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Edition 2
December 2013

Reversible Angle Screwdrivers and Angle Wrenches

Series QA1L

Maintenance Information



Save These Instructions

 **Ingersoll Rand**[®]

Product Safety Information

WARNING

- Failure to observe the following warnings, and to avoid these potentially hazardous situations, could result in death or serious injury.
- Read and understand this and all other supplied manuals before installing, operating, repairing, maintaining, changing accessories on, or working near this product.
- Always wear eye protection when operating or performing maintenance on this tool. The grade of protection required should be assessed for each use and may include impact-resistant glasses with side shields, goggles, or a full face shield over those glasses.
- Always turn off the air supply, bleed the air pressure and disconnect the air supply hose when not in use, before installing, removing or adjusting any accessory on this tool, or before performing any maintenance on this tool or any accessory.

Note: When reading the instructions, refer to exploded diagrams in Parts Information Manuals when applicable (see under Related Documentation for form numbers).

Lubrication

Each time a Series QA Angle Wrench or Angle Screwdriver is disassembled for maintenance and repair or replacement of parts, lubricate the tool as follows:

1. Coat all exposed gears with **Ingersoll Rand** No. 67 Grease and work some of the Grease into the gearing of the Angle Housing (100).
 2. Work approximately 6 to 8 cc of **Ingersoll Rand** No. 28 Grease into the ball pockets, jaws, adjusting nut lock and shaft threads of the clutch mechanism.
 3. Use **Ingersoll Rand** No. 10 Oil to lubricate the motor. Inject approximately 1 to 2 cc of oil into the air inlet before attaching the air hose to the tool.
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Speed Adjustment

In addition to adjustable clutches for controlling torque, Series QA Angle Wrenches and Angle Screwdrivers are furnished with the ability to precisely control speed, within certain ranges. Setting the speed requires a tachometer. Therefore, the adjustment, although simple, should only be attempted by a competent technician using the proper equipment.

The Back Cap (7) has a small, molded stud on the end face of the Cap nearest the Exhaust Diffuser (16). That stud controls the radial location of the Diffuser which controls the opening size of the exhaust ports. Take an initial reading of the tool speed by applying a tachometer to the end of the Spindle (113). Using the procedure required to activate the motor of your particular model tool, bring the motor to maximum free speed. After determining the actual velocity, shut off the air supply and disconnect the air line. Use a 3/4" wrench to loosen the Inlet Bushing. The longest slot in the Exhaust Diffuser will contain the molded stud on the Back Cap. Rotate the Diffuser to open the exhaust ports to increase speed or rotate it to restrict the exhaust to reduce speed. Being careful not to allow the Diffuser to damage the molded stud, tighten the Inlet Bushing to 15 ft-lbs. (20 Nm) torque. Connect the air line and restore the air supply and check the velocity again. Determine which direction you need to rotate the Diffuser to obtain the desired speed and then rotate it accordingly. Best results are achieved by using gradual increments and frequent tachometer readings. Be sure to turn off the air supply and disconnect the line when making adjustments.

Disassembly

General Instructions

1. Do not disassemble the tool any further than necessary to replace or repair damaged parts.
2. Whenever grasping a tool or part in a vise, always use leather-covered or copper-covered vice jaws to protect the surface of the part and help prevent distortion. This is particularly true of threaded members and housings.
3. Do not remove any part which is a press fit in or on a subassembly unless the removal of that part is necessary for repairs or replacement.
4. Do not disassemble the tool unless you have a complete set of gaskets and O-rings for replacement.

Disassembly of the Tool

Each Series QA Angle Wrench or Angle Screwdriver is made up of modules or units. These units can be disassembled for repair or service without affecting remaining units that require no service. The same modules are not included in every model. Direct drive models have no clutches. To separate the modules, proceed as follows:

1. Lightly grasp the hex body portion of the Angle Head (100) in copper-covered or leather-covered vise jaws in a manner that provides access to the Coupling Nut (104).

NOTICE

The Coupling Nut has a left-hand thread. Rotate the Nut clockwise to loosen it.

2. Using a wrench on the flats of the Coupling Nut, loosen the Coupling Nut and then remove the tool from the vise jaws.
3. With the Angle Head upward, unscrew the Coupling Nut and pull the assembled Angle Head off the front end of the tool. Remove the Housing Lock Spacer (87) from the Angle Head, Gear Case (43) or Clutch Housing (81).
4. **For models without a clutch**, remove the Grip Spacer (91) and pull the Grip Assembly (88) off the Gear Case.

For models with a clutch, proceed as follows:

- a. Grasp the wrench flats near the inlet end of the tool in copper-covered or leather-covered vise jaws with the clutch end upward.
- b. Grasp the Clutch Adjusting Hole Cover (83) and pull it upward off the Clutch Housing. Remove the Cover O-ring (84) from inside the Cover if it needs to be replaced.

NOTICE

The Grip Retaining Nut has a left-hand thread. Rotate the Nut clockwise to loosen it.

- c. Using a spanner wrench with a 1/8" pin, unscrew and remove the Grip Retaining Nut (82).
- d. Pull the Grip Assembly (88) off the Clutch Housing.
- e. Using pliers, pull the Angle Wrench Drive Adapter (85) with the Drive Adapter Bearing (86) out of the Clutch Housing.
- f. Reposition the tool in the vise jaws to grasp the flats on the Gear Case with the Clutch Housing upward.

NOTICE

The Clutch Housing has a left-hand thread. Rotate the Housing clockwise to loosen it.

