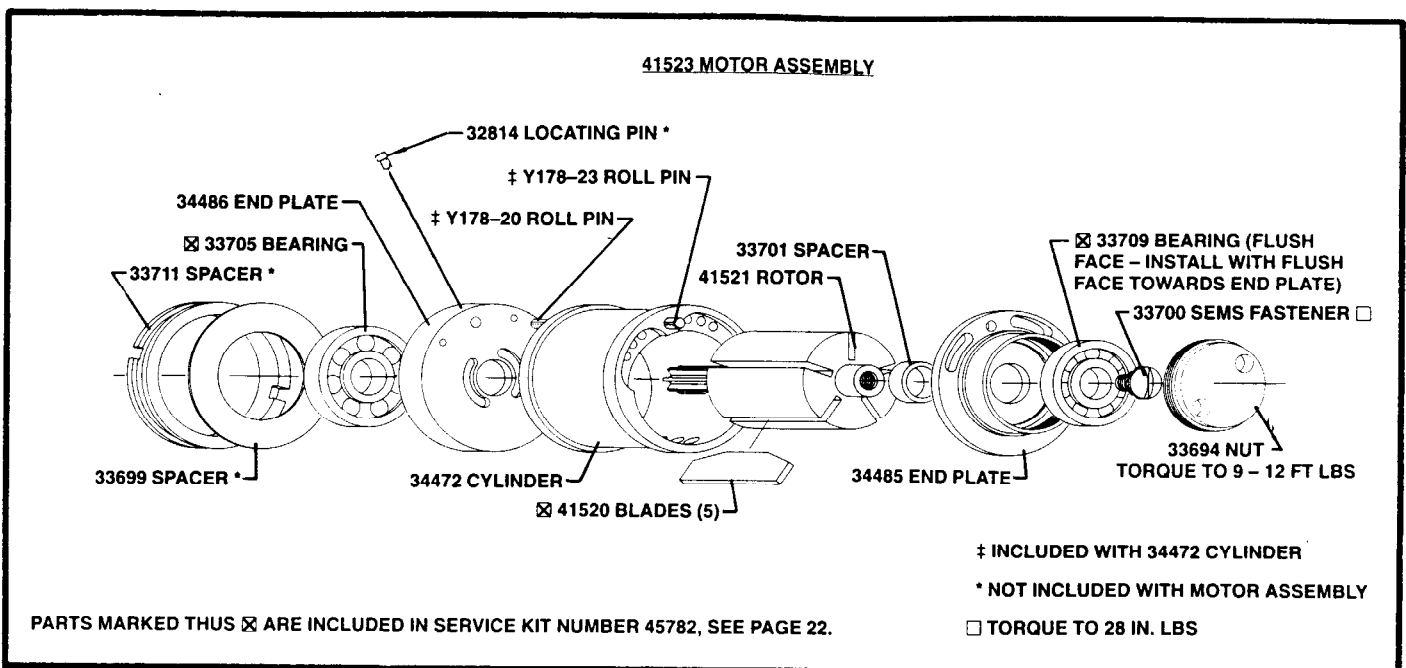
Assemble bearings into end plates, pressing on outer race of bearings. NOTE: Bearing (33709) is a flush face bearing and must be assembled with the flush face of bearing towards end plate (lettering on bearing facing away from end plate). Assemble end plate (34485), with spacer (33701), to rotor, pressing on inner race of bearing. Assemble cylinder over rotor to end plate (34485).

Coat blades (41520) with 29665 spindle oil and assemble to rotor – straight side out. Assemble end plate (34486), with bearing (33705), to cylinder and rotor, pressing on inner race of bearing. Assemble sems fastener (33700) and nut (33694) to motor. NOTE: Torque fastener to 28 in. lbs and nut to 9 – 12 ft lbs.

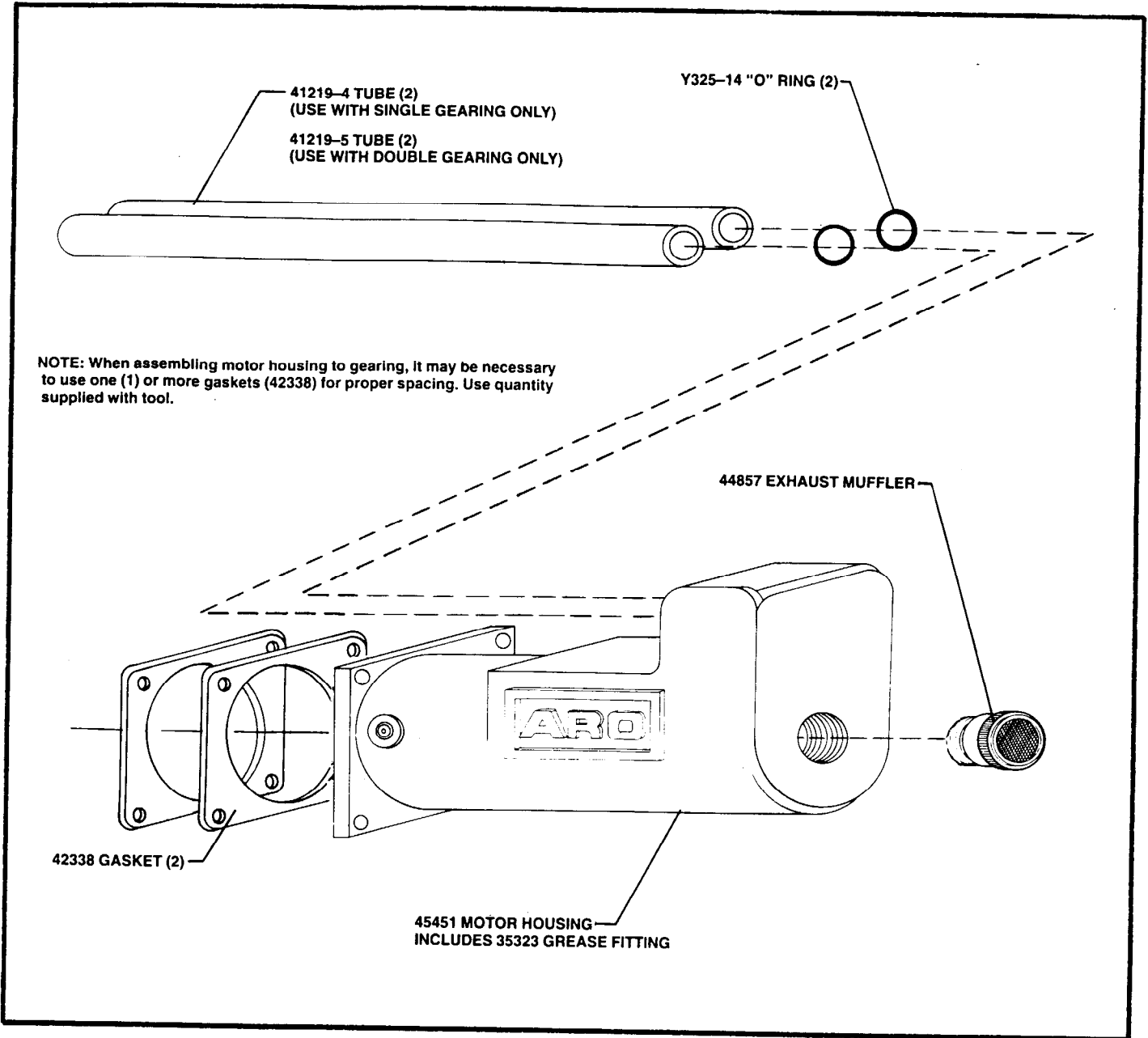
Be sure rotor does not bind (if motor binds, tap splined end lightly with a soft face hammer to loosen).

Assemble locating pin (32814) to end plate (34486) and assemble motor, with spacers (33699 and 33711), to motor housing, aligning locating pin with groove in motor housing.

Assemble gearing to motor housing and assemble power unit section to tool.



MOTOR HOUSING AND AIR TUBES



# SPINDLE AND LEAD SCREW SECTION

## DISASSEMBLY

To remove spindle and sleeve assembly (41242-1), the valve section must be removed to gain access to bracket (41235), set screws and taper pin which hold the drive spindle (41239-1) and shaft (40516-1) together. Remove as outlined under "Valve Section", page 8.

See "Spindle and Lead Screw Section" on page 8 and remove the valve section and lead screw and nut assembly from the tool.

To remove sensor valve from housing (45443); remove retaining ring (Y147-3) and lightly tap housing with a soft face hammer until bushing (45447) extends enough to grasp with fingers and remove with valve stem (39382).

**CAUTION:** If the tool is mounted in a vertical or near vertical position, block the chuck end of the drive spindle to prevent the spindle from dropping down when set screws and taper pin are removed.

Remove two (2) screws (Y154-53), washers (Y1-10) and bracket (41235). Remove set screws (45445), rotate shaft until "X" identification mark stamped on o.d. of shaft is up, insert a punch thru spindle and tap lightly to remove taper pin. After taper pin has been removed, spindle (41239-1) and shaft (40516-1) may be separated and spindle assembly removed out thru the front of housing. Shaft (40516-1) must be removed out thru the rear of housing.

To remove spindle assembly from housing, carefully slide spindle assembly from housing, taking care as not to mar sleeve or damage wiper. Remove chuck and arbor with a chuck removal wedge. Remove nut (40514-1), washer (41259) and spacer (41260) from drive end of spindle (41239-1). Remove spindle from rear end of sleeve (41263). NOTE: Bearings (41864) are press fit on spindle. To remove bearings (41864), remove retaining nut (40515). Needle bearing (41241) is pressed into sleeve.

To remove driving gear (41366), idler gear (40518) and driven gear (40517-1), remove five cap screws (Y154-56) and washers (Y14-10) and carefully pull housings (40507-1 and 40508-2) apart. Remove gears from housing.

## REASSEMBLY

Before reassembling, pack all bearings and lubricate gears liberally with 40036-1 grease, or equivalent. NOTE: Whenever a part containing "O" rings has been removed from the tool, it is recommended that the "O" rings be replaced with new ones before reassembling the part to the tool. Lubricate all "O" rings with "O" ring lube (36460) when assembling.

Press bearings (32325) onto driving gear (41366). Press needle bearings (31198) into idler gear (40518). Press bearings (31068) onto driven gear (40517-1).

Place housing (40508-2) in a suitable holding device, with the gearing end up. Assemble gears (41366 and 40517-1) into housing (40508-2). Assemble one (1) washer (40512-1), gear assembly (41231) and other washer (40512-1) over dowel pin (Y148-416). Assemble spindle housing (40507-1) to housing (40508-2), being careful to maintain alignment of housing with bearings, gears and dowel pin. Secure housings with cap screws (Y154-56) and washers (Y14-10).

