

BRUKSANVISNING / USER MANUAL

4800 Series Multi Vane Air Motors Operation Maintenance 03523545

Ingersoll Rand 4800D · 4800K · 4800M · 4800P · 4800Q · 4800U · +8

Originaldokument: Ingersoll Rand

Tillhandahålls av Professional Technologies Sweden AB

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Service · Kalibrering · Originalreservdelar

Service · Calibration · Genuine spare parts



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MULTI-VANE® Air Motors

4800 Series Non-Reversible

4840 Series Reversible

Operation and Maintenance Information

EN Operation and Maintenance Information

ZH 操作和维护信息



Save These Instructions

 **Ingersoll Rand**

WARNING**General Product Safety Information**

- **Read and understand this manual before operating this product.**
- **It is your responsibility to make this safety information available to others that will operate this product.**
- **Failure to observe the following warnings could result in injury.**

WARNING

- Always operate, inspect and maintain this motor in accordance with American National Standards Institute Safety Code for Portable Air Tools (ANSI B186.1).
- For safety, top performance and maximum durability of parts, operate this motor at 90 psig (6.2 bar/620 kPa) air pressure at the inlet with 3/4" (19 mm) air supply hose.
- Always turn off the air supply and disconnect the air supply hose before installing, removing or adjusting any accessory on this motor or before performing any maintenance on this motor.
- Do not use damaged, frayed or deteriorated air hoses and fittings.
- Keep hands, loose clothing and long hair away from rotating end of motor.
- Always wear eye protection when operating or performing maintenance on this motor.
- Always wear hearing protection when operating this motor.
- Anticipate and be alert for sudden changes in motion during start up and operation of any motor.
- Motor shaft may continue to rotate briefly after throttle is released.
- Do not lubricate motor with flammable or volatile liquids such as kerosene, diesel or jet fuel.
- Do not remove any labels. Replace any damaged label.
- Use accessories recommended by **Ingersoll Rand**.
- This motor is not designed for working in explosive atmospheres.
- This motor is not insulated against electric shock.

NOTICE

- The use of other than genuine **Ingersoll Rand** replacement parts may result in safety hazards, decreased Motor performance and increased maintenance, and may invalidate all warranties.
- **Ingersoll Rand** is not responsible for customer modification of motors for applications on which **Ingersoll Rand** was not consulted.
- Repairs should be made only by authorized, trained personnel. Consult your nearest **Ingersoll Rand** Authorized Service centre.
- It is the responsibility of the employer to place the information in this manual into the hands of the operator.

Safety Symbol Identification

Wear Respiratory
Protection



Wear Eye
Protection



Wear Hearing
Protection



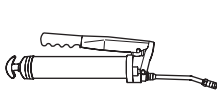
Read Manuals Before
Operating Product

(Dwg. MHP2598)

Safety Information - Explanation of Safety Signal Words

 DANGER	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
 WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
 CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or property damage.
NOTICE	Indicates information or a company policy that relates directly or indirectly to the safety of personnel or protection of property.

Placing Tool in Service Lubrication



Ingersoll Rand No. 50



Ingersoll Rand No. 28

Always use an air line lubricator with this motor.

We recommend the following Filter-Lubricator-Regulator Unit: No. C28-04-FKG0-28

Where the lubricator cannot be permanently mounted, use

Ingersoll Rand No. 3LUB8 Lubricator.

We recommend the use of an air line lubricator in the air supply line. Attach the unit as close to the tool as practical. For permanent installations, we recommend using an **Ingersoll Rand C28-04-FKG0-28 Filter-Lubricator-Regulator Unit**. These units have 1/2" pipe tap inlet and outlet. The 3LUB8 has 1/6 pt. (79 ml) capacity; the C28-04-FKG0-28 has 11 oz (180 ml) capacity. Larger capacity units may be used, but do not use a unit having less than 1/2" pipe tap inlet and outlet.