- g. Engage the hook of the Clutch Housing Spanner Wrench (Part No. TRH-478) in the adjustment slot in the Gear Case and loosen the Clutch Housing.
 - h. Remove the tool from the vise jaws and unscrew and remove the Clutch Housing, assembled clutch and Clutch return Spring (46 or 65) from the tool.
 - i. Over a workbench, turn the gear case end of the tool downward to remove the Push Rod (35) from the power unit.
5. Lightly grasp the flats of the Gear Case in leathercovered or copper-covered vise jaws with the Inlet Bushing (17) upward.
 6. Place a 1-3/16" open end wrench on the flats of the Back Cap (7) to prevent it from rotating, and use a 3/4" wrench to unscrew and remove the Inlet Bushing.
 7. Lift the Exhaust Diffuser (16) off the Back Cap.
 8. If the Throttle Valve Spring (15) did not come out of the tool with the Inlet Bushing, use needle nose pliers to remove it and the Throttle Valve (14) from the Motor Housing (1).
 9. To remove the Throttle Valve Seat (13), insert a hooked tool through the central opening of the Seat and pull it from the Motor Housing.
 10. Using a 1/16" pilot punch, tap the Throttle Lever Pin (12) out of the Back Cap and remove the Throttle Lever (11).
 11. Pull the Throttle Plunger (6) out of the Motor Housing and remove the assembly from the vise.
 12. Holding the assembly horizontally, remove the Back Cap, the Memory Chip (10) (if included with the tool), the Back Cap Gasket (8) and the Shutoff Valve (21) (if included with the tool).
 13. If the Muffler Elements (9) need to be cleaned or replaced, pull them out of the Back Cap.
 14. Grasp the flats at the inlet end of the Motor Housing in leather-covered or copper-covered vise jaws, and using a 1-1/16" wrench on the flats of the Motor Housing, unscrew and separate the Gear Case from the Motor Housing.
 15. Set the assembled Gear Case on the workbench.
 16. Remove the Motor Clamp Washer (34) and the Motor Seal (33) from the assembled motor in the Housing.
 17. Tap the Motor Housing on a wood block to remove the Motor Assembly from the Housing.

Disassembly of the Angle Head

1. Slide the Coupling Nut (104) toward the output end of the Angle Head (100) and using a thin blade screwdriver, work the Coupling Nut Retaining Ring (105) out of the groove in the Angle Head. Slide the Coupling Nut off the Angle Head.
2. Using a piece of 9/16" hexagon bar stock with a 1/4" hole drilled 3/4" deep in the center to clear the hex of the Bevel Pinion (107) and a 9/16" wrench, unscrew and remove the Angle Housing Plug (106).
3. To pull the assembled Bevel Pinion out of the Angle Head, proceed as follows:
 - a. Gather together a 1/2" square drive socket for a nut larger than one inch, an 8-32 UNC socket head cap screw that is one half inch longer than the socket, a nut for the Screw and a flat washer that is larger than the socket with a hole that is smaller than the nut and thick enough to withstand some pressure. A wrench for the nut and a hex wrench for the screw are also required.
 - b. Thread the nut onto the cap screw until it stops against the screw head.
 - c. To restrict the rotation of the angle head spindle, clamp a box wrench that will fit the square drive or one leg of a hex wrench that will fit into the end of the spindle opening into a vise. Insert the output end of the Spindle (113) into the wrench.
 - d. Place the square drive end of the socket against the notched end of the Angle Head.
 - e. With the cap screw and nut inserted through the flat washer, thread the cap screw through the square drive opening into the end of the Bevel Pinion until it bottoms out.
 - f. Thread the nut along the cap screw until it contacts and holds the flat washer and socket against the Angle Head.
 - g. Use a hex wrench to hold the cap screw in position while turning the nut with a wrench to jack the assembled Bevel Pinion out of the Angle Head. Unscrew the cap screw from the Bevel Pinion.
4. Slide the Pinion Rear Bearing (109) and Pinion Front Bearing (108) off the Bevel Pinion.
5. Grasp the Angle Housing lightly in copper-covered or leather-covered vise jaws with the Spindle upward.

NOTICE

The thread in the following step is a left-hand thread. Rotate the wrench clockwise to remove the Cap.

6. **For TRL254, TRL256, TRL2Q4 and TRL2H4 Angle Heads**, use the Spindle Bearing Cap Wrench (Part No. 141A12-26) to unscrew and remove the Lower Spindle Bearing Cap (117).
For TRL154 Angle Heads, using a fixed or adjustable face spanner wrench, unscrew and remove the Lower Spindle Bearing Cap (117).
7. Pull the assembled Spindle out of the Angle Head.
8. **For TRL154 Angle Heads**, slide the Spindle Lower Bearing (112) off the Spindle.
For TRL2H4, TRL2Q4, TRL254 and TRL256 Angle Heads, install a bearing separator between the shoulder of the Spindle and the end of the Spindle Lower Bearing (112) that is farthest from the Bevel Gear (110). Support the separator on the table of an arbor press with the output end of the Spindle downward and using a pressing plug that clears the inside of the Bevel Gear Retainer (111), press the Spindle out of the Retainer, Bevel Gear and Lower Spindle Bearing.

NOTICE

In the following steps, the Retaining Clip and Spring for Angle Heads will most likely be damaged or destroyed during the removal process. Make certain you have a replacement available before attempting to remove it.

9. **For TRL154, TRL254 and TRL256 Angle Heads**, grasp the end of the Detent Retainer (115) with needle nose pliers and pull it from the end of the Spindle. Push the Spindle Detent (114) inward to have it fall out the end of the Spindle.
For TRL2Q4 Angle Heads, use a screwdriver to pry the Detent Retainer (115) off the Spindle and remove the Spindle Detent (114) from the hole in the Spindle.
For TRL2H4 Angle Heads, use a pointed probe to spiral the Spindle Detent (114) out of the internal groove in the Spindle.

10. For **TRL154 Angle Heads**, to remove the Spindle Upper Bearing Shaft (116), stand the gear end of the Spindle on a block with clearance for the Shaft. Insert a 1/8" round rod into the detent retainer opening and using an arbor press, press the Shaft out of the Spindle.
11. For **TRL154 Angle Heads**, if the Spindle Upper Bearing (102) must be replaced, press the Bearing and Spindle Upper Bearing Cap (103) out the end of the Angle Housing opposite the spindle end.
For **TRL2H4, TRL2Q4, TRL2S4 and TRL2S6 Angle Heads**, if the Spindle Upper Bearing (102) must be replaced, press the Bearing out the end of the Angle Housing opposite the spindle end.