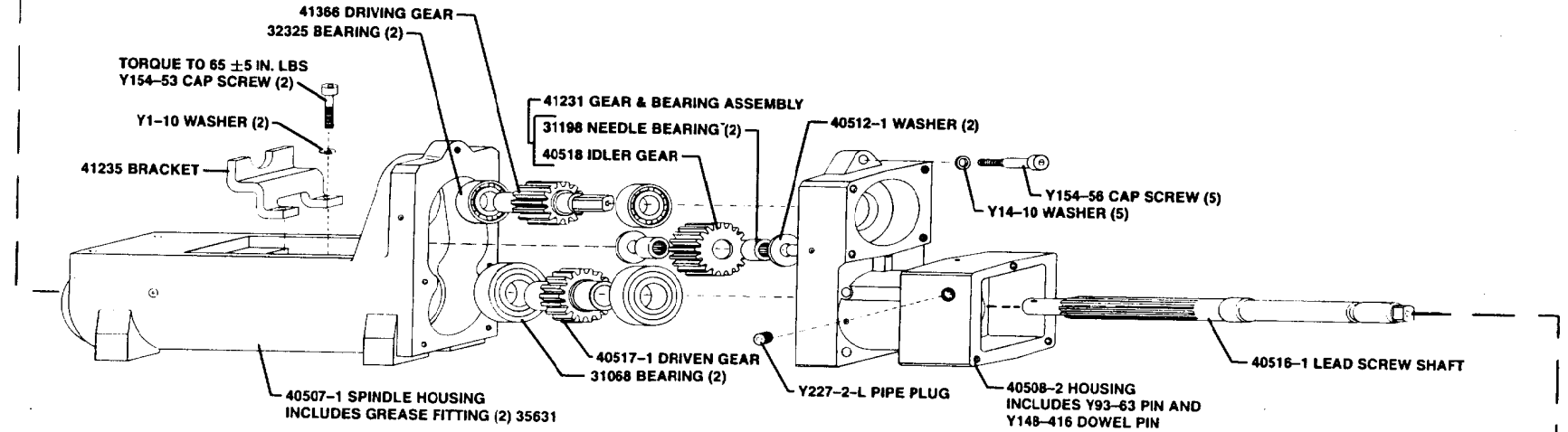
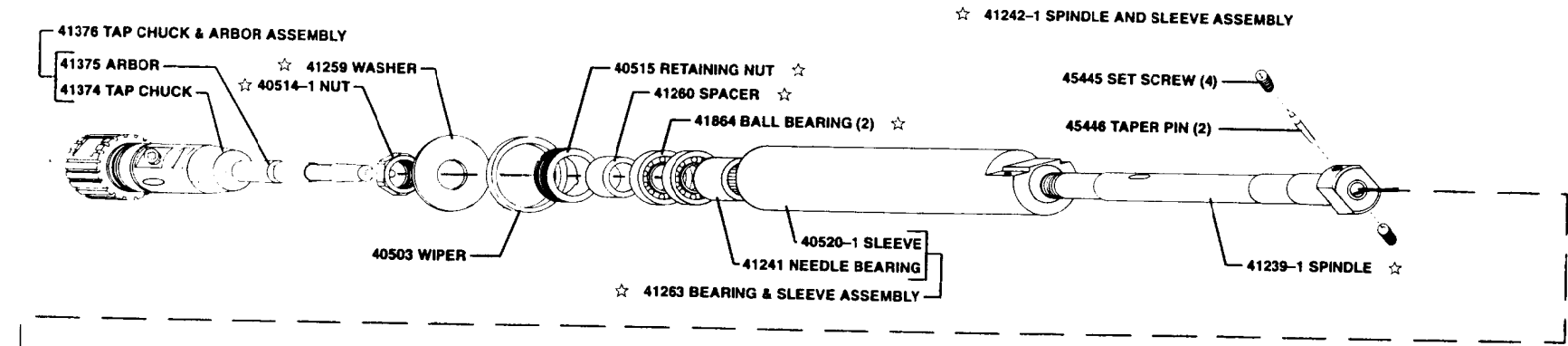
Assemble spindle (41239-1) into rear end of sleeve (41263) and press bearings (41864) onto spindle and secure with retaining nut (40515). Assemble wiper (40503) to sleeve, spacer (41260) and washer (41259) to spindle, securing with nut (40514-1).

Assemble spindle and sleeve assembly (41242-1) into front of spindle housing (40507-1), using caution to be sure wiper is in correct position (see page 9) and that it is not damaged while assembling. Assemble bracket (41235) to sleeve (41263) with screws (Y154-53) and washers (Y1-10). Assemble chuck and arbor to spindle.

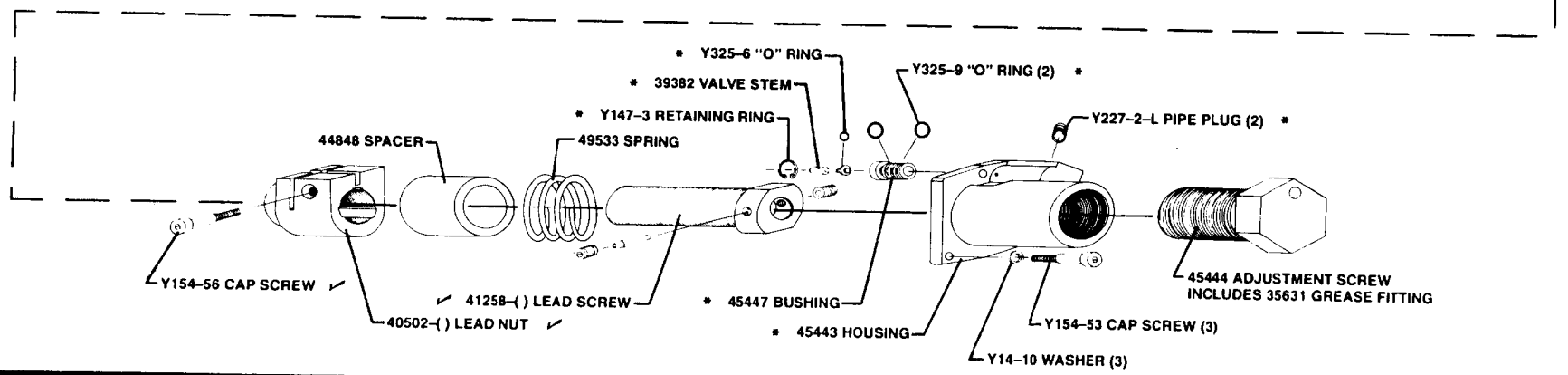
Assemble lead screw shaft (40516-1) with splined end thru gear (40517-1) and into spindle (41239-1), aligning holes thru shaft and spindle. Rotate lead screw shaft so the "X" identification mark stamped on the shaft is down (small end of tapered hole thru shaft is down and large end of tapered hole is up) and assemble taper pin (45446) - with long tapered first - thru spindle and lead screw shaft. Assemble one set screw (45445) into same hole in spindle against taper pin and tighten set screw, forcing taper pin into lock position. Torque set screw to 40 in. lbs. ( $\pm 2$  in. lbs.). Rotate spindle 180 degrees and assemble other set screw (45445) into spindle and torque to 35 in. lbs. ( $\pm 2$  in. lbs.). When correctly assembled, no backlash (play) should be evident while holding chuck and end of lead screw shaft and twisting in opposite directions.

Install valve stem (39382), with "O" ring (Y325-6), into bushing (45447) with "O" rings (Y325-9) and place in housing (45443) and secure with retaining ring (Y147-3). For installation of lead screw and nut assembly, see page 5. Install housing and valve assembly (45452) to housing (40508-2) and secure with washers (Y14-10) and screws (Y154-53). See "Lube Requirements" on page 6.

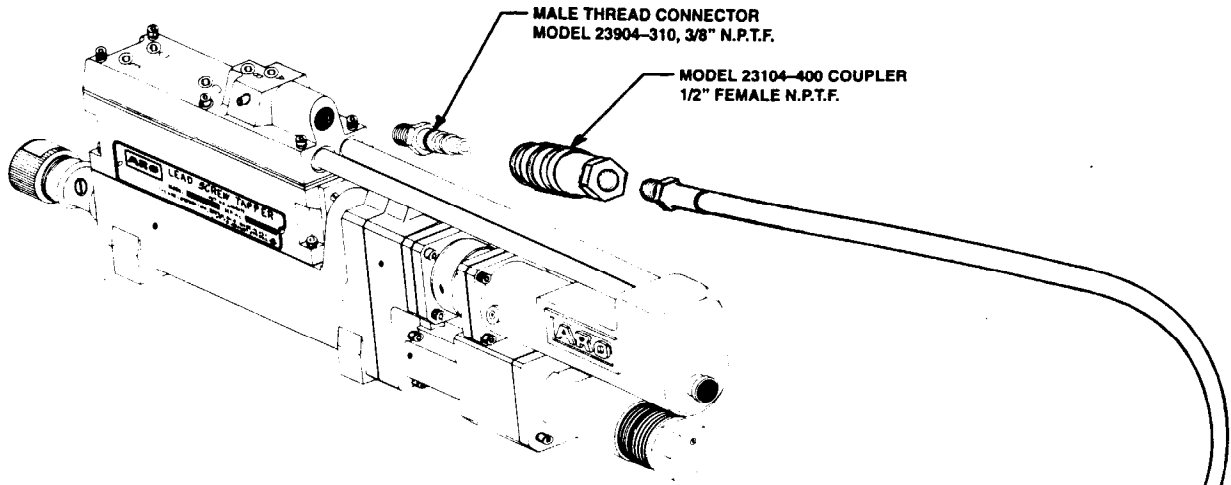




- ✓ INCLUDED IN 45453-( ) LEAD SCREW AND NUT ASSEMBLY - SEE PAGE 22.
- INCLUDED WITH 45452 HOUSING AND VALVE ASSEMBLY.



# RECOMMENDED POWER AIR INLET SYSTEM



1/2" I.D. HOSE WITH 1/2" N.P.T.F. MALE FITTING EACH END (RECOMMENDED MAXIMUM LENGTH, 4 FEET)

INSTALL LUBRICATOR AS CLOSE AS POSSIBLE TO TAPPER

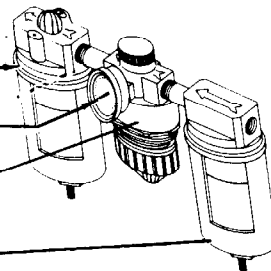
MODEL C28241-810 FILTER-REGULATOR-GAUGE-LUBRICATOR ASSEMBLY

MODEL L26241-110 STANDARD DUTY LUBRICATOR - 1/2" PORTS

GAUGE 100067, PRESSURE RANGE 0 - 160 P.S.I.G.

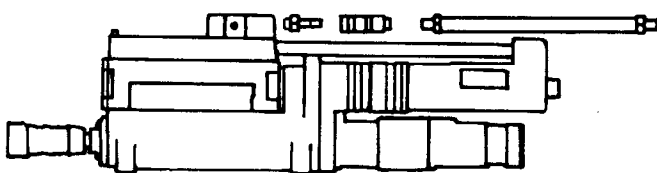
MODEL R27241-100 STANDARD DUTY REGULATOR, 1/2" INLET AND OUTLET PORTS - 1/4" GAUGE PORTS.

MODEL F25241-110 STANDARD DUTY FILTER - 3/8" PORTS



← SUPPLY

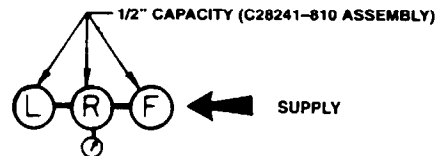
SHOWN BELOW IS THE SAME SYSTEM IN SCHEMATIC FORM



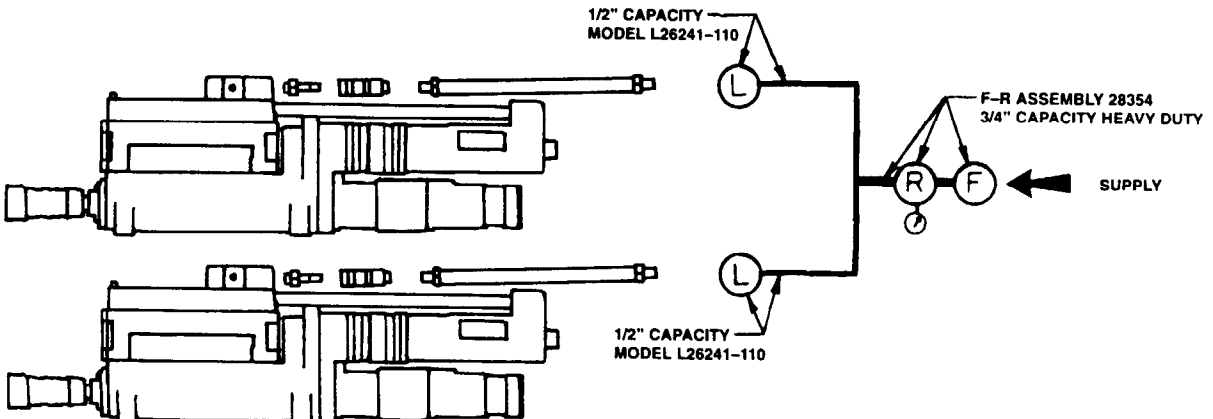
L = LUBRICATOR

R = REGULATOR

F = FILTER



If two units are to be installed, the units should be supplied with a system like that shown below or use two systems like that above.