After each 40,000 cycles or one month, whichever occurs first, inject 1.5 cc of **Ingersoll Rand No. 28 Grease** into the Grease Fitting (60).

Direction of Spindle Rotation

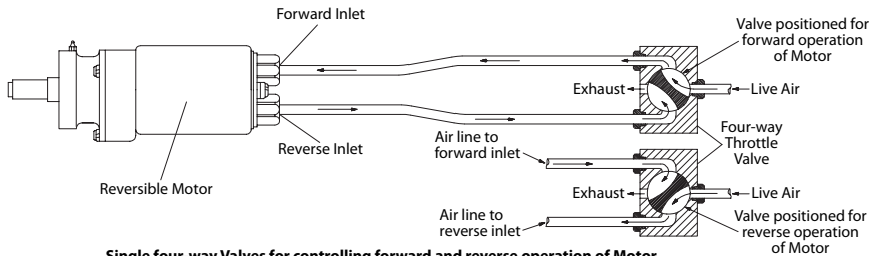
Series 4800 Non-reversible Motors can be assembled so that the Spindle rotates either clockwise or counter-clockwise. To reverse the direction of the spindle rotation:

1. Remove the motor assembly from the Motor Housing (10).
2. Remove one End Plate and Bearing assembly from the motor.

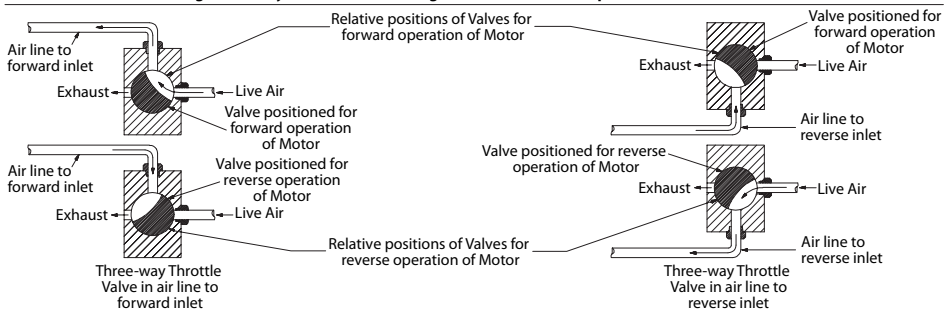
3. Lift the Cylinder (19) from the Rotor (17), turn it end for end, and slide it back over the Rotor.
4. Install the End Plate and Bearing assembly on the Rotor Hub and install the assembled motor in the Housing.
5. Remove the three Backhead Cap Screws (11) and rotate the Backhead (2) and Backhead Gasket (3) 120° so that the cavity in the face of the Backhead is in alignment with the alternate set of holes in the back face of the Motor Housing. When the Backhead is correctly applied, the cavity will be over the letter "F" for counterclockwise spindle rotation (when facing the end of the Spindle), and over the letter "R" for clockwise rotation. The rotational direction of an assembled Non-reversible Series 4800 Motor can be determined by removing the Air Strainer (1) and looking through the tapped opening to see whether the letter "F" or letter "R" is visible. Apply the Backhead on Series 4840 Reversible Motors so that each inlet port aligns with a group of three holes through the housing rear wall.

NOTICE

A four-way Throttle Valve (whether manually, remotely, or automatically controlled) must be used in the air supply line to Series 4840 reversible motors, as one motor inlet is expelling secondary exhaust air, and therefore must be open to atmosphere whenever the opposite inlet is admitting live air to the motor. The use of any throttle valve that closes or restricts the secondary exhaust line will result in sufficient back pressure to drastically reduce the speed and power of the motor. When the application requires a separate Throttle Valve in each air line, the two three-way valves must be used.



Single four-way Valves for controlling forward and reverse operation of Motor



Two three-way Valves for controlling forward and reverse operation of Motor

(Dwg. TPB176)

Parts and Maintenance

When the life of the motor has expired, it is recommended that the motor be disassembled, degreased and parts be separated by material so that they can be recycled.