Disassembly of the Adjustable Shutoff Clutch

1. Using a thin blade screwdriver, pry the Clutch Adjusting Nut Stop (64) off the end of the Clutch Shaft (52).
2. Insert the tip of a #1 Phillips Head Screwdriver into the adjustment opening between the Clutch Adjusting Nut (63) and the Clutch Adjusting Nut Washer (62). Rotate the screwdriver clockwise to thread the Adjustment Nut off the Clutch Shaft.

NOTICE

In the following step, the Clutch Cam Balls will be free to fall from the assembly when the Cam Ball Seat is moved. Make certain the Balls fall into a non-damaging container.

3. Holding the assembly over a small pasteboard box, slide the Adjusting Nut Washer, the Thrust Bearing (61), the Spring Seat (60), the Clutch Spring (59) and the Cam Ball Seat (58) off the Clutch Shaft. Allow the three Clutch Cam Balls (56) to fall into the pasteboard box.
4. The Clutch Cam Ball Driver (55) has a cross hole that is larger on one side than the other. Insert a 1/16" drill shank or piece of wire into the smaller hole and gently push the Clutch Driver Retaining Pin (57) out of the larger hole and out of the Driver and the Clutch Shaft.

NOTICE

In the following step, the Clutch Balls will be free to fall from the assembly when the Cam Jaw is moved along the Clutch Shaft. Make certain the Balls fall into a nondamaging container.

5. Holding the assembly over a small pasteboard box, and using care to drop the twelve Clutch Balls (53) into the box, slide the Clutch Cam Ball Driver and Cam Jaw (54) off the Clutch Shaft. If grease held some of the Balls inside the jaw cavity, remove them.
6. With the large end of the Clutch Shaft downward, depress the Automatic Shutoff Pin (50) with varying amounts of finger pressure while tapping the large end edge of the Clutch Shaft on a piece of wood until the Automatic Shutoff Plunger (48) protrudes slightly from the end of the Shaft. Grasp the Plunger and carefully pull it out of the Clutch Shaft.
7. Remove the Automatic Shutoff Pin and Automatic Shutoff Pin Spring (51) from the Clutch Shaft. The Pin Spring should remain in the pin recess when the Pin is removed. To separate the Spring from the Pin, gently rotate the Spring while pulling it from the recess to avoid elongating the Spring.
8. Using a hooked tool, reach into the opening in the end of the Clutch Shaft and carefully pull the Automatic Shutoff Plunger Return Spring (49) out of the Shaft without elongating the Spring.

Disassembly of the Adjustable Cushion Clutch

1. Using a thin blade screwdriver, pry the Clutch Adjusting Nut Stop (80) off the end of the Clutch Shaft (68).
2. Insert the tip of a #1 Phillips Head Screwdriver into the adjustment opening between the Clutch Adjusting Nut (79) and the Clutch Adjusting Nut Washer (78). Rotate the screwdriver clockwise to thread the Adjustment Nut off the Clutch Shaft.

NOTICE

In the following step, the Clutch Cam Balls will be free to fall from the assembly when the Cam Ball Seat is moved. Make certain the Balls fall into a non-damaging container.

3. Holding the assembly over a small pasteboard box, slide the Adjusting Nut Washer, the Thrust Bearing (77), the Spring Seat (76), the Clutch Spring (75) and the Cam Ball Seat (74) off the Clutch Shaft. Allow the eleven Clutch Cam Balls (72) to fall into the pasteboard box.
4. The Clutch Cam Ball Driver (71) has a cross hole that is larger on one side than the other. Insert a 1/16" drill shank or piece of wire into the smaller hole and gently push the Clutch Driver Retaining Pin (73) out of the larger hole and out of the Driver and the Clutch Shaft.

NOTICE

In the following step, the Clutch Balls will be free to fall from the assembly when the Cam Jaw is moved along the Clutch Shaft. Make certain the Balls fall into a nondamaging container.

5. Holding the assembly over a small pasteboard box, and using care to drop the twelve Clutch Balls (69) into the box, slide the Clutch Cam Ball Driver and Cam Jaw (70) off the Clutch Shaft. If grease held some of the Balls inside the jaw cavity, remove them.

Disassembly of the Gearing

1. Using snap ring pliers, remove the Gear Retainer (36) from the motor end of the Gear Case (43) and remove the Gear Head Spacer (37) as well.
2. For **Series QA1L02, QA1L05 and QA1L08**, lightly rap the motor end of the Gear Case on a wooden work bench top to remove the three Planet Gears (39), the Planet Gear Head Assembly (38) and the Planet Gear Head Spacer (41).
For **Series QA1L12 and QA1L18**, lightly rap the motor end of the Gear Case on a wooden work bench top to remove the three Planet Gears (39), the Gear Head Pinion (40), the Planet Gear Head Assembly (38) and the Planet Gear Head Spacer (41).
3. Using snap ring pliers, remove the Spindle Bearing Retaining Ring (45).
4. Stand the Gear Case on the table of an arbor press with the output spindle upward. Using a rod that neatly fits inside the internal hex of the Spindle (42), press the Spindle Assembly out of the Spindle Bearing (44).



CAUTION

Do not remove the Bearing in the following step unless you have a new replacement available for installation. The Bearing will be damaged by the removal process.

5. Invert the Gear Case on the table of an arbor press so that the end face having four notches makes contact with the table. Using a rod against the inner race of the Spindle Bearing, press the Bearing from the Gear Case.
6. If the Spindle Bearing Seat (45A) must be replaced, use a small, thin blade screwdriver to spiral it out of the groove in the Gear Case.