# BASIC REMOTE CONTROL FOR START AND EMERGENCY RETRACT FUNCTIONS

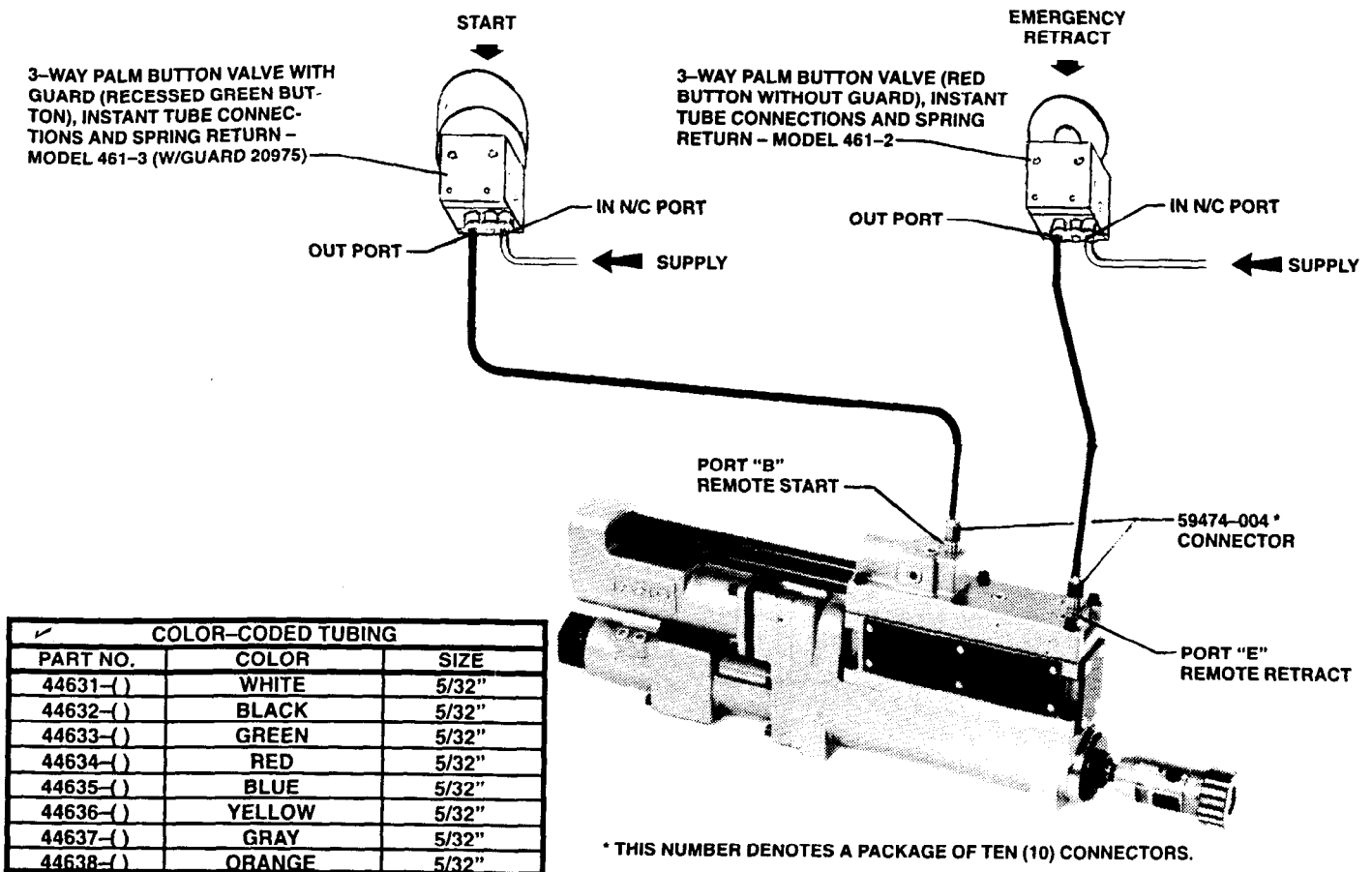
M104  
32

Remote start is accomplished by introducing a momentary pressure signal to port "B", using fitting, valve and signal quality tubing as shown. The pressure signal should be about one (1) second in duration, this is sufficient for most applications. NOTE: For very low spindle speeds with medium to fine pitch lead screw, the signal duration may need to be increased beyond one second. For very high spindle speeds and short stroke settings, the signal duration may need to be decreased and positively controlled - consult factory in this case.

The start valve should be a 3-way type valve capable of proper response.

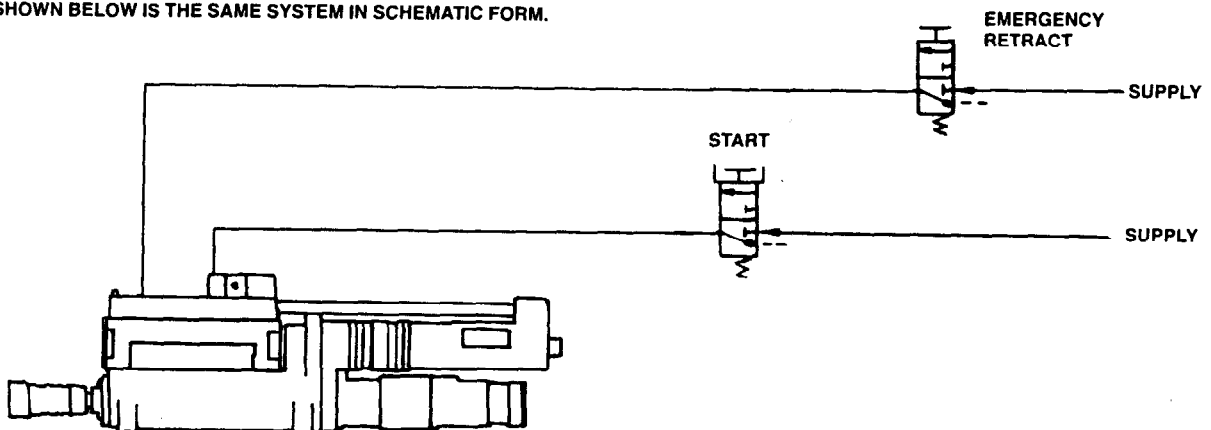
Remove retract: Even though the taper automatically retracts at a preset stroke, it may be desirable to connect an "Emergency Retract" function. This will allow the operator to retract the taper during operation if it should become necessary. Remote emergency retract is accomplished by introducing a momentary pressure signal to port "E", using fitting, valve and signal quality tubing as shown. The pressure signal should be about one (1) second in duration, this is sufficient for most applications. The remote retract signal should be terminated by releasing the 3-way valve once the tool is retracting.

The retract valve should be a 3-way type valve capable of proper response.

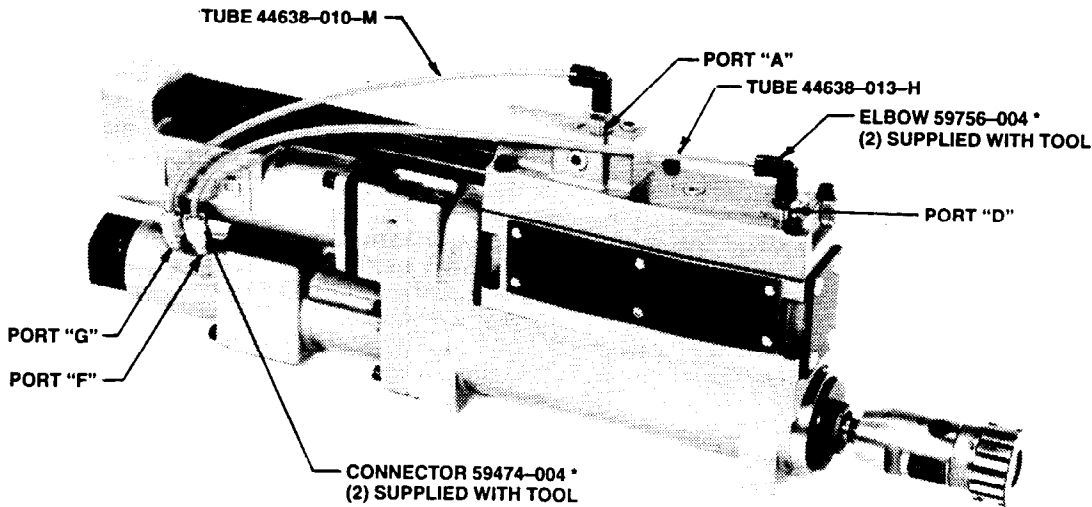


WHEN ORDERING, SPECIFY DESIRED LENGTH IN INCHES BY ADDING DASH NUMBER TO PART NUMBER. EXAMPLE - 44631-036, THE -036 REPRESENTS 36 INCHES IN LENGTH. TUBING IS ALSO AVAILABLE IN 100 FT ROLLS, CONSULT ARO CORPORATION.

SHOWN BELOW IS THE SAME SYSTEM IN SCHEMATIC FORM.



# NO-HOLE SENSOR SYSTEM

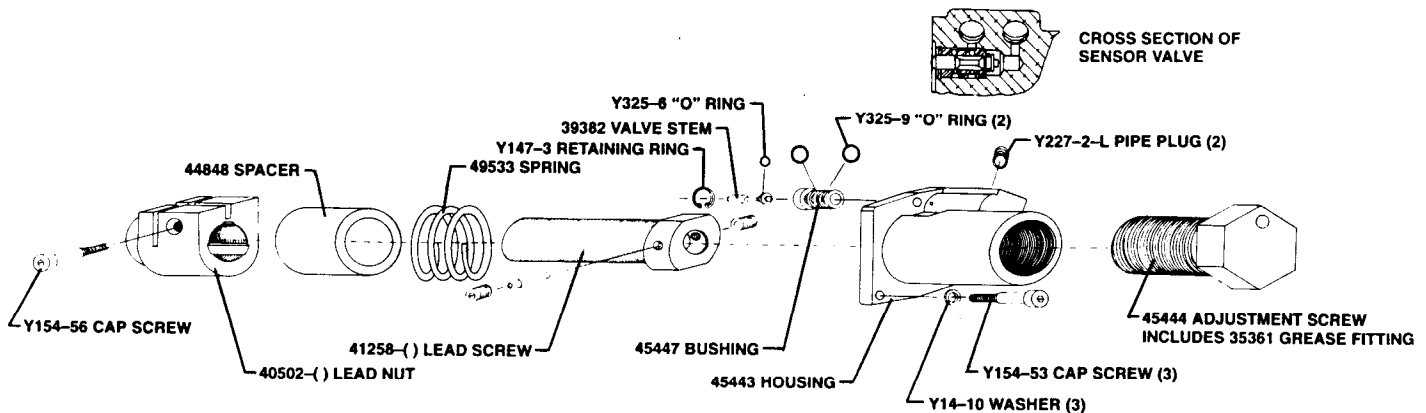


\* THIS NUMBER DENOTES A PACKAGE OF TEN (10).

The "B" series Lead Screw Tapper models have a built-in system that will cause the unit to retract if there is no pre-drilled hole present in the workpiece or in an excessive mis-alignment of hole in workpiece with the tap of tool. To use this system, remove the pipe plugs in the ports "A", "D", "F" and "G", being sure air supply is disconnected from tool before removing pipe plugs. Assemble the fittings supplied with tool (two connectors and two elbows) as shown above and connect the tubing to fittings as shown (short tube from port "A" to port "G" and long tube from port "D" to port "F"). To assemble tubes to fittings, simply push tube firmly into fit-

ting - tube will lock in place. To remove tube from fitting, push in on tube and, at the same time, depress brass sleeve around tube then pull tube out of fitting.