Manuals can be downloaded from www.irttools.com.

Refer all communications to the nearest **Ingersoll Rand** Office or Distributor.

警告**通用产品安全信息**

- 操作本产品前请阅读并理解本手册。
- 您有责任为其他操作该产品的人员提供本安全信息。
- 不按照以下警告进行操作将可能导致人员受伤。

警告

- 请始终按照美国国家标准协会便携式气动工具安全标准 (ANSI B186.1) 操作、检查和维护该马达。
- 为确保使用安全并达到最佳性能和零部件的最长使用寿命，在操作马达时，进口处的气压应为 90psig(6.2巴/620kPa)，并使用规格为 3/4" (19 毫米) 的气源软管。
- 请务必在安装、拆卸或调节马达零件或进行任何维修之前，关闭气源并断开气源软管。
- 切勿使用已损坏、磨损或老化的空气软管及其连接件。
- 保持手、宽松衣服和长发远离马达旋转端。
- 在操作或维修马达时，务必戴上防护眼镜。
- 在操作马达时，务必戴上听力保护装置。
- 在马达启动时和操作过程中，注意马达转速的突变情况。
- 节流阀释放后，马达轴在短时间内仍会继续旋转。
- 请勿使用易燃、易爆液体如煤油、柴油或喷气燃料润滑马达。
- 请勿撕掉任何标签。请更换任何受损的标签。
- 请使用 **Ingersoll Rand** 推荐配件。
- 该马达的设计不适用于爆炸性气体。
- 该马达没有防电击绝缘装置。

注意

- 如果使用非 **Ingersoll Rand** 原装配件，将可导致安全危害、并会降低马达性能、增加维修次数，还会导致所有保证失效。
- 用户如未经咨询 **Ingersoll Rand** 而擅自对马达应用进行改动，**Ingersoll Rand** 不承担任何责任。
- 维修须由授权并经过培训的专业人员进行。请就近垂询 **Ingersoll Rand** 授权维修中心。
- 雇主有责任将本手册的信息提供给操作人员。

安全标识识别

配戴呼吸保护装置



配戴防护眼镜



配戴听力保护装置



操作产品前，请阅读手册

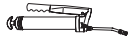
(图 MHP2598)

安全信息：安全信号文字说明

危险	表示不采取措施将会导致严重伤害甚至死亡的隐患。
警告	表示不采取措施可能会导致严重伤害甚至死亡的隐患。
小心	表示不采取措施可能会导致轻微或中度伤害或财产损失的隐患。
注意	表示与人身安全或财产保护有直接或间接关联的信息或公司政策。

安装在工具

润滑油



Ingersoll Rand 50 号



Ingersoll Rand 28 号

请始终对本马达使用空气管路润滑器。

我们推荐使用下列过滤润滑调节器装置：

C28-04-FKG0-28 号

在不能永久安装润滑器的地方，请使用**Ingersoll Rand 3LUB8** 号润滑器。

我们在供气管路中使用空气管路润滑器。将该装置尽可能靠近工具连接。需要永久安装时，我们推荐使用

Ingersoll Rand C28-04-FKG0-28 过滤润滑调节器装置。这些装置有 1/2" 管活栓进口和出口。3LUB8 的容量为1/6 品脱 (79 毫升)；C28-04-FKG0-28 的容量为11盎司 (180 毫升)。可以使用更大容量的装置，但不要使用管活栓进口和出口小于 1/2" 的装置。

每运行 **40,000 转** 或一个月（以先发生的为准），注入 1.5 cc 的 **Ingersoll Rand 28 号** 润滑脂到润滑脂嘴(60)内。