Disassembly of the Motor

1. Using snap ring pliers, remove the Rear End Plate Assembly Retainer (24) from the shaft of the Rotor (28).
2. Pull the Rear End Plate Face Plate (23) and Rear End Plate Assembly (22) off the hub of the Rotor.
3. Lift the Cylinder (25) from the Rotor.
4. Remove the Vanes (29) from the Rotor.
5. Support the Front End Plate Assembly (30), as near the rotor body as possible, on the table of an arbor press and press the Rotor from the Front Rotor Bearing (32). Remove the Bearing from the Front End Plate.

Disassembly of the Housing

1. Pull the Reverse Lever (20) off the inlet end of the Motor Housing (1).
2. Using a #2 Phillips Head Screwdriver, unscrew and remove the Housing Screw (3).
3. Insert a 5/16" wooden dowel between 6 and 8 inches long, into the inlet end of the Motor Housing and push the Reverse Valve Assembly (4) out the motor end of the Housing.
4. Use a hooked tool to pull the Housing O-ring (2) out of the Motor Housing.

Assembly

General Instructions

1. Always press on the **inner** ring of a ball-type bearing when installing the bearing on a shaft.
2. Always press on the **outer** ring of a ball-type bearing when pressing the bearing into a bearing recess.
3. Whenever grasping a tool or part in a vise, always use leather-covered or copper-covered vise jaws to protect the surface of the part and help prevent distortion. This is particularly true of threaded members and housings.
4. Except for bearings, always clean every part and wipe every part with a thin film of oil before installation.
5. Apply O-ring lubricant to all O-rings before final assembly.
6. Check every bearing for roughness. If an open bearing must be cleaned, wash it thoroughly in a clean, suitable cleaning solution and dry with a clean cloth. **Sealed or shielded bearings should never be cleaned.** Work grease into every open bearing before installation.

Assembly of the Housing

1. Lubricate the Housing O-ring (2) with O-ring lubricant and install it at the bottom of the cylinder bore in the Motor Housing (1).
2. Inspect the face of the Reverse Valve Assembly (4) and Reverse Valve Seal (5) for nicks or damage. Replace the Reverse Valve Assembly or Seal if any damage is evident.
3. Lubricate the Seal on the hub of the Reverse Valve Assembly with O-ring lubricant and insert the Assembly, Seal end leading, into the cylinder bore of the Motor Housing. Push the Assembly toward the bottom of the cylinder bore until it "snaps" into its proper location.
4. Rotate the Valve inside the Housing until the threaded hole into the side of the Valve for the Motor Housing Screw (3) aligns with the hole in the Motor Housing.
5. Using a #2 Phillips Head Screwdriver, thread the Motor Housing Screw into the Reverse Valve Assembly through the Housing until the underside of the screw head stops against the Housing. Back the Screw out of the Valve between 1/4 and 1/2 turn.
6. Align the open end of the slot inside the Reverse Lever (20) with the head of the Housing Screw. From the inlet end of the Housing, slide the Lever onto the Housing, making certain the screw head enters the slot, and move it along the Housing until it stops against the housing shoulder.
7. Rotate the Lever to make certain the Valve only has slight resistance.

Assembly of the Motor

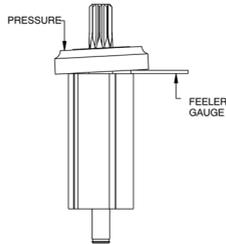
1. Place the Front End Plate (30) on the splined shaft of the Rotor (28) with the bearing recess away from the rotor body.
2. Place the Front Rotor Bearing (32) onto the shaft and using a sleeve or piece of tubing that contacts the inner race of the Bearing, press the Bearing onto the shaft until the Front End Plate nearly contacts the rotor body.

NOTICE

In the following step, the measurement must be made at the end corner of the large rotor body.

3. The clearance between the Front End Plate and Rotor is critical. While pressing down with your finger on the outer edge of the Front End Plate on the bearing side, insert a 0.004" (0.1 mm) feeler gauge between the face of the rotor body and the face of the End Plate at a point that is 180 degrees from where the pressure is applied. Refer to Dwg. TPA1740. To increase the gap, support the End Plate and lightly tap the rotor shaft with a plastic hammer; to decrease the gap, press the Bearing farther onto the rotor shaft.

Measurement of Front End Plate Clearance



(Dwg. TPA1740)

4. Wipe each Vane (29) with a light film of **Ingersoll Rand** No.10 Oil and place a Vane in each slot in the Rotor.
5. One end of the Cylinder Assembly (25) has a notch that breaks the outer wall and end face of the Cylinder. With that end trailing, install the Cylinder Assembly over the Rotor and Vanes against the Front End Plate. Make certain the Cylinder Front Alignment Pin (27) enters the hole in the Front End Plate.
6. Install the Rear End Plate Assembly (22), flat face leading, on the rear hub of the Rotor. Make certain the Cylinder Rear Alignment Pin (26) enters the hole in the Rear End Plate.
7. Examine the Rear End Plate Face Plate (23) for scratches. If it is scratched, replace it. If it is not, slide it onto the rear hub of the Rotor and onto the Cylinder Rear Alignment Pin against the Rear End Plate. Some pressure may be required to fit the hole in the Plate onto the Alignment Pin.
8. Using snap ring pliers, install the Rear End Plate Assembly Retainer (24) in the annular groove on the rear rotor hub to secure the assembly in position.
9. Set the assembled motor aside.

