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Edition 2
May 2014

Air Drill

QA Series

Maintenance Information



Save These Instructions

IR *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 Manual when applicable (see under Related Documentation for form number).

Lubrication

Each time a Series QA Angle Drill 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 Spindle Assembly (41) and Angle Head Assembly (50 or 68).
2. 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.
3. Inject 2 or 3 drops of light oil into the oil hole in the Throttle Sleeve (123).

Speed Adjustment

Series QA Angle Drills are furnished with the ability to precisely control speed, within certain ranges. Setting the speed requires a tachometer. Although the adjustment is simple, only a competent technician using the proper equipment should attempt it.

The Back Cap (7) has a small, molded stud on the end face of the Cap nearest the Exhaust Diffuser (16). Take an initial reading of

the tool speed by applying a tachometer to the end of the Chuck (66) or Spindle (63 or 76) without a drill bit and with the Lever (11) completely depressed. If the tachometer has a concave tip, close the Chuck completely; if the tip is convex, open the Chuck completely.

After determining the actual velocity, shut off the air supply and disconnect the airline. Use a 3/4" wrench to loosen the Inlet Bushing (17). 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 airline 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 vise 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 new gaskets and O-rings for replacement.

Disassembly of the Tool

Each Series QA Angle Drill is composed of four modules including a housing and throttle unit, a motor unit, a combined gearing with spindle unit and an angle head unit. The tool can be disassembled for repairs to each individual unit without disturbing the other units. To separate the modules, proceed as follows:

1. Remove the Chuck (66) using the following technique:
 - a) Insert the short leg of a 1/4" hex wrench into the jaws of the Chuck and tighten the Chuck.
 - b) Using a brass hammer, sharply rap the long leg of the wrench in a counterclockwise direction to loosen the Chuck.
 - c) Unscrew and remove the Chuck from the spindle.
2. Lightly grasp the body portion of the Angle Head (50 or 68) in copper-covered or leather-covered vise jaws in a manner that provides access to the Coupling Nut (54 or 70).

NOTICE

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

3. Using a wrench on the flats of the Coupling Nut, loosen the Coupling Nut and then remove the tool from the vise jaws.
4. 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 (49) from the Angle Head or Gear Case (42).
5. Remove the Grip Spacer (49A) and pull the Grip Assembly (46) off the Gear Case.
6. For large and 45° angle heads, remove the Shaft Coupler (49B) from the Bevel Pinion (57 or 72) or the Spindle (41).
7. Lightly grasp the flats of the Motor Housing in leather covered or copper-covered vise jaws with the Inlet Bushing (17) upward
- 8' Place a 1-3/16" 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.
9. Lift the Exhaust Diffuser (16) off the Back Cap.
10. 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.
11. If the Throttle Valve Seat (13) is damaged and must be replaced, insert a hooked tool through the central opening of the Seat and pull it from the Motor Housing.
12. Using a 1/16" pilot punch, tap the Throttle Lever Pin (12) out of the Back Cap and remove the Throttle Lever (11).
13. Pull the Throttle Plunger (6) out of the Motor Housing and remove the assembly from the vise.
14. Holding the assembly horizontally, remove the Back Cap, the Memory Chip (10) (if included with the tool), and the Back Cap Gasket (8).

- If the Muffler Elements (9) need to be cleaned or replaced, pull them out of the Back Cap.
- 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 Gear Case, unscrew and remove the Gear case from the Motor Housing.
- Set the assembled Gear Case on the workbench.
- Remove the Motor Clamp Washer (33) and the Motor Seal (32) from the assembled motor in the Housing.
- Tap the Motor Housing on a block of wood to remove the motor assembly from the Motor Housing.

Disassembly of the TRL4M24 Angle Head

- Carefully grasp the assembled Angle Head in leather - covered or copper-covered vise jaws with the Coupling Nut Retainer (55) upward.

NOTICE

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

- Insert a piece of flat stock into the slots of the Coupling Nut Retainer for leverage, and unscrew and remove the Retainer.
- Lift the Coupling Nut (54) off the Angle Head (50).
- Pull the assembled Bevel Pinion (57) out of the Angle Head.
- Pull the Pinion Rear Bearing (59) off the shaft of the Bevel Pinion.
- Use a thin blade screwdriver to pry the Bearing Spacer Retainer (58B) out of the groove on the shaft of the Bevel Pinion and slide the Bearing Spacer (58A) off the Bevel Pinion.
- Pull the Pinion Front Bearing (58) off the shaft of the Bevel Pinion.
- Reposition the Angle Head in the vise jaws with the Spindle Assembly (60) upward.