轴的旋转方向

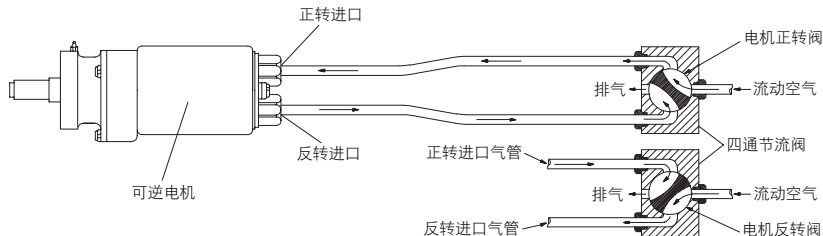
可以组装 4800 系列不可逆转马达，轴可以顺时针旋转或逆时针旋转。要使轴反转：

1. 从马达机座 (10) 上拆下马达组件。

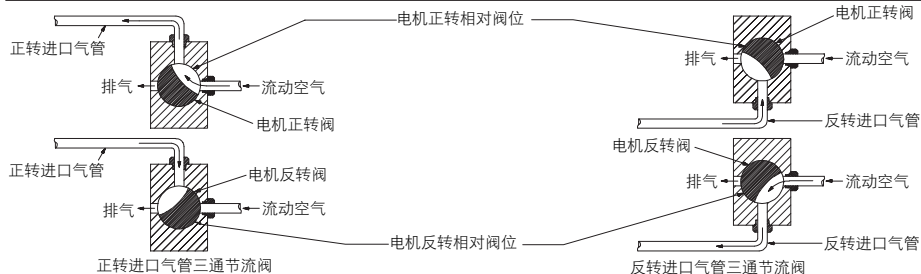
2. 从马达上拆下端盖和轴承。
3. 将缸体 (19) 从转子 (17) 上抬起，将其两端对调，然后再将其装回转子。
4. 在转子轮毂上安装端板和轴承组件，并将组装好的马达安装到机座中。
5. 拆下 3 颗背头带帽螺丝 (11)，将背头 (2) 和背头垫圈 (3) 转动 120°，使背头面上的孔槽与马达机座后面的一组错位孔对齐。如背头安装正确，则当孔槽位于字母 “F” 上方时，为逆时针轴旋转（面向轴端），位于字母 “R” 上方时，为顺时针轴旋转。组装后的 4800 系列不可逆转马达旋转方向可以通过拆下空气过滤器 (1)，从锥形开口内看到是字母 “F” 或 “R” 来确定。将背头安装在 4840 系列可逆转马达上，每个进气端口通过机座后壁与三个孔位组对齐。

注 意

由于其中一个马达进气口要排出二次废气，因此必须将一个四通节流阀（无论是手动、遥控或自动控制）装在通向 4840 系列可逆转马达的供气管路中，当相反的进气口将空气吸入马达时，该四通阀必须与大气相通。如果使用关闭或限制二次排气管线的节流阀，将导致很大的反压，大大降低了马达的速度和功率。当应用中要求在每根气管中使用单独的节流阀时，必须使用两个三通阀。



一个控制电机正转和反转的四通阀



两个控制电机正转和反转的三通阀

(图 TPB176)