Assembly of the Gearing

1. Using a small screwdriver, work the Spindle Bearing Seat (45A) into the internal groove nearest the notched end of the Gear Case (43).
2. Stand the Gear Case, notched end upward, on the table of an arbor press. Using a piece of tubing that contacts the outer race of the Spindle Bearing (44), press a new Bearing into the Gear Case against the Seat.
3. Lubricate the gears in the Spindle Assembly (42) with **Ingersoll Rand** No. 67 Grease.
4. Invert the Gear Case and using another piece of tubing that supports the inner race of the Bearing and clears the output end of the Spindle Assembly, press the Spindle Assembly into the Bearing from the motor end of the Gear Case.
5. Using snap ring pliers, install the Spindle Bearing Retaining Ring (45) in the external groove near the driver end of the spindle.
6. Lightly lubricate the Planet Gear Head Spacer (41) with **Ingersoll Rand** No. 67 Grease and install it in the Gear Case against the Spindle Assembly.
7. Lubricate the shafts of the Planet Gear Head Assembly (38) with **Ingersoll Rand** No. 67 Grease and install the Gear Head in the Gear Case meshing the spline on the shaft with the gear teeth in the Spindle Assembly.
8. **For Series QA1L02, QA1L05 and QA1L08**, lubricate the Planet Gears (39) with **Ingersoll Rand** No. 67 Grease and install them on the shafts of the Planet Gear Frame Assembly.
For Series QA1L12 and QA1L18, lubricate the Planet Gears (39) and Gear Head Pinion (40) with **Ingersoll Rand** No. 67 Grease and install the Planet Gears on the shafts of the Planet Gear Frame Assembly. Insert the Gear Head Pinion in the center of the Planet Gears making certain the teeth mesh.
9. Install the Gear Head Spacer (37) against the Gears and secure the assembly by using snap ring pliers to install the Gear Retainer (36) in the internal groove at the motor end of the Gear Case.

Assembly of the Adjustable Cushion Clutch

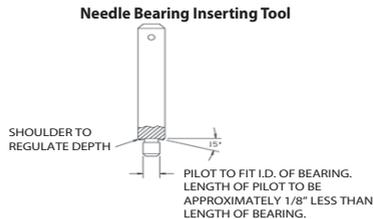
1. Insert the small end of the Clutch Shaft (68) into the end of the Cam Jaw (70) having the large opening and slide the Shaft about half way into the Jaw.
2. Drop the twelve Clutch Balls (69) into the Cam Jaw forming a ring around the Clutch Shaft.
3. Lay a bead of **Ingersoll Rand** No. 28 Grease, approximately 2 to 3 cc, on top of the Clutch Balls and then bring the Clutch Shaft and Cam Jaw together capturing the Balls between them.
4. While holding the Shaft and Jaw together, slide the Clutch Cam Ball Driver (71), large end leading, onto the Clutch Shaft until it is against the Cam Jaw.
5. Rotate the Driver to align the large hole through one wall of the Driver with the comparable size opening of the cross hole through the Clutch Shaft. Push the Clutch Cam Ball Driver Retaining Pin (73) into the hole to lock the Driver in position on the Clutch Shaft.
6. Apply a coating of **Ingersoll Rand** No. 28 Grease to each of the eleven Clutch Cam Balls (72).
7. Holding the assembled Clutch Shaft with the Clutch Cam Ball Driver upward, insert a lubricated Ball into each of the eleven ball pockets in the Driver.
8. Slide the Cam Ball Seat (74), large end leading, onto the Shaft against the Balls. Follow with the Clutch Spring (75), Spring Seat (76), Thrust Bearing (77) and the Clutch Adjusting Nut Washer (78) with the smooth face leading.
9. Thread the Clutch Adjusting Nut (79), smooth face trailing, onto the Clutch Shaft.
10. Insert the tip of a #1 Phillips Head Screwdriver into the adjustment opening between the Clutch Adjusting Nut and the Clutch Adjusting Nut Washer. Rotate the screwdriver counterclockwise and thread the Adjustment Nut onto the Clutch Shaft until the external groove for the Clutch Adjusting Nut Stop (80) is visible.
11. Install the Nut Stop in the groove.

Assembly of the Adjustable Shutoff Clutch

1. Hold the Clutch Shaft (52) in your hand with the large end upward.
2. Insert the Automatic Shutoff Plunger Return Spring (49) into the central opening in the large end of the Clutch Shaft. Use a 1/8" dowel to push the Spring below the cross hole for the Automatic Shutoff Pin (50).
3. Insert the Automatic Shutoff Pin Spring (51) in the end hole of the Automatic Shutoff Pin opposite the pointed end. Rotate the Spring a little to keep it in the hole.
4. Drip one or two drops of **Ingersoll Rand** No. 10 Oil into the central hole with the Plunger Return Spring.
5. Position the Shutoff Pin, Spring leading, in the cross hole on the large end of the Clutch Shaft with the hole in the Shutoff Pin aligned with the central hole containing the Return Spring.
6. Push on the pointed end of the Shutoff Pin to depress the Spring while inserting the Automatic Shutoff Plunger (48) into the central opening with the Return Spring. The smaller center portion of the Shutoff Plunger will allow the Shutoff Pin to spring outward and capture the components within the Clutch Shaft when properly positioned.
7. Insert the small end of the Clutch Shaft into the end of the Cam Jaw (54) having the large opening and slide the Shaft about half way into the Jaw.
8. Drop the twelve Clutch Balls (53) into the Cam Jaw forming a ring around the Clutch Shaft.
9. Lay a bead of **Ingersoll Rand** No. 28 Grease, approximately 2 to 3 cc, on top of the Clutch Balls and then bring the Clutch Shaft and Cam Jaw together capturing the Balls between them.
10. While holding the Shaft and Jaw together, slide the Clutch Cam Ball Driver (55), large end leading, onto the Clutch Shaft until it is against the Cam Jaw.
11. Rotate the Driver to align the large hole through one wall of the Driver with the comparable size opening of the cross hole through the Clutch Shaft. Push the Clutch Cam Ball Driver Retaining Pin (57) into the hole to lock the Driver in position on the Clutch Shaft.
12. Apply a coating of **Ingersoll Rand** No. 28 Grease to each of the three Clutch Cam Balls (56).
13. Holding the assembled Clutch Shaft with the Clutch Cam Ball Driver upward, insert a lubricated Ball into each of the three ball slots in the Driver.
14. Slide the Cam Ball Seat (58), large end leading, onto the Shaft against the Balls. Follow with the Clutch Spring (59), Spring Seat (60), Thrust Bearing (61) and the Clutch Adjusting Nut Washer (62) with the smooth face leading.
15. Thread the Clutch Adjusting Nut (63), smooth face trailing, onto the Clutch Shaft.
16. Insert the tip of a #1 Phillips Head Screwdriver into the adjustment opening between the Clutch Adjusting Nut and the Clutch Adjusting Nut Washer. Rotate the screwdriver counterclockwise and thread the Adjustment Nut onto the Clutch Shaft until the external groove for the Clutch Adjusting Nut Stop (64) is visible.
17. Install the Nut Stop in the groove.