To test reaction and function of no-hole sensor, set the tapper stroke near maximum. Place a dowel pin in chuck (to represent tap) and simulate a no-hole condition by using a block of wood or other suitable object. Start tapper. Upon encountering resistance to forward movement, the tapper will retract automatically - so long as the tap is not engaged in a hole. See below for adjustment.



The "no-hole" sensor valve (39382) located in the rear housing (45443) is positioned relative to the lead nut (40502). The lead nut (40502) is spring loaded in the forward position and will activate the sensor valve when the tap contacts the workpiece in a "no-hole" or excessive mis-alignment condition. In a "no-hole" or excessive mis-alignment condition, the lead nut is forced back, overcoming the spring force against the lead nut and activating the sensor valve. The sensor valve signals the main retract valve located in the valve housing for immediate retraction of the unit.

"No- Hole" Sensor Adjustment: The adjustment screw (45444), which sets the spring tension against the lead nut, is pre-set at the factory for most applications. If the unit retracts when the tap

makes contact with the pre-drilled hole in the workpiece, rotate adjustment screw (45444) clockwise to increase spring tension on the lead nut. The initial setting for the no-hole sensor adjustment is obtained as follows: Turn adjustment screw (45444) clockwise into housing (45443) until contact is made with spring (49533). Rotate adjustment screw an additional 1/2 revolution clockwise (this will produce a .025" to .030" preload on the spring 49533).

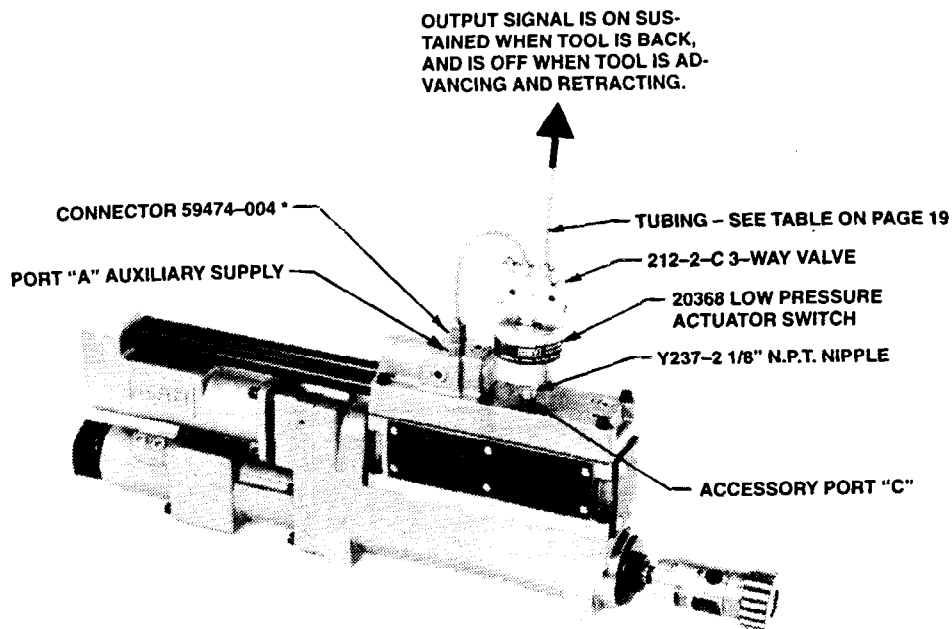
NOTE: Four complete revolutions of adjustment screw (45444) beyond this setting will produce the maximum .250" preload on the spring (49533).

## "TOOL IS BACK" CONNECTIONS

M104  
32

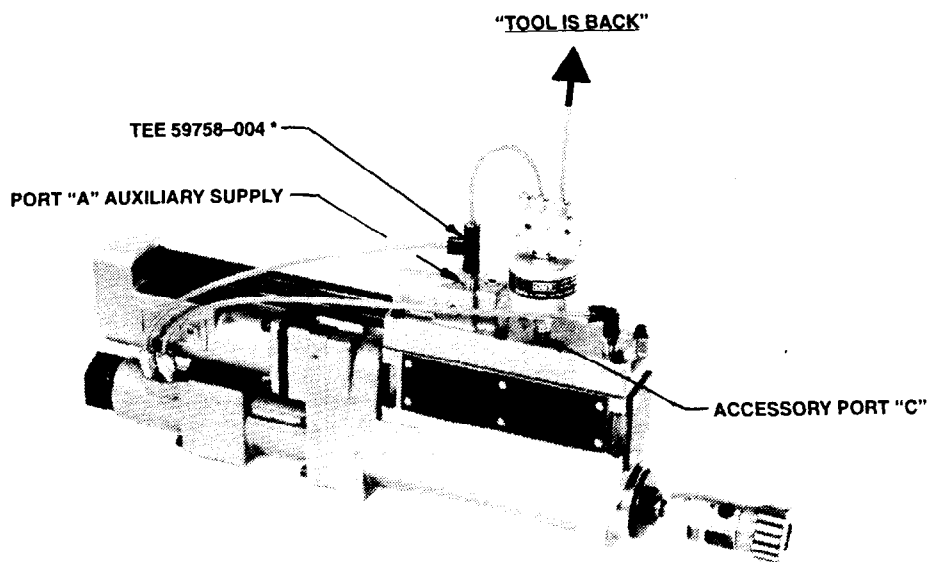
"Tool is back" signal, used to interlock tapper with machinery, activate coolant, etc., may be accomplished by connecting port "C" as shown below. Air supply is taken from port "A" and the pilot pressure is taken from port "C". When the tapper is retracted and

shut off, the pilot valve is deactivated, allowing pressure to flow from the IN n/o port of the valve to the OUT port of the valve to supply a steady signal. This signal will be on when the tool is back and off when the tool is advancing or retracting.



\* THIS NUMBER DENOTES A PACKAGE OF TEN (10) CONNECTORS

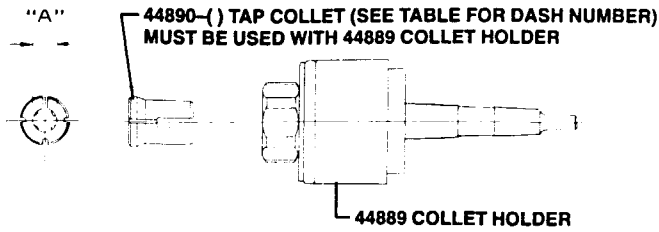
## "TOOL IS BACK" AND "NO-HOLE" SENSOR COMBINED CONNECTIONS



SEE ILLUSTRATION ON PAGE 20 FOR NO-HOLE SENSOR CONNECTIONS.

\* THIS NUMBER DENOTES A PACKAGE OF TEN (10) TEES.

# ACCESSORIES

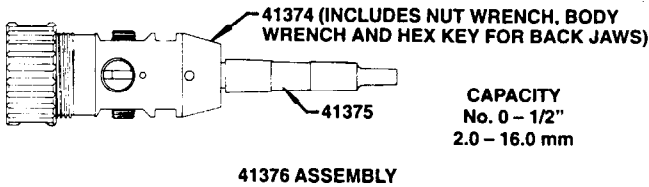


## SERVICE KIT NUMBER 45782

QTY	PART NUMBER	DESCRIPTION
4	15066	"O" RING
1	33705	BEARING
1	33709	BEARING
2	39452	SPRING
4	40284	"O" RING
2	41222-1	GASKET
5	41520	BLADE
1	41795	MOTOR OIL
1	41799	GEAR LUBE
1	41954	"O" RING LUBE
2	Y325-7	"O" RING
4	Y325-15	"O" RING
9	Y325-17	"O" RING

PART NUMBER	TAP SIZE		COLLET SIZE "A" DIMENSION
	INCHES	MM	
44890-1	0 - 6	1.6 - 3.5	.141"
44890-2	No. 8	4.0	.168"
44890-3	No. 10	4.5 - 5.0	.194"
44890-4	No. 12		.220"
44890-5	No. 14 & 1/4	6.0	.255"
44890-6	5/16	7.0 - 8.0	.318"
44890-7	3/8		.381"
44890-8	7/16	10.0	.323"
44890-9	1/2	12.0	.367"
44890-10	9/16	14.0	.429"
44890-11	5/8	16.0	.480"
44890-12	* 1/8 S.S. Pipe		.313"
44890-13	1/8 L.S. Pipe		.438"

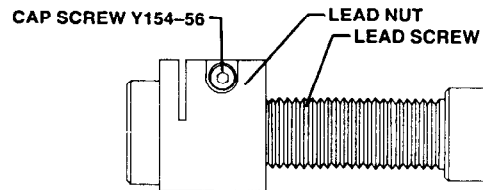
\* FOR 1/16 PIPE & 1/8 S.S. PIPE TAPS



## LEAD SCREW AND NUT ASSEMBLIES

### AMERICAN STANDARD THREAD

LEAD SCREW AND NUT ASSEMBLY	THREAD PITCH	LEAD SCREW	LEAD NUT
45453-11	11	41258-11	40502-11
45453-12	12	41258-12	40502-12
45453-13	13	41258-13	40502-13
45453-14	14	41258-14	40502-14
45453-16	16	41258-16	40502-16
45453-18	18	41258-18	40502-18
45453-20	20	41258-20	40502-20
45453-24	24	41258-24	40502-24
45453-27	27	41258-27	40502-27
45453-28	28	41258-28	40502-28
45453-32	32	41258-32	40502-32
45453-36	36	41258-36	40502-36
45453-40	40	41258-40	40502-40
45453-44	44	41258-44	40502-44
45453-48	48	41258-48	40502-48
45453-56	56	41258-56	40502-56



### METRIC THREAD

LEAD SCREW AND NUT ASSEMBLY	THREAD LEAD (mm)	LEAD SCREW	LEAD NUT
45785-40	0.40	45783-40	45784-40
45785-45	0.45	45783-45	45784-45
45785-50	0.50	45783-50	45784-50
45785-60	0.60	45783-60	45784-60
45785-70	0.70	45783-70	45784-70
45785-75	0.75	45783-75	45784-75
45785-80	0.80	45783-80	45784-80
45785-100	1.00	45783-100	45784-100
45785-125	1.25	45783-125	45784-125
45785-150	1.50	45783-150	45784-150

# ACCESSORIES

## DUAL SPINDLE SECTION

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### DISASSEMBLY

The dual spindle attachment can be serviced without removing the complete assembly from the tool. Using the 4 mm hex wrench supplied with the unit, loosen both adjusting screws (45992) – NOTE: Alternately unthread adjusting screws approximately 1/2 turn at a time or unthread screws simultaneously to prevent damaging the unit.

After the body and components have been removed from the adapter, driving spindle (47757-302) and components can be removed from adapter. To remove bearing (32325) and/or gear (45991); remove retaining ring (45989), press bearing back on spindle to expose needle roller (45986) and remove roller to remove gear. Remove bearing from spindle.

To remove gear (45996) and/or components, remove crescent ring (45997). Rotate spindle turret, and at the same time, pull back slightly on turret to locate alignment of spindle with notch in body (45999) and remove spindle assembly from body. To remove gear (45996) from body, remove oil reservoir (46009) and nylon washer (45993) bending washer slightly to remove. Bearings (46602), spacer (45995) and washer (45994) are loose parts and will drop out. Do not disassemble spindle (46022). If necessary to replace a part, replace as complete spindle assembly (46022).

### REASSEMBLY

Pack bearings and coat gears with a good grade of bearing grease when assembling. Saturate oil reservoirs with a good multigrade 10W/30 oil.