NOTICE

The thread in the following step is a left-hand thread. Rotate the Bearing Cap counterclockwise to loosen it.

- Using a wrench on the flats of the Bearing Cap, unscrew and remove the Lower Spindle Bearing Cap (65).
- Pull the Spindle Assembly out of the Angle Head.
- Install a bearing separator between the Bevel Gear Retainer (61A) and the Bevel Gear (61) and press the Spindle Assembly out of the Retainer.
- Lift the Bevel Gear and Bevel Gear Spacer (61B) off the shaft of the Spindle.
- Pull the Spindle Lower Bearing (61C) off the shaft of the Spindle.
- Remove the Angle Head from the vise jaws.
- If the Spindle Upper Bearing (52) must be replaced, press the Bearing out the end of the Angle Head opposite the spindle end.

Disassembly of the TRL1F40, TRL1F28 and TRL1P45

Angle Heads

- Slide the Coupling Nut (54) toward the output end of the Angle Head (50) and using a thin blade screwdriver, work the Coupling Nut Retaining Ring (55) out of the groove in the Angle Head. Slide the Coupling Nut off the Angle Head.
- 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 (57) and a 9/16" wrench, unscrew and remove the Angle Housing Plug (56).
- To pull the assembled Bevel Pinion out of the Angle Head, proceed as follows:
 - Gather together a 1/2" square drive socket that would be used for a nut that is larger than one inch and an 8-32 UNC socket head cap screw that is one half inch longer than the socket. In addition, a nut for the Screw and a flat washer that is larger than the socket with a hole that is smaller than the nut, yet is thick enough to withstand some pressure, are also necessary. A wrench for the nut and a hex wrench for the screw are also required.
 - Thread the nut onto the cap screw until it stops against the

screw head.

- To restrict the rotation of the small angle head Spindle (63), thread a 1/4"-28 thread bolt into the Spindle or insert a rod into the collet and clamp the bolt or rod into a vise with the motor end upward.
- Place the square drive end of the socket against the notched end of the Angle Head.
- 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.
- Thread the nut along the cap screw until it contacts and holds the flat washer against the Angle Head.
- 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.
- Slide the Pinion Rear Bearing (59) and Pinion Front Bearing (58) off the Bevel Pinion.
- 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 Bearing Cap counterclockwise to loosen it.

- Use a fixed or adjustable face spanner wrench to unscrew and remove the Lower Spindle Bearing Cap (65).
- Pull the assembled Spindle out of the Angle Head.
- Slide the two Spindle Lower Bearings (62) off the Spindle.
- To remove the Spindle Upper Bearing Shaft (64), stand the gear end of the Spindle on a block with clearance for the Shaft. Insert a 1/8" round rod into the opening in the output end of the Spindle and using an arbor press, press the Shaft out of the Spindle.
- If the Spindle Upper Bearing (52) must be replaced, press the Bearing and Spindle Upper Bearing Cap (53) out the end of the Angle Housing opposite the spindle end.

Disassembly of the TRL3F40, TRL3F28 and TRL3P45

Angle Heads

- Carefully grasp the assembled Angle Head (68) in leather-covered or copper-covered vise jaws with the Coupling Nut Retainer (71) upward.

NOTICE

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

- Using a wrench on the flats of the Pinion Housing (75) to prevent it from turning, and placing a piece of flat stock into the slots of the Coupling Nut Retainer for leverage, unscrew and remove the Retainer.
- Lift the Coupling Nut (70) off the Angle Head (68).

NOTICE

The thread in the following step is a left-hand thread. Rotate the Pinion Housing counterclockwise to loosen it.

- Using a wrench on the flats of the Pinion Housing, unscrew and remove the Housing from the Angle Head.
- Grasp the gear end of the Bevel Pinion (72) in coppercovered vise jaws and, being careful not to drop the Pinion Rear Bearing (74), pull the Housing off the Pinion.
- Pull the Pinion Rear Bearing out of the Pinion Housing and the Pinion Front Bearing (73) off the shaft of the Bevel Pinion.
- Reposition the Angle Head in the vise jaws with the Lower Spindle Bearing Cap (79) upward.