Assembly of the Angle Head

1. For **TRL154 Angle Heads**, if the Spindle Upper Bearing (102) was removed, stand the output end of the Angle Head (100) on the table of an arbor press. Using a Needle Bearing Inserting Tool as shown in Dwg. TPD786, press the Bearing into the small opening at the top of the Angle Head until the trailing end of the Bearing is 1/8" below the surface of the Angle Head. Press the Spindle Upper Bearing Cap (103) into the Angle Head against the Bearing.



(Dwg. TPD786)

- For **TRL2H4, TRL2Q4, TRL2S4 and TRL2S6 Angle Heads**, if the Spindle Upper Bearing (102) was removed, stand the output end of the Angle Head (100) on the table of an arbor press. Pressing against the closed end of a new Bearing, press the Bearing into the small opening until the trailing end is flush with the outside surface of the Angle Head.
2. Apply a light film of Ingersoll Rand No. 67 Grease to the shaft of the Bevel Pinion (107) and to the inside of the Pinion Front Bearing (108).
3. Slide the Pinion Front Bearing, stamped end trailing, onto the shaft until it stops against the back of the gear.
4. Without distorting the Angle Head, support the hex flats of the Angle Head in a machine vise on the table of an arbor press with the notched end upward and the Head resting on a solid stop. Apply 2 to 4 cc of Ingersoll Rand No.67 Grease to the gear on the end of the Bevel Pinion.
5. Insert the gear end of the Bevel Pinion into the notched end of the Angle Head while aligning the Pinion Front Bearing with the central opening.
6. For **TRL2S4, TRL2S6, TRL2Q4 and TRL2H4 Angle Heads**, use a piece of tubing that clears the shaft of the Bevel Pinion and the inner wall of the Angle Head and press the Bearing into the Angle Head against the stop. For **TRL154 Angle Heads**, use a piece of tubing that clears the shaft of the Bevel Pinion and the inner wall of the Angle Head and is between 1.455" and 1.465" (36.95 and 37.21 mm) long to press the Bearing into the Angle Head. Press the Bearing until the trailing end of the pressing tube is flush with the notched end of the Angle Head.
7. Apply some Ingersoll Rand No. 67 Grease to the Pinion Rear Bearing (109) and slide it onto the shaft of the Bevel Pinion and into the Angle Head recess.

8. Use the 9/16" hex stock with clearance for the bevel pinion shaft that was used during disassembly to screw the Angle Head Plug (106) into the Angle Head against Pinion Rear Bearing. Tighten the Plug between 8 and 12 ft-lbs. (10.8 and 16.2 Nm) torque.
9. Remove the assembly from the machine vise and position it in leather-covered or copper-covered vise jaws with the opening for the output spindle upward.
10. **For TRL2H4, TRL2Q4, TRL2S4 and TRL2S6 Angle Heads**, stand the Spindle (113) on the table of an arbor press and using a piece of tubing that clears the shaft of the Spindle and contacts the inner ring of the Spindle Lower Bearing (112), press the Bearing onto the shaft of the Spindle until it stops against the shoulder.
11. **For TRL2H4, TRL2Q4, TRL2S4 and TRL2S6 Angle Heads**, in the same manner press the Bevel Gear (110), flat end leading, onto the hex portion of the spindle shaft. Likewise, press the Bevel Gear Retainer (111) onto the spindle shaft until it stops against the gear face.
For TRL1S4 Angle Heads, if the Spindle Upper Bearing Shaft (116) was removed, stand the square drive end of the Spindle (113) on the table of an arbor press. One end of the Shaft has a bevel and the other end is rounded. Press the Shaft, bevel end leading, into the gear end of the Spindle until the rounded end protrudes between 0.250" and 0.260" (6.35 and 6.60 mm) above the face of the gear.
12. **For TRL1S4 Angle Heads**, slide the Spindle Lower Bearing (112) onto the shaft of the Spindle against the gear and insert the assembled Spindle, gear end leading, into the Angle Head. Push the Bearing into the housing below the threads. For TRL2H4, TRL2Q4, TRL2S4 and TRL2S6 Angle Heads, insert the assembled Spindle, output end trailing, into the Angle Head. Disassembly of the Motor Housing.

NOTICE

The thread in the following step is a left-hand thread. Rotate the wrench counterclockwise to tighten the Cap.

13. **For TRL2S4, TRL2S6, TRL2Q4 and TRL2H4 Angle Heads**, thread the Lower Spindle Bearing Cap (117) into the Angle Head and using the Spindle Bearing Cap Wrench (Part No. 141A12-26), tighten the Cap between 8 and 12 ft-lbs. (10.8 and 16.2 Nm) torque.
For TRL1S4 Angle Heads, thread the Lower Spindle Bearing Cap (117) into the Angle Head and using a spanner wrench, tighten the Cap between 8 and 12 ft-lbs. (10.8 and 16.2 Nm) torque.
14. **For TRL1S4, TRL2S4 and TRL2S6 Angle Heads**, install the Spindle Detent (114) into position through the end of the Spindle and push the Detent Retainer (115), tapered end leading, into the end of the Spindle.
For TRL2Q4 Angle Heads, place the Spindle Detent (114) into the hole in the groove of the Spindle. Spread the Detent Retainer (115) and install it on the Spindle to capture the Detent. For TRL2H4 Angle Heads, install the Spindle Detent (114) in the internal groove in the Spindle.
15. Remove the assembly from the vise jaws and slide the Coupling Nut (104), threaded end trailing, onto the notched end of the Angle Head. Move the Nut far enough onto the housing to install the Coupling Nut Retainer (105) in the annular groove at the notched end of the Angle Head.