Insert a dummy adjusting screw (45992) (or a shaft of the same diameter) thru adapter side of body to maintain alignment of parts to be assembled into body and assemble nylon washer (45994) to dummy screw. Assemble one bearing (46002), spacer (46995) and another bearing (46002) into gear (45996) and assemble gear to the dummy screw. Assemble nylon washer (45993) into body, bending washer slightly to insert into body, and assemble oil reservoir (46009) into body.

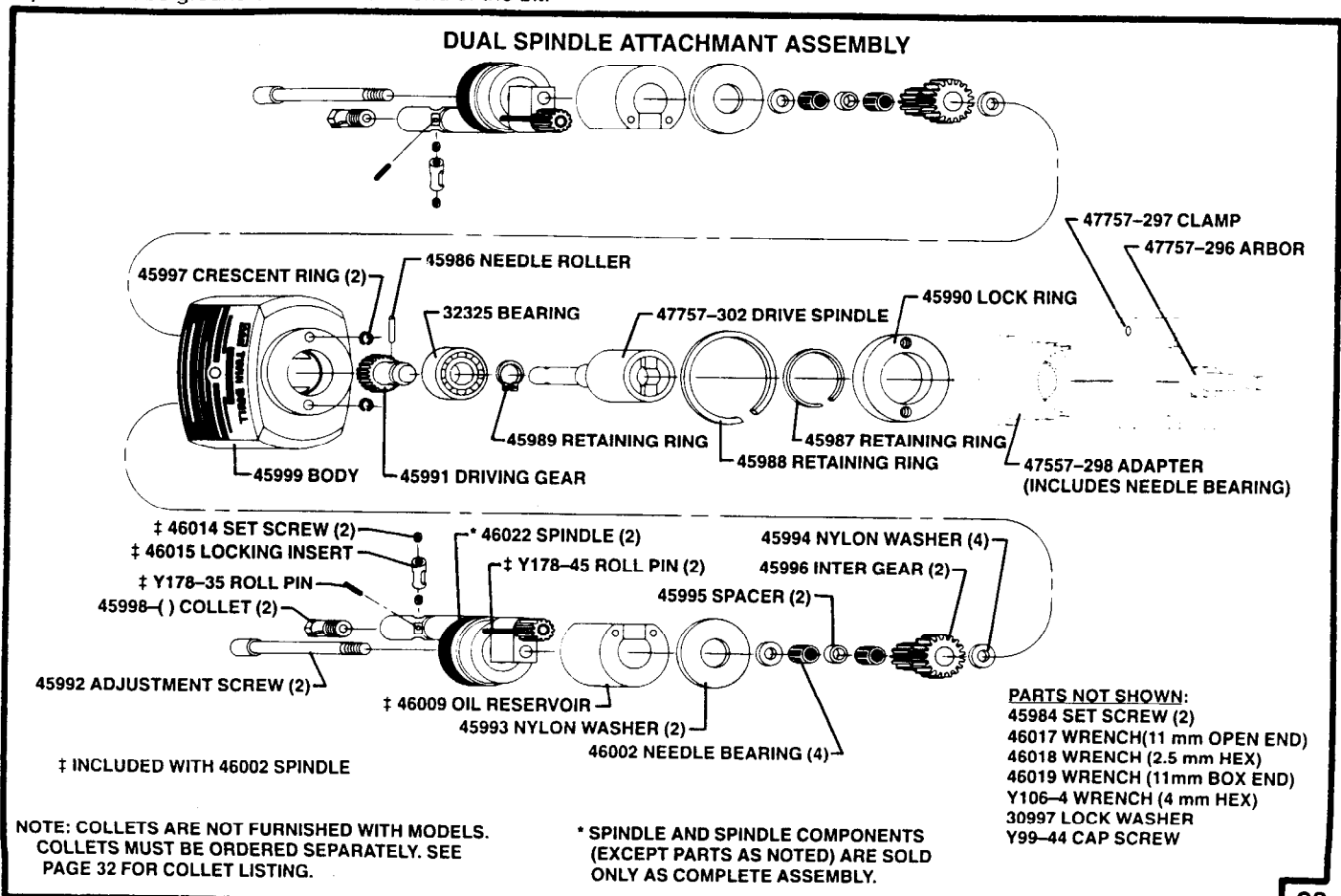
Assemble adjusting screw to spindle assembly (46022) and assemble nylon washer (45994) to adjusting screw. Assemble the spindle assembly into body while holding adjusting screw in alignment with dummy screw to maintain parts alignment and using adjustment screw to push the dummy screw out of body. NOTE: Align spindle assembly with notch in body to assemble. After assembling spindle to body, assemble crescent ring (45997) to adjusting screw, securing screw to body.

Reassemble driving spindle (47757-302) and components and the body (45999) and spindle assemblies (46022) to adapter (47757-298) in the reverse manner of disassembly.

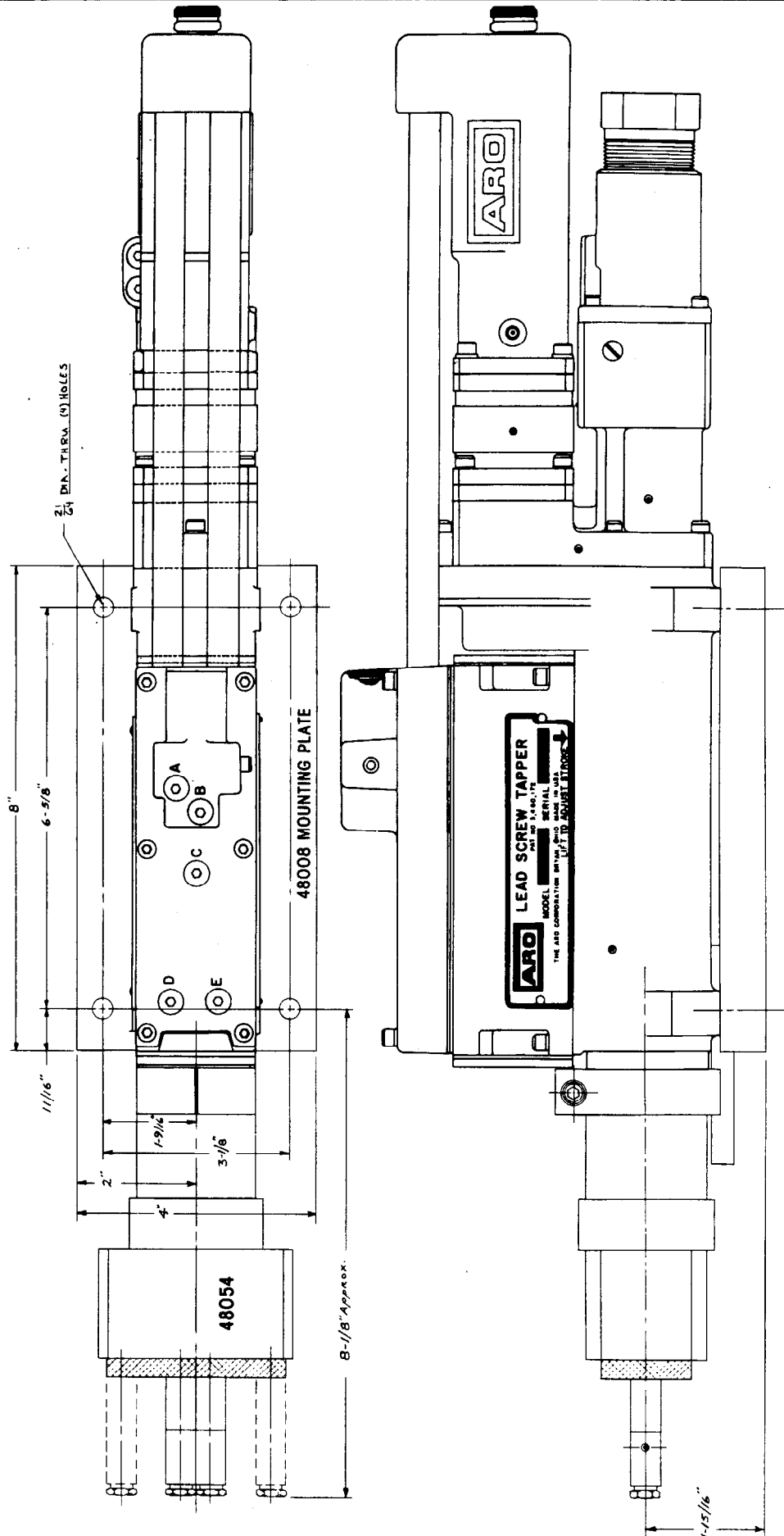
### RECOMMENDED METHOD FOR HOLDING DRILLS IN SPINDLES

To properly hold drill bit in collet and reduce the chance of slippage, a flat must be ground on the shank end of the bit. The flat should be approximately 5/16" (8 mm) long and the depth should be 1/3 of the bit diameter. NOTE: If bit is too large to fit into locking insert (smaller capacity dual spindles do not have insert), a square must be ground onto the shank end of the bit.

Insert bit into spindle and into locking insert (where applicable) insuring that one of the set screws locates squarely on the flat of the bit. Tighten collet firmly, then tighten set screws. NOTE: DO NOT overtighten collet. NOTE: Intent of set screws is only to keep bit from turning in collet.



# ACCESSORIES



**MOUNTING THE DUAL SPINDLE ATTACHMENT TO THE LEAD SCREW TAPPER REDUCES THE EFFECTIVE STROKE LENGTH FROM 2" TO 1-1/4".**



# ACCESSORIES

## DUAL SPINDLE SECTION

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### DISASSEMBLY

The dual spindle attachment can be serviced without removing the complete assembly from the tool. Using the 5 mm hex wrench supplied with the unit, loosen both adjusting screws (46036) NOTE: Alternately unthread adjusting screws approximately 1/2 turn at a time or unthread screws simultaneously to prevent damaging the unit.

After the body and components have been removed from the adapter, driving spindle (47757-303) and components can be removed from adapter. To remove bearing (46038) and/or gear (46025); remove retaining ring (37285), press bearing back on spindle to expose needle roller (46029) and remove roller to remove gear. Remove bearing from spindle.

Push back on head of adjusting screw (46063) to compress spring washer (46035) and expose "E" ring (Y180-31) out of counterbore of body and remove "E" ring. Rotate spindle turret, and at the same time, pull back slightly on turret to locate alignment of spindle with notch in body (46039) and remove spindle assembly from body. To remove gear (46030) from body, remove oil reservoir (46053) and nylon washer (46031) bending washer slightly to remove. Needle cage (46037), spacer (46034) and washer (46032) are loose parts and will drop out. Do not disassemble spindle (46062). If necessary to replace a part, replace as complete spindle assembly (46062).