NOTICE

The thread in the following step is a left-hand thread. Rotate the Lower Spindle Bearing Cap counterclockwise to loosen it.

- Using a wrench on the flats of the Bearing Cap, loosen, but do not remove, the Lower Spindle Bearing Cap.
- Remove the Angle Head from the vise jaws and while holding it over a pasteboard container, unscrew and remove the Bearing Cap. Make certain the eleven Lower Spindle Bearing Cap Balls (78) fall into the container and not onto a hard surface.
- Pull the Spindle (76) out of the Angle Head and pull the Spindle Lower Bearing (77) off the shaft of the Spindle.

Disassembly of the Gearing

- Using snap ring pliers, remove the Gear Retainer (34) from inside the Gear Case (42) and remove the Gear Head Spacer (35).
- For Series QA27 and QA35, and models QA2139, QA2159, QA2119, QA2129, QA1719, and QA1729, lightly rap the motor end of the Gear Case on a wooden work bench top to remove the Planet Gear Head Drive Plate (36), Planet Gear Head Assembly (37) and the Planet Gear Head Spacer (40). For Series QA05, QA083 and QA085, lightly rap the motor end of the Gear Case on a wooden work bench top to remove the three Planet Gears (38), the Planet Gear Head Assembly (37) and the Planet Gear Head Spacer (40). For Series QA081, QA12, QA173, QA175, and QA082, and models QA2134 and QA2154, lightly rap the motor end of the Gear Case on a wooden work bench top to remove the three Planet Gears (38), the Gear Head Pinion (39), the Planet Gear Head Assembly (37) and the Planet Gear Head Spacer (40).
- Using snap ring pliers, remove the Spindle Bearing Retaining Ring (44).
- 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 (41), press the Spindle Assembly out of the Spindle Bearing (43).

NOTICE

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

Assembly

General Instructions

- Always press on the inner ring of a ball-type bearing when installing the bearing on a shaft.
- Always press on the outer ring of a ball-type bearing when pressing the bearing into a bearing recess.
- 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.
- Except for bearings, always clean every part and wipe every part with a thin film of oil before installation.
- Apply O-ring lubricant to all O-rings before final assembly.
- 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. Lubricate all open bearings with grease before installation.

Assembly of the Housing

- 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).
- Inspect the face and Reverse Valve Seal (5) on the hub of the Reverse Valve Assembly (4) for nicks or damage. Replace the Reverse Valve Assembly or Seal if any damage is evident.
- Lubricate the Reverse Valve Seal with O-ring lubricant and insert the Assembly, seal end leading, into the cylinder bore of the

- Invert the Gear Case on the table of an arbor press so that the end face having the 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.
- If the Spindle Bearing Seat (45) must be replaced, use a small, thin blade screwdriver to spiral it out of the groove in the Gear Case.

Disassembly of the Motor

- If the motor was not removed from the Housing (1) when the tool was disassembled, slide the Motor Clamp Washer (33) off the shaft of the Rotor (27) and remove the Motor Seal (32).
- Tap the Motor Housing on a block of wood to remove the motor assembly from the Motor Housing.
- Using snap ring pliers, remove the Rear End Plate Assembly Retainer (23) from the shaft of the Rotor.
- Pull the Rear End Plate Face Plate (22) and Rear End Plate Assembly (21) off the hub of the Rotor.
- Using a piece of leather or other type of protective material, grasp the shaft of the Rotor and pull the Rotor out of the Cylinder (24). Remove the Vanes (28) from the Rotor.
- Support the Front End Plate Assembly (29), as near the rotor body as possible, on the table of an arbor press and press the Rotor from the Front Rotor Bearing (31). Remove the Bearing from the Front End Plate.

Disassembly of the Housing

- Pull the Housing Plug Cover (20) off the inlet end of the Motor Housing (1).
- If the Housing Plug (3) does not drop out of the Housing when the Cover is removed, tap the inlet end of the Housing on a block of wood to dislodge the Plug from the Housing.
- 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.
- Use a hooked tool to pull the Housing O-ring (2) out of the Motor Housing.