Assembly of the Tool

1. Lightly grasp the flats at the inlet end of the Motor Housing (1) in leather-covered or copper-covered vise jaws with the motor bore upward.
2. Grasp the spline of the Rotor (28) in the assembled motor and after aligning the End Plate Alignment Pin (31) with the internal notch in the motor end of the housing bore, insert the assembled motor into the Motor Housing. Make certain the motor is far enough into the Housing to have the undercut below the internal housing thread visible.
3. Lubricate the Motor Seal (33) with O-ring lubricant and install it around the Front End Plate (30) and into the undercut in the Housing.
4. Align the tab of the Motor Clamp Washer (34) with the internal notch in the Housing and install it over the rotor hub and End Plate Alignment Pin against the Motor Seal. Make certain the Pin enters the hole in the Washer and the Washer is flat against the Seal.
5. Apply some **Ingersoll Rand** No. 67 Grease to the spline on the rotor shaft.
6. Thread the assembled Gear Case (43), output spindle trailing, into the Motor Housing and using a 1-1/16" wrench, tighten the joint between 15 and 20 ft-lbs. (20 and 27 Nm) torque.
7. **For Models with a Clutch**, place the narrow end of the Clutch Return Spring (46 or 65) in the Gear Case against the inner race of the Spindle Bearing (44).
8. **For Models with a Clutch**, place the hex drive end of the Clutch Input Driver (47 or 66) on the Spring and compress the Spring until the hex on the Driver enters the hex recess in the Spindle Assembly (42). While holding the Driver in position, engage the raised bar on the face of the Driver with the jaw of the Cam Jaw (54 or 70).

NOTICE

The following step has parts with a left-hand thread. Rotate the components counterclockwise to tighten them.

9. **For Models with a Clutch**, install the Clutch Housing (81) over the clutch components and thread it onto the Gear Case. Using a 1/16" wrench on the flats of the Gear Case and the Clutch Housing Spanner Wrench (Part No. TRH-478) in the clutch housing slot, tighten the joint between 15 and 20 ft-lbs. (20 and 27 Nm) torque.
10. Invert the assembled tool in the vise jaws and lightly grasp the flats on the Gear Case with the inlet end of the tool upward.
11. Insert a 5/8" dowel through the opening in the Back Cap (7), and using the dowel as an alignment device, install the three Muffler Elements (9) in the cavity of the Back Cap. Make certain the notches in the outer edge of the Elements fit over the memory chip pocket in the bottom of the Cap.
12. If the tool is equipped with a Memory Chip (10), install it (with the leads entering first) in the pocket at the bottom of the Back Cap.
13. Make certain the tab on the inside edge of the Back Cap Gasket (8) is aligned with the pocket for the Memory Chip and install the Gasket, metal face leading, in the recess of the Back Cap against the face with the cavity containing the Muffler Elements.
14. Position the gasket end of the alignment dowel against the inlet hub on the Motor Housing. Align the flats on the Cap with the flats on the Housing. Orient the Back Cap and slide the Back Cap Assembly off the alignment dowel and onto the Motor Housing.
15. **For all Models with a Shutoff Clutch**, install the Push Rod (35) into the central hole in the inlet hub. The Rod will enter the assembled motor and disappear from view when released. Install the Shutoff Valve (21), small end first, in the same opening.
16. Being careful not to damage it, insert the Throttle Valve Seat (13) into the central opening at the inlet end of the Motor Housing at an angle until it clears the threads in the Housing. Using a rod with a flat end and no sharp edges, push the Seat to the bottom of the opening until it seats flush.

17. Using needle nose pliers, insert the Throttle Valve (14), long stem leading, into the opening against the Seat. Center the Valve in the Seat.
18. Install the Throttle Valve Spring (15) in the opening so that it encircles the Valve.
19. The Exhaust Diffuser (16) has one slot that is longer than the other five slots. The Back Cap has a short, molded stud projecting from the inlet end. Place the Exhaust Diffuser against the Back Cap with the long slot encircling the molded stud. Rotate the Diffuser counterclockwise until the wall of the slot stops against the stud. The exhaust ports are now in the full open position which will provide maximum free speed.
20. If the Inlet Screen (19) required replacement, use a wooden dowel to carefully push a new one into the Inlet Bushing (17).
21. If the Inlet Bushing Seal (18) is nicked or damaged, carefully install a new one over the threads of the Inlet Bushing.
22. Thread the Inlet Bushing Assembly through the Diffuser and Back Cap into the Motor Housing. Using a 1-3/16" wrench on the flats of the Back Cap to keep it from turning, tighten the Inlet Bushing between 15 and 20 ftlbs. (20 and 27 Nm) torque.
23. The Throttle Plunger (6) has a lengthwise flat on the outer edge at one end of the Plunger. Insert the Plunger, flat end first, into the cross hole in the Housing. Push on the end of the Plunger to make certain it springs back from contact with the stem of the Throttle Valve.
24. Position the Throttle Lever (11) in the slot in the Back Cap and Motor Housing and using a 1/16" diameter rod, align the holes through the Back Cap, Motor Housing and Throttle Lever. While maintaining alignment, install the Throttle Lever Pin (12) in place of the rod by tapping it through all three pieces.
25. Remove the tool from the vise jaws and install the Grip Assembly (88), internal slotted end leading, over the Clutch Housing or Gear Case. Engage the slots in the Grip Assembly with the notches on the Motor Housing (1).
26. **For Models with a Clutch**, proceed as follows:

NOTICE

The thread in the following step is a left-hand thread. Rotate the Nut counterclockwise to tighten it.