### REASSEMBLY

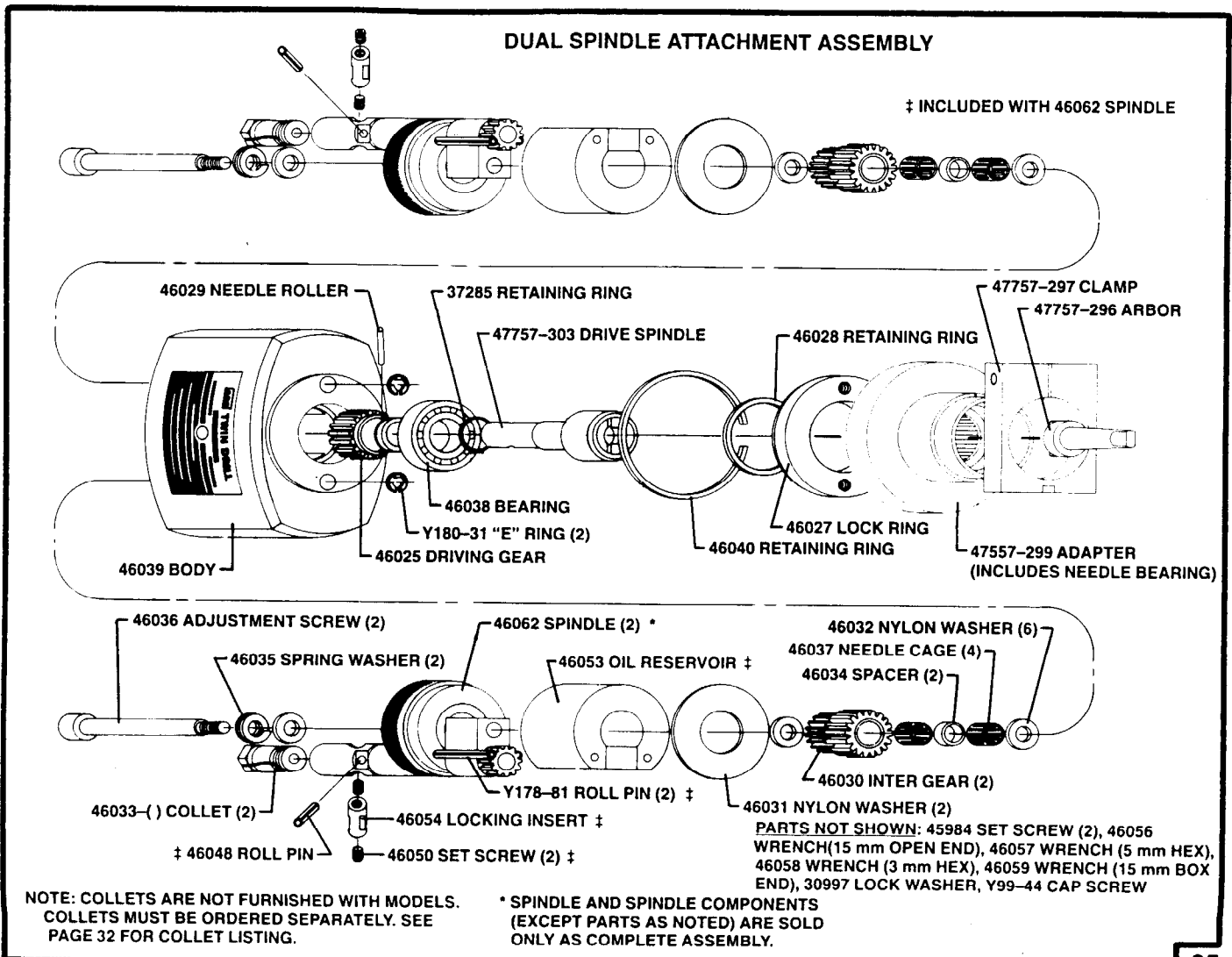
Pack bearings and coat gears with a good grade of bearing grease when assembling. Saturate oil reservoirs with a good multigrade 10W/30 oil.

Insert a dummy adjusting screw (46036) (or a shaft of the same diameter) thru adapter side of body to maintain alignment of parts to be assembled into body and assemble nylon washer (46032) to dummy screw. Assemble one needle cage (46037), spacer (46034) and another needle cage (46037) into gear (46030) and assemble gear to the dummy screw. Assemble nylon washer (46031) into body, bending washer slightly to insert into body, and assemble oil reservoir (46053) into body.

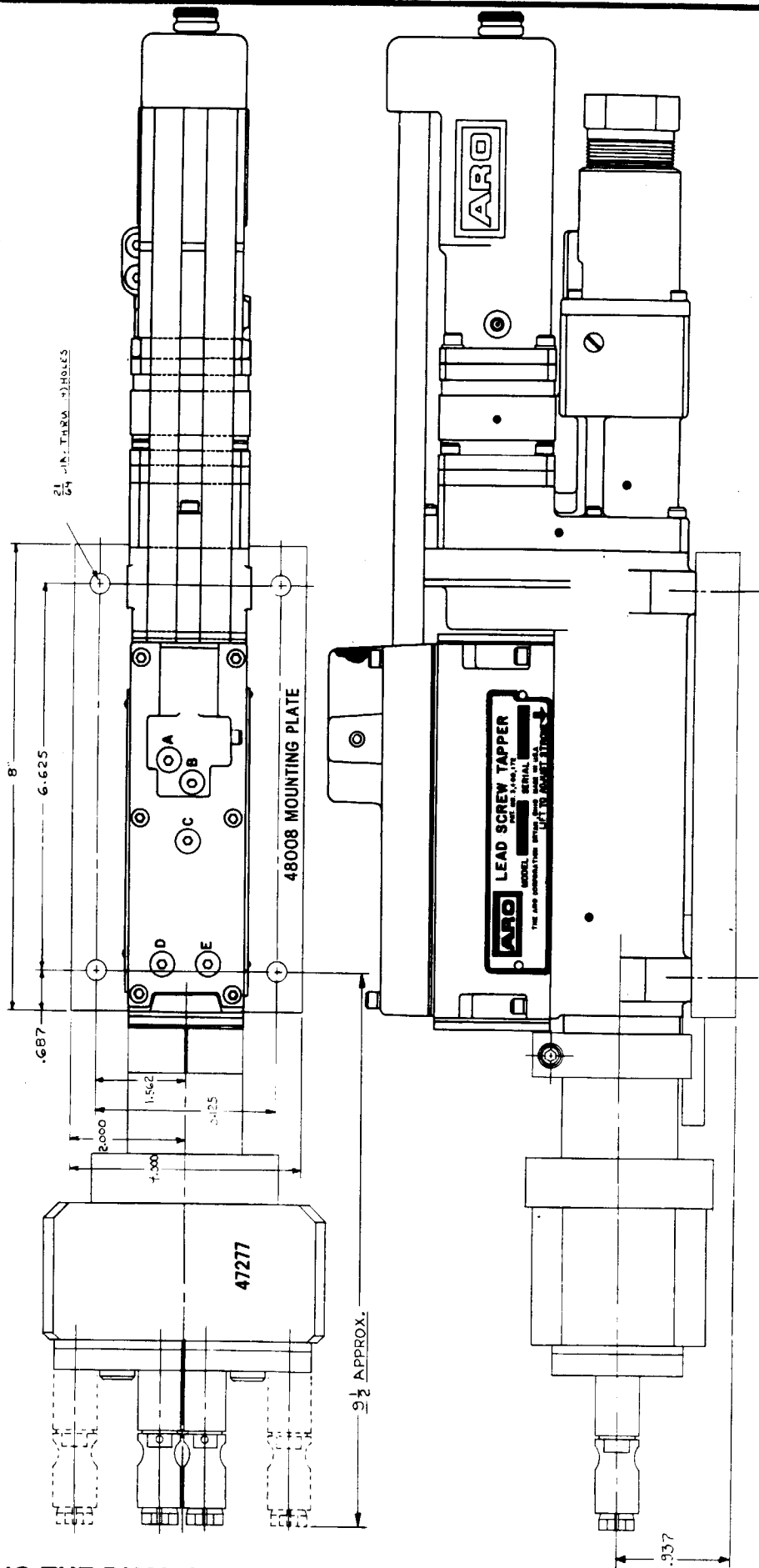
Assemble spring washer (46035) and nylon washer (46032) to adjusting screw (46036) and assemble adjusting screw to spindle assembly (46062) and assemble nylon washer (46032) to adjusting screw. Assemble the spindle assembly into body while holding adjusting screw in alignment with dummy screw to maintain parts alignment and using adjustment screw to push the dummy screw out of body. NOTE: Align spindle assembly with notch in body to assemble. After assembling spindle to body, depress head of adjusting screw and assemble "E" ring to screw, securing to body.

Reassemble driving spindle (47757-303) and components and the body (46039) and spindle assemblies (46062) to adapter (47757-299) in the reverse manner of disassembly.

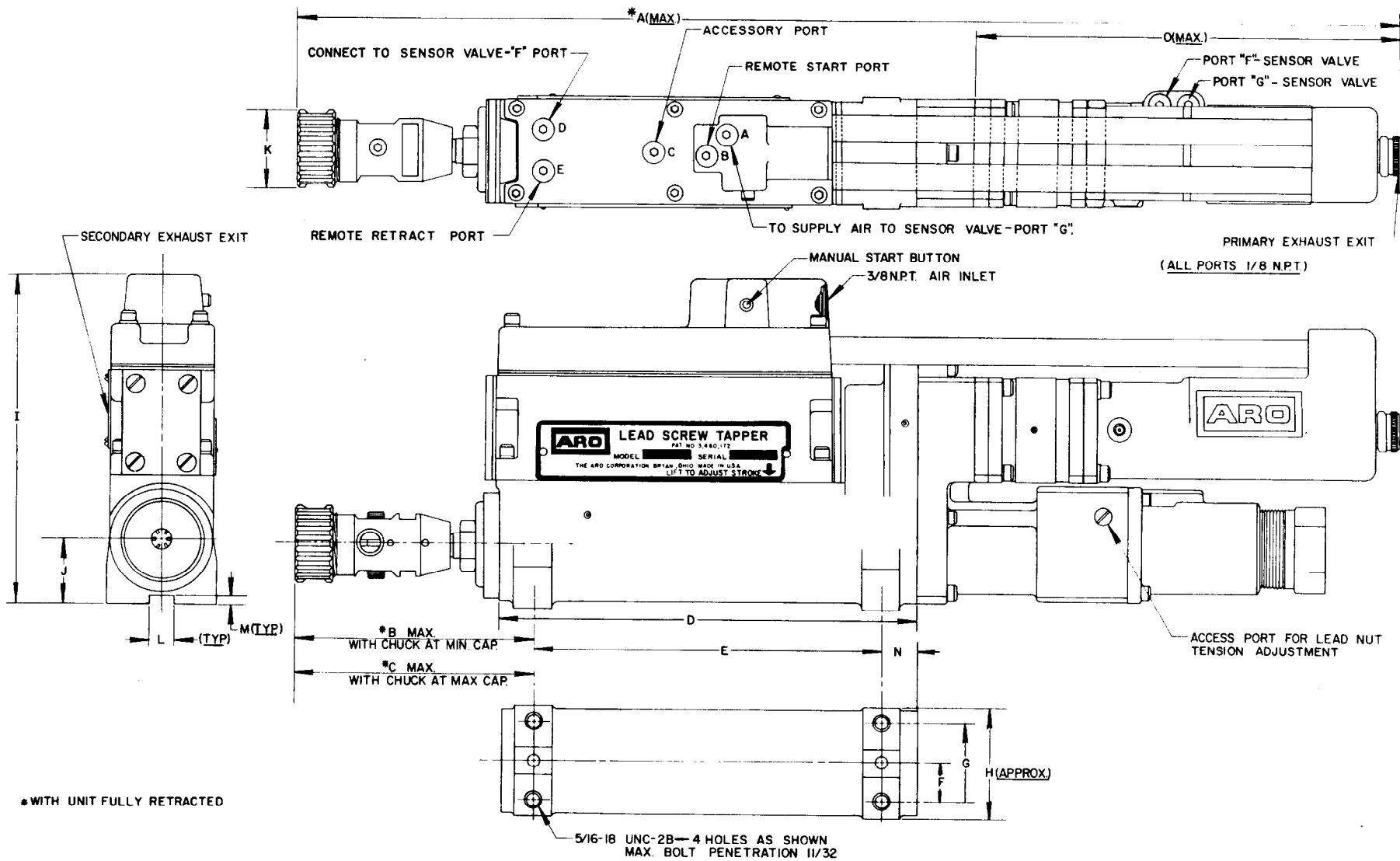
SEE PAGE 23 FOR RECOMMENDED METHOD FOR HOLDING DRILLS IN SPINDLES



# ACCESSORIES



**MOUNTING THE DUAL SPINDLE ATTACHMENT TO THE LEAD SCREW TAPPER REDUCES THE EFFECTIVE STROKE LENGTH FROM 2" TO 1-1/4".**



	DOUBLE REDUCTION	A SINGLE REDUCTION	B	C	D	E	F	G	H	I	J	K	L	M	N	SINGLE RED.	DOUBLE RED.
INCHES	21-1/8	19-11/32	4.421	4.546	7.932 7.942	6.623 6.627	7.45 7.55	1.495 1.505	2-1/8	6-5/16	11.865 11.875	1-15/32	4.998 5.010	.159 .164	.682 .692	8.182	6.401
MM	536.575	491.331	112.293	115.468	201.473 201.727	168.224 168.326	18.923 19.177	37.973 38.227	53.975	160.338	30.1371 30.1625	37.306	12.6949 12.7254	4.039 4.166	17.323 17.577	207.82	162.58

DIMENSIONAL DATA

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# TROUBLE SHOOTING

LISTED BELOW ARE SOME OF THE MOST COMMON CAUSES FOR THE LEAD SCREW TAPPER TO MALFUNCTION. MALFUNCTIONS BEYOND THE SCOPE OF THIS MANUAL SHOULD BE BROUGHT TO THE ATTENTION OF YOUR ARO REPRESENTATIVE OR RETURN THE TOOL TO THE FACTORY FOR REPAIR.