- Motor Housing. Push the Assembly toward the bottom of the cylinder bore until it "snaps" into its proper location.
- Rotate the Valve inside the Housing until the threaded hole into the side of the Valve aligns with the hole for the Housing Plug (3) in the side of the Motor Housing.
- Insert the pin end of the Housing Plug into the hole in the Reverse Valve and fit the remainder of the Plug into the recess in the Motor Housing.
- While holding the Plug in position, from the inlet end of the Housing, slide the Housing Plug Cover (20) onto the Housing. Make certain it captures the Plug when it moves along the Housing and stops against the housing shoulder.

Assembly of the Motor

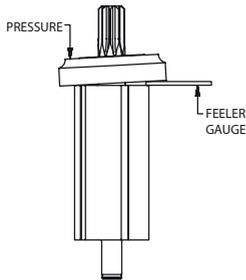
- Place the Front End Plate (29) on the splined shaft of the Rotor (27) with the bearing recess away from the rotor body.
- Place the Front Rotor Bearing (31) onto the shaft and using a sleeve or piece of tubing that makes contact with the inner race of the Bearing, press the Bearing onto the shaft until 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.

- The clearance between the Front End Plate and Rotor is critical. While pressing downward with your finger on the outer edge of

the Front End Plate on the bearing side of the End Plate, 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 away 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.



(Dwg. TPA1740)

- Wipe each Vane (28) with a light film of Ingersoll Rand No.10 Oil and place a Vane in each slot in the Rotor.
- One end of the Cylinder Assembly (24) 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 (26) enters the hole in the Front End Plate.
- Install the Rear End Plate Assembly (21), flat face leading, on the rear hub of the Rotor. Make certain the Cylinder Rear Alignment Pin (25) enters the hole in the Rear End Plate.
- Examine the Rear End Plate Face Plate (22) 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.
- Using snap ring pliers, install the Rear End Plate Assembly Retainer (23) in the annular groove on the rear rotor hub to secure the assembly in position.
- Set the assembled motor aside.

Assembly of the Gearing

- Using a small screwdriver, work the Spindle Bearing Seat (45) into the internal groove nearest the notched end of the Gear Case (42).
- 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 (43), press a new Bearing into the Gear Case against the Seat.
- Lubricate the gears in the Spindle Assembly (41) with Ingersoll Rand No. 67 Grease.
- 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.
- Using snap ring pliers, install the Spindle Bearing Retainer (44) in the external groove near the drive end of the spindle.
- Apply some Ingersoll Rand No. 67 Grease to the Planet Gear Head Spacer (40) and the shafts of the Planet Gear Head Assembly (37).
- Insert the Planet Gear Head Spacer (39) and Planet Gear Head Assembly (36), spline hub leading, into the open end of the Gear Case.
- For Series QA05, QA08, QA12, QA173 and QA175, and models QA2134 and QA2154, apply Ingersoll Rand No. 67 Grease to the three Planet Gears (38) and install them on the shafts of the Planet Gear Head Assembly.
- For Series QA081, QA12, QA082, QA173, and QA175, and models QA2134 and QA2154, apply Ingersoll Rand No. 67 Grease to the Gear Head Pinion (39) and while meshing the gear teeth, insert it

in the opening between the three Planet Gears.

- For Series QA27 and QA35, and models QA2119, QA2129, QA2139, QA2159, QA1719, and QA1729, install the Planet Gear Head Drive Plate (36) on the shafts of the Planet Gear Head Assembly.
- Place the Gear Head Spacer (35) in the Gear Case and secure the assembly by using snap ring pliers to install the Gear Retainer (34) in the annular groove inside the Gear Case.

Assembly of the TRL4M24 Angle Head

- If the Spindle Upper Bearing (52) was removed, position the spindle end of the Angle Head (50) on the table of an arbor press. Press a new Bearing into the Head until it is flush with the top of the housing.
- Install the Spindle Lower Bearing (61C), followed by the Bevel Gear Spacer (61B) and the Bevel Gear (61), gear end trailing, onto the shaft of the Spindle (60).
- Using a piece of tubing that clears the shaft of the Spindle, press the Bevel Gear Retainer (61A) onto the shaft to secure the assembly.
- Insert the assembled Spindle into the Angle Head making certain that shaft of the Spindle enters the Spindle Upper Bearing.