- a. Thread the Grip Retaining Nut (82) onto the Clutch Housing to secure the Grip Assembly. Use a pin type spanner wrench to tighten it until the Grip is not loose.
 - b. If the Cover O-ring (84) inside the Clutch Adjusting Hole Cover (83) is worn or damaged, replace it and install the Cover on the Clutch Housing.
 - c. Install the large end of the Angle Wrench Drive Adapter (85) on the hex end of the Clutch Shaft (52 or 68).
 - d. Slide the Drive Adapter Bearing (86) onto the small end of the Adapter and into the bearing recess in the Clutch Housing.
27. Position the Housing Lock Spacer (87) in the Clutch Housing or Gear Case with the tabs of the Spacer going into the notch openings.

NOTICE

The thread in the following step has a left-hand thread. Rotate the Nut counterclockwise to tighten it.

28. **For Models without a Clutch**, install the Grip Spacer (91) against the Grip and orient the assembled Angle Head to the desired position. Insert the notched end of the Angle Head into the Gear Case to engage the tabs of the Spacer. Thread the Coupling Nut (104) onto the Gear Case and tighten it between 2 and 5 ft.-lbs. (2.7 and 6.8 Nm) torque.

For Models with a Clutch, orient the assembled Angle Head to the desired position and insert the notched end of the Angle Head into the Clutch Housing to engage the tabs of the Spacer. While compressing the Clutch Return Spring (46 or 65) with the Angle Head, thread the Coupling Nut (104) onto the Clutch Housing and tighten it between 2 and 5 ft.-lbs. (2.7 and 6.8 Nm) torque.

Testing the Tool

Before placing the tool back in service, test the tool in a run down application to determine if adjustments are necessary to satisfactorily perform the operation. Since a number of interrelated adjustments can affect tool performance, only experience, along with trial and error, can dictate which adjustment or combination of adjustments will provide the desired results.

The Clutch Spring (59 or 75), the clutch adjustment procedure, the exhaust flow, the length of the Push Rod (35) and the length of the Shutoff Valve (21) can individually or collectively have an effect on torque and/or speed. Always try to make adjustments before replacing or attempting to modify components.

If adjustments are unable to provide the desired torque, it may be necessary to install a lighter or heavier Clutch Spring.

If the tool ratchets when operated but fails to shutoff, it may be necessary to shorten the Push Rod. Only shorten the Push Rod in small increments. Increments between 0.005" and 0.010" (0.13 and 0.25 mm) are recommended. If the tool stalls and does not shutoff, runs slower than normal or has low power, the Shutoff Valve may require lengthening.

To lengthen the Shutoff Valve, grasp the stem between two pieces of rubber or other non-slip, non-marring material and rotate the molded nut counterclockwise. Rotating the nut one half revolution will lengthen the Valve approximately 0.009" (0.23 mm). **Should the stem of the Valve become bent, marred, nicked or damaged in any way during the adjustment process, replace it.**

Troubleshooting Guide

Trouble	Probable Cause	Solution
Loss of Power	Low air pressure	Check air supply. For top performance, the air pressure must be 90 psig (6.2 bar/620 kPa) at the inlet.
	Plugged Inlet Bushing Screen	Clean the Inlet Bushing Screen using a clean, suit-able cleaning solution. If the Screen cannot be cleaned, replace it.
	Worn or broken Vanes	Replace a complete set of Vanes.
	Worn or broken Cylinder	Replace the Cylinder if it is cracked or if the bore appears wavy or scored.
	Exhaust control restricted	Make certain the Exhaust Diffuser against the Back Cap is in the fully open position.
	Shutoff Valve too short	Lengthen the Shutoff Valve. Refer to TESTING THE TOOL on page 7.
Motor won't run	Motor Clamp Washer binding	Remove the Gear Case make certain the Washer is flat and the Motor Seal is properly positioned.
	Gears binding	Clean and inspect all gearing. Replace any worn or damaged gearing.
	Push Rod worn	Install a new Push Rod.
Gear Case gets hot	Excessive grease	Clean and inspect Gear Case and gearing parts and lubricate as instructed.
	Worn or damaged parts	Clean and inspect the gear Case and Gearing. Replace worn or broken components.
Inconsistent disengagement of the Adjustable Clutch	Improper lubrication	Remove the Adjustable Clutch mechanism and examine the parts. Lubricate as instructed.
	Wrong Clutch Spring (using Heavy Clutch Spring on light torque application)	Change to Medium or Light Clutch Spring.
Motor stalls before Adjustable Clutch ratchets	Improper Clutch adjustment or improper tool ratio for application	Check Clutch Adjustment and review tool performance vs. requirements.
	Low pressure at the inlet	Check the air supply. For top performance, the air pressure must be 90 psig (6.2bar/620kPa) at the inlet.
	Insufficient grease	Lubricate the Clutch as instructed.
	Improper exhaust control adjustment	Adjust the exhaust flow to obtain the desired speed.
Tool ratchets before shutoff	Push Rod too long	Shorten the push Rod. Refer to TESTING THE TOOL on page 7.
Tool stalls without shutting off	Shutoff Valve too short	Lengthen the Shutoff Valve. Refer to TESTING THE TOOL on page 7.
Tool runs slower than normal	Shutoff Valve too short	Lengthen the Shutoff Valve. Refer to TESTING THE TOOL on page 7.

Related Documentation

For additional information refer to:

Product Safety Information Manual Form 04585006.

Product Information Manual Form 80167406.

Parts List Information Manual Form 16574519.

Manuals can be downloaded from ingersollrandproducts.com

Notes:

ingersollrandproducts.com

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