CONDITION	POSSIBLE CAUSE	CORRECTIVE ACTION
LOW SPEED OR FAILURE TO OPERATE.	<ol style="list-style-type: none"> <li>1. INADEQUATE AIR SUPPLY.</li> <li>2. START SIGNAL TOO SHORT (MANUAL OR REMOTE).</li> <li>3. LEAKING OR DAMAGED GASKETS (40524 AND 45459).</li> <li>4. WORN OR DAMAGED "O" RINGS (Y325-17) IN BUSHING (41214-1).</li> <li>5. BROKEN OR BADLY WORN ROTOR BLADES IN MOTOR.</li> </ol>	<ol style="list-style-type: none"> <li>1. CHECK AIR SUPPLY FOR CORRECT REGULATOR ADJUSTMENT (90 P.S.I.G. MAX. WHEN TOOL IS OPERATING).</li> <li>2. DEPRESS MANUAL OR REMOTE VALVE LONG ENOUGH TO PROPERLY START ADVANCE CYCLE (1/2 TO 1 SECOND).</li> <li>3. CHECK TORQUE ON SCREWS (Y154-57) AND TIGHTEN IN SEQUENCE AS SHOWN ON PAGE 11. REPLACE GASKETS IF NECESSARY.</li> <li>4. REPLACE "O" RINGS IN BUSHING (41214-1). REFER TO PAGE 11 FOR DISASSEMBLY AND REASSEMBLY.</li> <li>5. DISASSEMBLE MOTOR, CLEAN, INSPECT, REPLACE WORN OR DAMAGED PARTS. REFER TO PAGES 8 AND 14.</li> </ol>
UNIT WILL NOT RETRACT PROPERLY.	<ol style="list-style-type: none"> <li>1. MANUAL START VALVE NOT RELEASED, BROKEN VALVE SPRING (31125), DAMAGED "O" RING ON VALVE.</li> <li>2. REMOTE START SIGNAL NOT SHUT OFF AND BLED (EXHAUSTED PROPERLY).</li> <li>3. RETRACT TRIP TAB NOT PROPERLY POSITIONED OR LOOSE ON ACTUATOR (40521-1).</li> </ol>	<ol style="list-style-type: none"> <li>1. INSURE MANUAL START VALVE IS PROPERLY RELEASED. DISASSEMBLE VALVE COMPONENTS FROM HOUSING, CLEAN, INSPECT, REPLACE PARTS IF NECESSARY.</li> <li>2. INSURE THAT REMOTE 3-WAY VALVE HAS SHIFTED TO EXHAUST POSITION BEFORE TAPPER REACHES RETRACT POINT.</li> <li>3. CHECK FOR PROPER ALIGNMENT AND TIGHTEN SCREW (45457), SECURING TRIP TAB TO ACTUATOR (SEE FIGURE 2, PAGE 4).</li> </ol>
UNIT RETRACTS BEFORE COMPLETING CYCLE.	<ol style="list-style-type: none"> <li>1. LEAKING OR DAMAGED GASKETS (40524 AND 45459).</li> <li>2. WORN OR DAMAGED "O" RINGS (Y325-17 AND 40284) IN BUSHING (41215).</li> <li>3. WORKPIECE IS NOT PRE-DRILLED FOR TAP OR HOLE IS GREATLY MIS-ALIGNED.</li> </ol>	<ol style="list-style-type: none"> <li>1. CHECK TORQUE ON SCREWS (Y154-57) AND TIGHTEN IN SEQUENCE AS SHOWN ON PAGE 11. REPLACE GASKETS IF NECESSARY.</li> <li>2. REPLACE "O" RINGS IN BUSHING (41215). REFER TO PAGE 11 FOR DISASSEMBLY AND REASSEMBLY.</li> <li>3. CHECK WORKPIECE FOR PROPER ALIGNMENT WITH TAPPER OR FOR PRE-DRILLED HOLE.</li> </ol>
ROUGH SPINDLE ROTATION.	<ol style="list-style-type: none"> <li>1. IMPROPER TENSION OF LEAD NUT ON LEAD SCREW (THIS WILL BE EVIDENT BY EXCESSIVE HEAT ON LEAD SCREW).</li> <li>2. WORN OR DAMAGED SPINDLE BEARINGS (41864).</li> <li>3. IMPROPER LUBRICATION OF POWER UNIT (MOTOR AND/OR GEARING) OR DIRTY MOTOR (ROTOR BLADES STICKING ETC.).</li> </ol>	<ol style="list-style-type: none"> <li>1. REMOVE PIPE PLUG AT SIDE OF HOUSING (USING A 5/16" ALLEN WRENCH). ADJUST CAP SCREW TO INSURE LEAD NUT TENSION IS PROPERLY SET. SEE PAGE 5 FOR TENSION ADJUSTMENT.</li> <li>2. REPLACE BEARINGS. REFER TO PAGE 16.</li> <li>3. INSURE LUBRICATOR IS FULL OF OIL AND GEARING IS LUBRICATED REGULARLY, REFER TO PAGE 6. DISASSEMBLE POWER UNIT SECTION (PAGES 12, 13 AND 14), CLEAN, INSPECT, REPLACE WORN OR DAMAGED PARTS, LUBRICATE.</li> </ol>
TAP BINDS IN WORKPIECE.	<ol style="list-style-type: none"> <li>1. WORKPIECE IMPROPERLY ALIGNED WITH TAP AXIS.</li> <li>2. BACKLASH IN SPINDLES.</li> </ol>	<ol style="list-style-type: none"> <li>1. CHECK FOR PROPER ALIGNMENT OF WORKPIECE TO TOOL.</li> <li>2. CHECK FOR PLAY WHERE SPINDLE, LEAD SCREW SHAFT AND LEAD NUT ARE CONNECTED BY TAPER PINS BY GRASPING END OF LEAD SCREW SHAFT AND CHUCK AND TWISTING (BY HAND) IN OPPOSITE DIRECTIONS. CHECK TORQUE ON SET SCREWS.</li> </ol>
UNIT WILL NOT REMAIN STOPPED AFTER COMPLETION OF CYCLE.	<ol style="list-style-type: none"> <li>1. LEAKING OR DAMAGED GASKETS (40524 AND 45459).</li> <li>2. WORN OR DAMAGED "O" RINGS (Y325-17) IN BUSHING (41214-1).</li> </ol>	<ol style="list-style-type: none"> <li>1. CHECK TORQUE ON SCREWS (Y154-57) AND TIGHTEN IN SEQUENCE AS SHOWN ON PAGE 11. REPLACE GASKETS IF NECESSARY.</li> <li>2. REPLACE "O" RINGS IN BUSHING (41214-1). REFER TO PAGE 11 FOR DISASSEMBLY AND REASSEMBLY.</li> </ol>
CHUCK OR HOLDER DISENGAGES FROM SPINDLE.	<ol style="list-style-type: none"> <li>1. EXCESSIVE SIDE FORCE DUE TO MISALIGNMENT OF WORKPIECE.</li> <li>2. DIRTY OR DAMAGED SURFACES AT TAPER FIT.</li> </ol>	<ol style="list-style-type: none"> <li>1. INSURE CORRECT ALIGNMENT OF WORKPIECE TO CHUCK OR HOLDER AXIS.</li> <li>2. INSPECT, CLEAN, REPLACE PARTS IF NECESSARY. REFER TO PAGE 16.</li> </ol>

## CUTTING FACE ANGLES, SPEEDS AND LUBRICANTS FOR TAPPING VARIOUS MATERIALS

MATERIAL	CUTTING FACE ANGLE	SPEED: FEET PER MINUTE	LUBRICANT
ALUMINUM	10 - 12°	90 - 100	KEROSENE AND LARD OIL OR KEROSENE AND LIGHT BASE OIL
AMPCO METAL: (ALUMINUM BRONZE)			
GRADES 8 - 12	10 - 12°	60 - 80	SOLUBLE OIL
16 - 18	6 - 8°	50 - 70	SOLUBLE OIL
20 - 24	0 - 2°	30 - 50	SOLUBLE OIL
BAKELITE	0 - 2°	60 - 70	DRY
BRASS	0 - 2°	90 - 100	SOLUBLE OIL OR LIGHT BASE OIL
CAST IRON	0 - 2°	70 - 80	DRY OR SOLUBLE OIL
COPPER (99% PLUS)	16 - 18°	30 - 60	MINERAL OIL WITH LARD OR LIGHT BASE OIL
FIBER	6 - 8°	80 - 90	DRY
MAGNESIUM	16 - 18°	20 - 50	LIGHT BASE OIL DILUTED WITH 30 - 40% KEROSENE
MALLEABLE IRON	6 - 8°	35 - 60	SOLUBLE OIL OR SULPHUR BASE OIL
MANGANESE BRONZE	10 - 12°	30 - 60	MINERAL OIL WITH LARD OR LIGHT BASE OIL
MONEL METAL	10 - 12°	20 - 40	MINERAL OIL WITH LARD OR LIGHT BASE OIL
NAVAL BRASS	6 - 8°	80 - 100	MINERAL OIL WITH LARD OR LIGHT BASE OIL
NICKEL SILVER	16 - 18°	30 - 60	SULPHUR BASE OIL
PHOSPHOR BRONZE	10 - 12°	30 - 60	MINERAL OIL WITH LARD OR LIGHT BASE OIL
PLASTIC:			
THERMOPLASTIC	6 - 8°	50 - 70	DRY OR AIR JET
THERMOSETTING	0 - 2°	50 - 70	DRY OR AIR JET
RUBBER (HARD)	6 - 8°	80 - 90	DRY
STEELS:			
CARBON (HIGH)	6 - 8°	25 - 35	SULPHUR BASE OIL
CARBON (LOW)	10 - 12°	40 - 60	SULPHUR BASE OIL
CAST	10 - 12°	20 - 30	SULPHUR BASE OIL
CHROMIUM	10 - 12°	10 - 35	SULPHUR BASE OIL
CHROME - VANADIUM	10 - 12°	10 - 35	SULPHUR BASE OIL
FREE CUTTING	6 - 8°	60 - 80	SOLUBLE OIL
LEADED	6 - 8°	60 - 80	SOLUBLE OIL
MANGANESE	6 - 8°	10 - 35	SULPHUR BASE OIL
MOLYBDENUM	6 - 8°	10 - 35	SULPHUR BASE OIL
NICKEL	10 - 12°	10 - 35	SULPHUR BASE OIL
NICKEL - CHROMIUM	10 - 12°	10 - 35	SULPHUR BASE OIL
SILICON - MANGANESE	6 - 8°	10 - 35	SULPHUR BASE OIL
STAINLESS	10 - 12°	10 - 35	SULPHUR BASE OIL
TITANIUM	10 - 12°	20 - 40	SULPHURIZED AND CHLORINATED OIL
TOBIN BRONZE	6 - 8°	80 - 100	MINERAL OIL WITH LARD OR LIGHT BASE OIL
ZINC, DIE CAST	10 - 12°	60 - 70	SOLUBLE OIL

Speeds listed apply to high speed steel taps only. Carbon taps are not recommended for production tapping. If used, however, they should be run at speeds no greater than 50% of those listed.