NOTICE

The thread in the following step is a left-hand thread. Rotate the Bearing Cap clockwise to tighten it.

- Thread the Spindle Bearing Cap (65) into the Angle Head and tighten it.
- The location of the Pinion Front Bearing (58) on the Bevel Pinion (57) is critical. Using a sleeve that clears the front bearing inner race shaft and is between 0.595" and 0.605" (15.1 and 15.3 Nm) long, push the Bearing onto the shaft of the Pinion until the trailing end of the sleeve is flush with the end of the front bearing inner race shaft.
- Slide the Bearing Spacer (58A) onto the Bevel Pinion and install the Bearing Spacer Retainer (58B) in the annular groove on the shaft of the Bevel Pinion.
- Apply approximately 1/8 oz. (3.5 g) of Ingersoll Rand No. 67 Grease to the gear end of the Bevel Pinion and insert the assembly into the Angle Head.
- Install the Pinion Rear Bearing (59) over the shaft of the Bevel Pinion and push the Bearing into the Angle Head recess against the shoulder of the Pinion. Apply pressure to the outer race of the Bearing.
- Install the Coupling Nut (54) with the internal threaded end trailing, on the Angle Head.

NOTICE

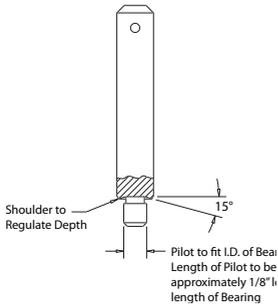
The thread in the following step is a left-hand thread. Rotate the Coupling Nut Retainer clockwise to tighten it.

- Thread the Coupling Nut Retainer (55) into the Angle Head and tighten it.

Assembly of the TRL1F40, TRL1P45 and TRL1F28 Angle Heads

- If the Spindle Upper Bearing (52) was removed, stand the output end of the Angle Head (50) 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.

Needle Bearing inserting Tool



(Dwg. TPD786)

2. Apply a light film of Ingersoll Rand No. 67 Grease to the shaft of the Bevel Pinion (57) and to the inside of the Pinion Front Bearing (58).
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. 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 (59) 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 (56) 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. If the Spindle Upper Bearing Shaft (64) was removed, stand the output end of the Spindle (63) 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.
11. Slide the Spindle Lower Bearing (62) 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.
12. Thread the Lower Spindle Bearing Cap (65) into the Angle Head and using a spanner wrench, tighten the Cap between 18 and 20 ft.-lbs. (24.4 and 27.1 Nm) torque.
13. Remove the assembly from the vise jaws and slide the Coupling Nut (54), 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 (55) in the annular groove at the notched end of the Angle Head.

Assembly of the TRL3F40, TRL3P45 and TRL3F28 Angle Heads

1. Push the Spindle Lower Bearing (77) onto the shaft of the Spindle

(76) against the gear head.

2. Apply some grease to the annular groove on the shaft of the Spindle. Position the output end of the shaft inside the Lower Spindle Bearing Cap (79) with the leading edge of the shaft groove slightly below the end of the Cap. Insert the eleven Lower Spindle Bearing Cap Balls (78) into the shaft groove and when all the Balls are in position, allow the Cap to move forward on the Spindle to capture the Balls between the Cap and shaft.

NOTICE

The thread in the following step is a left-hand thread. Rotate the Spindle Bearing Cap clockwise to tighten it.

3. Insert the assembled Spindle into the output end of the Angle Head (68) and thread the Spindle Bearing Cap into the housing. Using a wrench on the flats of the Bearing Cap, tighten the Cap in the Angle Head.
4. Slide the Pinion Front Bearing (73) onto the shaft of the Bevel Pinion (72) until it is against the gear head.
5. Insert the hex end of the Bevel Pinion into the small end of the Pinion Housing (75). Apply 2 to 4 cc of Ingersoll Rand No. 67 Grease to the gear end of the Bevel Pinion.

NOTICE

The thread in the following step is a left-hand thread. Rotate the Pinion Housing clockwise to tighten it.

6. Insert the gear end of the Bevel Pinion into the Angle Head and thread the Pinion Housing into the Angle Head. Using a wrench on the flats of the Pinion Housing, tighten the joint.
7. Install the Pinion Rear Bearing (74) over the shaft of the Bevel Pinion and push the Bearing into the Pinion Housing recess until it stops. Apply pressure to the outer race of the Bearing.
8. Install the Coupling Nut (70) with the internal threaded end trailing, on the Pinion Housing.

NOTICE

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

9. Thread the Coupling Nut Retainer (71) into the Pinion Housing and tighten it.

Assembly of the Tool

1. Lightly grasp the flats on the Motor Housing (1) in leather covered or copper-covered vise jaws with the inlet end of the tool upward.
2. 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.
3. 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.
4. 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.
5. 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.
6. 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 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 and will provide maximum free speed.
7. 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.
8. Using needle nose pliers, insert the Throttle Valve (14), long stem leading, into the opening against the Seat. Center the Valve in the Seat.
 9. Install the Throttle Valve Spring (15) in the opening so that it encircles the Valve.
 10. If the Inlet Screen (19) required replacement, use a wooden dowel to carefully push a new one into the Inlet Bushing (17).
 11. If the Inlet Bushing Seal (18) is nicked or damaged, carefully install a new one over the threads of the Inlet Bushing.
 12. 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.
 13. 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.
 14. 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.
 15. Remove the assembled Housing from the vise jaws. 16. Lightly grasp the flats of the Motor Housing in leathercovered or copper-covered vise jaws with the motor bore upward.
 17. Grasp the spline of the Rotor (27) in the assembled motor and after aligning the End Plate Alignment Pin (30) 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.
 18. Lubricate the Motor Seal (32) with o-ring lubricant and install it around the Front End Plate (29) and into the undercut in the Housing.
 19. Align the tab of the Motor Clamp Washer (33) 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.
 20. Apply some Ingersoll Rand No. 67 Grease to the spline on the rotor shaft.
 21. Thread the assembled Gear Case (42) and Spindle Assembly (41), gear case end leading, 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.
 22. Install the Housing Grip (46), internal slotted end leading, over the motor and Housing and engage the slots in the Grip with the projections on the Housing.
 23. Position the Housing Lock Spacer (49) in the Gear Case with the tabs of the Spacer going into the notch openings.
 24. For models with TRL4M24, TRL3F40 and TRL3F28 angle heads, insert the external hex of the Shaft Coupler (49B) into the hex recess in the Spindle Assembly (41).

NOTICE

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

25. Orient the assembled Angle Head to the desired position and insert the notched end of the Angle Head into the Gear Case to engage the tabs of the Spacers. Make certain the external hex of the Bevel Pinion (57 or 72) enters the hex recess of the Shaft Coupler (49B) or Spindle Assembly (41). Thread the Coupling Nut (54) EN-7 16572653_ed1 EN onto the Gear Case and tighten it between 2 and 5 ft-lbs. (2.7 and 6.8 Nm) torque.
26. For large angle heads, remove the tool from the vise jaws and thread the Chuck (66) onto the Spindle. For small angle heads, remove the tool from the vise jaws.
27. Check the free speed of the tool using a tachometer and following the instructions in the SPEED ADJUSTMENT section of this manual.

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, suitable, cleaning solution. If the Screen cannot be cleaned, replace it.
	Worn or broken Vanes.	Replace the complete set of Vanes.
	Worn or broken Cylinder.	Replace the Cylinder if it is cracked or if the bore appears wavy or scored.
Motor won't run	Exhaust control restricted.	Make certain the Exhaust Diffuser is in the fully open position.
	Motor Clamp Washer binding.	Remove the Gear Case make certain the Washer is flat and Motor Seal is properly positioned.
Leaky Throttle Valve	Gear binding.	Clean and inspect all gearing. replace any worn or damaged gearing.
	Worn Throttle Valve and/or Throttle Valve Seat.	Install a new Valve and/or a Seat
	Dirt accumulation on Throttle Valve and/or Throttle Valve Seat.	Clean or replace the Throttle Valve and /or Throttle Valve Seat.
Gear Case gets hot	Excessive grease.	Clean and inspect the 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.

Related Documentation

For additional information refer to:
 Air Drill Product Safety Information Manual Form 04580353.
 Air Drill Product Information Manual Form 16572158.
 Air Drill Parts List Manual Form 16572778.

Manuals can be downloaded from ingersollrandproducts.com

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