# TABLE OF SPEEDS

## FRACTIONAL SIZE TAPS

DIA.	1/4"	5/16"	3/8"	7/16"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"	1 1/4"	1 3/8"	1 1/2"
FEET PER MIN.	REVOLUTIONS PER MINUTE												
20	306	245	204	175	153	122	102	88	77	68	61	56	51
25	383	306	255	219	191	153	128	109	96	85	77	69	64
30	458	367	306	262	229	183	153	131	115	102	92	83	76
35	535	428	357	306	268	214	179	153	134	119	107	97	89
40	611	489	407	349	306	244	203	175	153	136	122	111	102
50	764	611	509	437	382	306	255	218	191	170	153	139	127
55	841	673	560	480	420	336	280	240	210	187	168	153	140
60	917	733	611	524	458	367	306	262	229	204	183	167	153
65	993	795	662	568	497	397	331	284	249	221	199	181	166
70	1070	856	713	611	535	428	357	306	267	238	214	194	178
80	1222	978	815	698	611	489	407	349	306	272	244	222	204
90	1375	1100	917	786	688	550	458	393	344	306	275	250	229
100	1528	1222	1019	873	764	611	509	436	382	340	306	278	255
110	1681	1345	1120	960	840	672	560	480	420	373	336	306	280
120	1833	1467	1222	1048	917	733	611	524	458	407	367	333	306
130	1986	1589	1324	1135	993	794	662	568	497	441	397	361	331
140	2139	1711	1426	1222	1070	856	713	611	535	475	428	389	357
150	2292	1833	1528	1310	1146	917	764	655	573	509	458	417	382

## MACHINE SCREW TAPS

MACHINE SCREW NO.	0	1	2	3	4	5	6	8	10	12	14
DECIMAL SIZE	.060	.073	.086	.099	.112	.125	.138	.164	.190	.216	.242
FEET PER MINUTE	REVOLUTIONS PER MINUTE										
20	1273	1046	888	772	682	611	554	466	402	354	316
25	1592	1308	1110	965	853	764	692	582	503	442	395
30	1910	1570	1332	1157	1023	917	830	699	603	531	474
35	2228	1831	1555	1350	1194	1070	969	815	704	619	552
40	2546	2093	1777	1543	1364	1222	1107	932	804	707	631
45	2865	2355	1999	1736	1535	1375	1246	1048	905	736	710
50	3183	2616	2221	1929	1705	1528	1384	1165	1005	884	789
55	3501	2879	2443	2122	1876	1681	1522	1281	1106	973	868
60	3820	3139	2665	2315	2046	1833	1661	1397	1206	1061	947
65	4138	3401	2887	2508	2217	1986	1799	1514	1307	1149	1026
70	4456	3663	3109	2701	2387	2139	1938	1630	1407	1238	1105
75	4775	3924	3331	2894	2558	2292	2076	1747	1508	1326	1184
80	5093	4186	3553	3086	2728	2445	2214	1863	1608	1415	1263
85	5411	4448	3775	3280	2899	2597	2353	1980	1709	1503	1342
90	5730	4709	3997	3472	3069	2750	2491	2096	1809	1592	1421
95	6048	4971	4219	3665	3240	2903	2630	2213	1910	1680	1499
100	6366	5232	4442	3858	3410	3056	2768	2329	2010	1768	1578
110	7003	5756	4886	4244	3751	3361	3045	2562	2211	1945	1736
120	7639	6279	5330	4630	4093	3667	3321	2795	2412	2122	1894
130	8276	6802	5774	5016	4434	3973	3598	3028	2613	2299	2052
140	8913	7325	6218	5402	4775	4278	3875	3261	2815	2476	2210
150	9549	7849	6662	5787	5116	4584	4151	3494	3016	2653	2368

# COMMON TAP PROBLEMS

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TROUBLE	CAUSE
TAP BREAKAGE	1. WRONG TYPE OF TAP.
	2. DULL TAP.
	3. TAP INCORRECTLY GROUND.
	4. TAP DRILL TOO SMALL.
	5. DRILLED HOLE TOO SHALLOW.
	6. MISALIGNMENT OF TAP AND HOLE.
	7. WRONG MACHINE.
	8. INCORRECT FIXTURE OR HOLDING DEVICE.
	9. WORK HARDENED MATERIAL.
	10. LACK OF LUBRICANT OR USE OF WRONG TYPE.
TAP FAILURE ON REVERSAL	1. TAP CUTTING TOO TIGHTLY. CUTTING FACE ANGLE SHOULD BE INCREASED.
	2. TAP GALLING. FACE ANGLE ON BACK OF LAND SHOULD BE INCREASED.
	3. CHIPS WEDGED BETWEEN FLUTES (SEE THE FOLLOWING).
CHIPS CLOGGING FLUTES	1. WRONG TYPE OF TAP.
	2. INSUFFICIENT CHAMFER.
	3. INCORRECT CUTTING FACE ANGLE.
	4. ROUGH FLUTES.
	5. FLUTES IMPROPERLY REGROUND.
	6. LACK OF LUBRICATION OR USE OF WRONG TYPE.
STRIPPED OR CHIPPED TAP THREADS	1. MISALIGNMENT.
	2. CARELESS HANDLING.
	3. DULL TAP.
	4. TAP TOO HARD.
	5. WRONG APPLICATION OF SURFACE TREATED TAPS.
	6. IMPROPER SHARPENING OF TAP.
TORN THREADS IN TAPPED PART	1. INCORRECT CUTTING FACE ANGLE (USUALLY TOO SMALL).
	2. TAP DRILL TOO SMALL.
	3. CHIPS CLOGGING FLUTES.
	4. BROKEN THREADS ON TAPS.
	5. IMPROPER RESHARPENING OF TAPS.
	6. LACK OF LUBRICANT OR USE OF WRONG TYPE.

TROUBLE	CAUSE
TAP STICKING OR BINDING	1. TAP DRILL TOO SMALL.
	2. TAP LANDS TOO WIDE.
	3. INCORRECT CUTTING FACE ANGLE.
	4. LACK OF LUBRICANT OR USE OF WRONG TYPE.
	5. SURFACE TREATMENT (LUBRICANT) REQUIRED.
EXCESSIVE TAP WEAR	1. MATERIAL IS ABRASIVE OR INCLUSIONS PRESENT. SURFACE TREATED TAP REQUIRED.
	2. MISALIGNMENT.
CUTTING FACE BREAKDOWN	1. INCORRECT CUTTING FACE ANGLE.
	2. SURFACE TREATMENT REQUIRED.
OVERHEATING OF TAP	1. EXCESSIVE LAND WIDTH.
	2. LACK OF LUBRICANT OR USE OF WRONG TYPE.
	3. DULL TAP.
	4. EXCESSIVE FLANK CONTACT, PITCH DIAMETER RELIEF REQUIRED.
	5. EXCESSIVE TAPPING SPEEDS.
POOR FINISH ON THREAD IN TAPPED PART	1. PITCH DIAMETER RELIEF REQUIRED.
	2. INCORRECT CUTTING FACE ANGLE, USUALLY TOO SMALL.
	3. TAP DRILL TOO SMALL.
	4. INSUFFICIENT NUMBER OF CHAMFERED THREADS.
	5. DULL TAP.
	6. LACK OF LUBRICANT OR USE OF WRONG TYPE.
EXCESSIVE FRICTION DRAG AND POWER REQUIREMENT	1. PITCH DIAMETER RELIEF REQUIRED.
	2. POINT SIZE ON TAP TOO LARGE.
	3. DULL TAP.
	4. INCORRECT CUTTING FACE ANGLE.
	5. INCORRECT TAPPING SPEED.
	6. LACK OF LUBRICANT OR USE OF WRONG TYPE.
	7. INCORRECT OR INADEQUATE EQUIPMENT.
	8. MISALIGNMENT.

PART NUMBER	INCH	TAP SIZE	
		NO.	MM
46033-1	5/64	47	2.0
46033-2		45	2.1
46033-3		44	2.2
46033-4		43	2.3
46033-5	3/32	42	2.4
46033-6		40	2.5
46033-7		38	2.6
46033-8		36	2.7
46033-9	7/64	35	2.8
46033-10		33	2.9
46033-11		32	3.0
46033-12		31	3.1
46033-13	1/8		3.2
46033-14		30	3.3
46033-15		29	3.4
46033-16			3.5
46033-17	9/64	28	3.6
46033-18		26	3.7
46033-19		25	3.8
46033-20		23	3.9
46033-21	5/32	22	4.0
46033-22		20	4.1
46033-23		19	4.2
46033-24		18	4.3
46033-25	11/64	17	4.4
46033-26		16	4.5
46033-27		14	4.6
46033-28		13	4.7
46033-29	3/16	12	4.8
46033-30		10	4.9
46033-31		9	5.0
46033-32		7	5.1
46033-33	13/64	5	5.2
46033-34		4	5.3
46033-35		3	5.4
46033-36			5.5
46033-37	7/32	2	5.6
46033-38			5.7
46033-39		1	5.8
46033-40			5.9
46033-41	15/64	A	6.0
46033-42		B	6.1
46033-43		C	6.2
46033-44		D	6.3
46033-45	1/4	E	6.4
46033-46		F	6.5
46033-47		G	6.6
46033-48	17/64		6.7
46033-49		H	6.8
46033-50		I	6.9
46033-51		J	7.0
46033-52	9/32	K	7.1
46033-53			7.2
46033-54			7.3
46033-55		L	7.4
46033-56		M	7.5
46033-57	19/64		7.6
46033-58		N	7.7
46033-59			7.8
46033-60	5/16		7.9
46033-61		O	8.0
46033-62			8.1
46033-63		P	8.2
46033-64	21/64		8.3
46033-65		Q	8.4
46033-66			8.5
46033-67		R	8.6
46033-68	11/32		8.7
46033-69			8.8
46033-70		S	8.9
46033-71			9.0
46033-72	23/64	T	9.1
46033-73			9.2
46033-74			9.3
46033-75		U	9.4
46033-76	3/8		9.5

PART NUMBER	INCH	TAP SIZE	
		NO.	MM
45998-1		61	1.0
45998-2		57	1.1
45998-3	3/64	56	1.2
45998-4		55	1.3
45998-5		54	1.4
45998-6		53	1.5
45998-7	1/16	52	1.6
45998-8		51	1.7
45998-9		50	1.8
45998-10		48	1.9
45998-11	5/64	47	2.0
45998-12		45	2.1
45998-13		44	2.2
45998-14		43	2.3
45998-15	3/32	42	2.4
45998-16		40	2.5
45998-17		38	2.6
45998-18		36	2.7
45998-19	7/64	35	2.8
45998-20		33	2.9
45998-21		32	3.0
45998-22		31	3.1
45998-23	1/8		3.2
45998-24		30	3.3
45998-25		29	3.4
45998-26			3.5
45998-27	9/64	28	3.6
45998-28		26	3.7
45998-29		25	3.8
45998-30		23	3.9
45998-31	5/32	22	4.0
45998-32		20	4.1
45998-33		19	4.2
45998-34		18	4.3
45998-35	11/64	17	4.4
45998-36		16	4.5
45998-37		14	4.6
45998-38		13	4.7
45998-39	3/16	12	4.8
45998-40		10	4.9
45998-41		9	5.0
45998-42		7	5.1
45998-43	13/64	5	5.2
45998-44		4	5.3
45998-45		3	5.4
45998-46			5.5
45998-47	7/32	2	5.6
45998-48			5.7
45998-49		1	5.8
45998-50			5.9
45998-51	15/64	A	6.0
45998-52		B	6.1
45998-53		C	6.2
45998-54		D	6.3
45998-55	1/4	E	6.4
45998-56		F	6.5



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