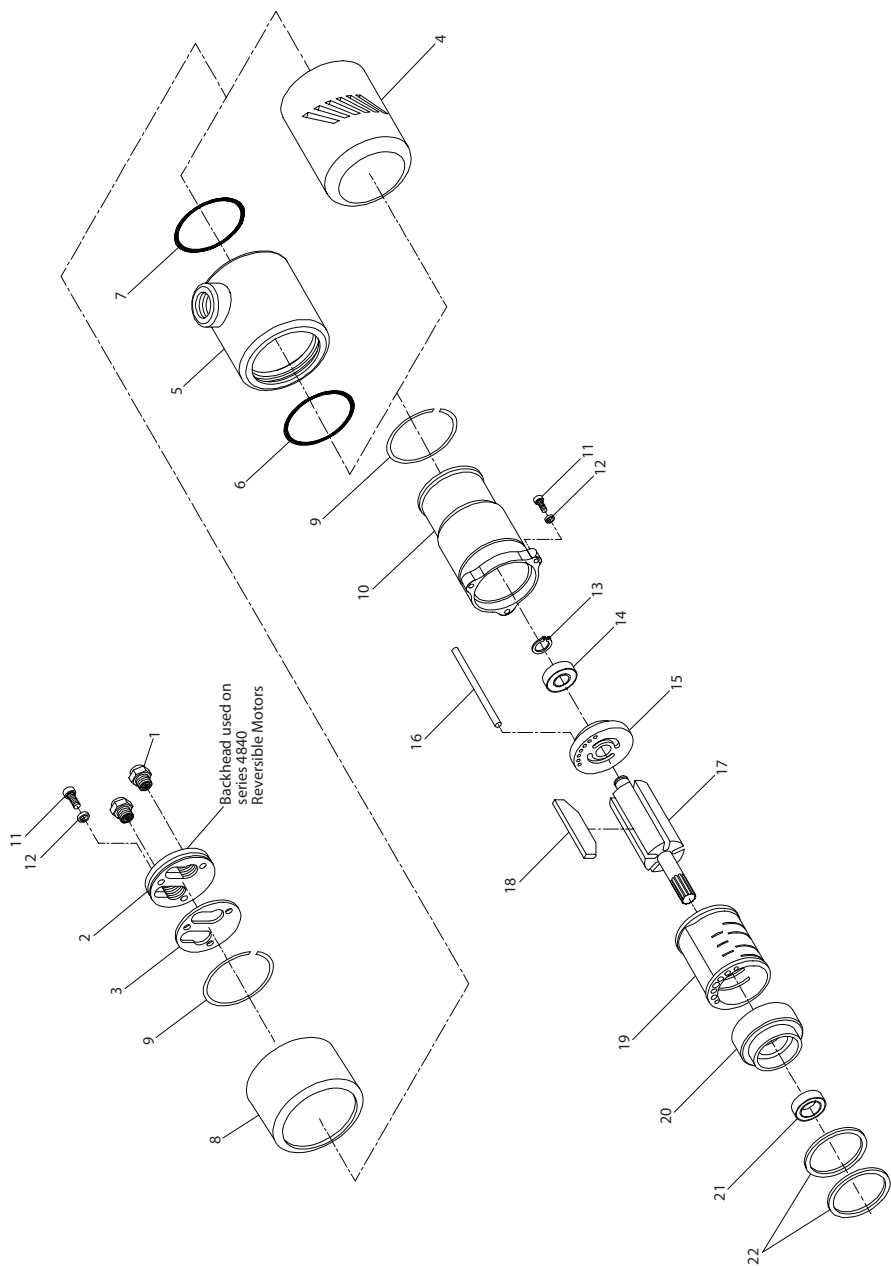
部件和维护

当马达寿命到期时，应将马达拆卸并去脂，零件按材料分开以进行回收。

手册可从 www.irttools.com 下载。

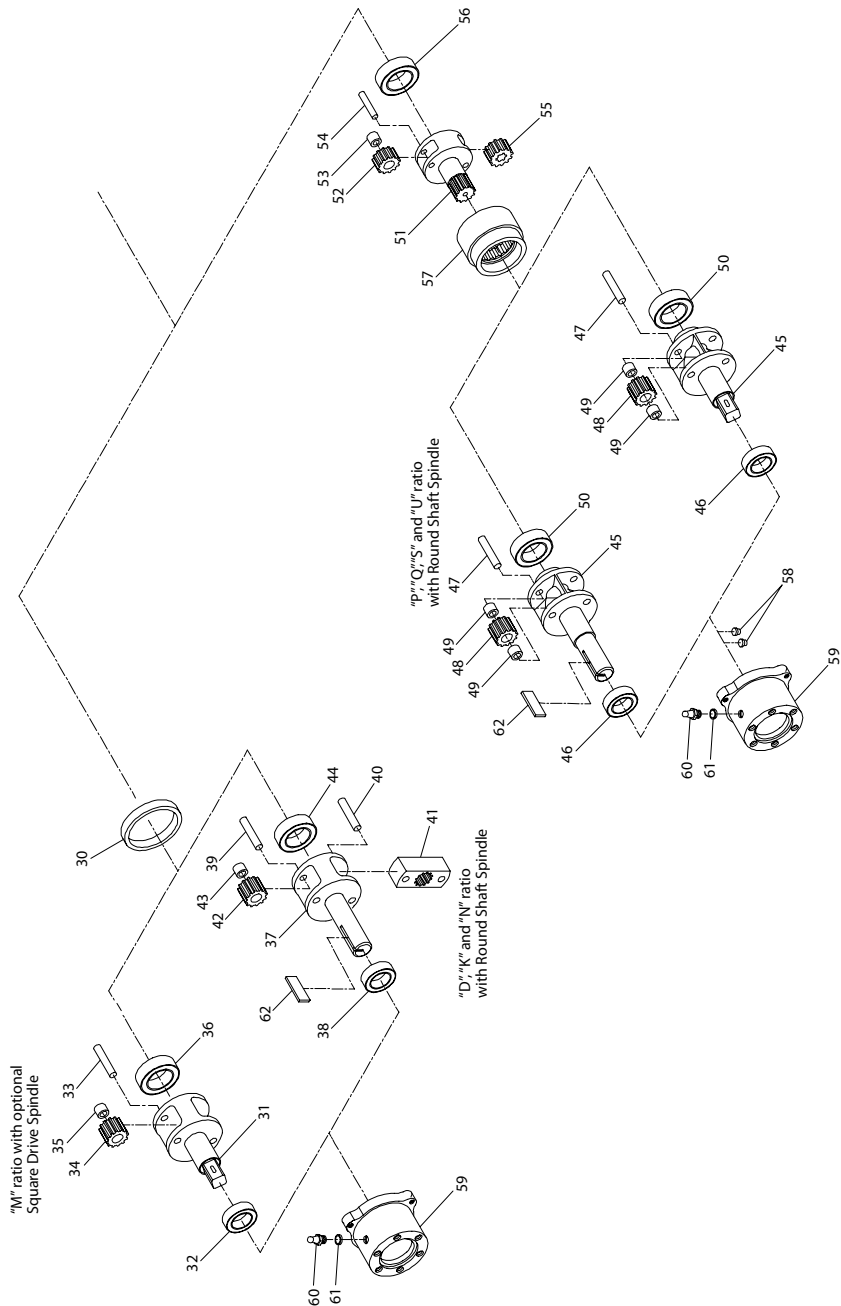
如有任何事宜，请就近垂询 **Ingersoll Rand** 办事处或经销商。

Air Motor Exploded Diagram



(Dwg. TPB1028)

Air Motor Exploded Diagram



(Dwg. TPA1349-1)

Air Motors Parts List

Item	Part Description	Part Number	Item	Part Description	Part Number
1	Air Strainer (1 for non-reversible models; 2 for reversible models)	R4800-565	• 43	Spindle Planet Gear Bearing (for N ratio) (3)	R4800-654
2	Backhead		44	Spindle Rear Bearing (for D, K or N ratio)	W44-97
	for non-reversible models	R4800-102		Spindle Assembly	
	for reversible models	R4840-102		Round Keyed Shaft (standard for P, Q or S ratio)	R4800P-A108
• 3	Backhead Gasket			Round Keyed Shaft (standard for U ratio)	R4801U-A108
	for non-reversible models	R4800-283		3/4" Square Drive Shaft (optional for P, Q or S ratio)	R4800P-A8
	for reversible models	R4840-283		3/4" Square Drive Shaft (optional for U ratio)	R4801U-A8
4	Exhaust Deflector (with slotted front exhaust) (standard)	R4800-23		1" Square Drive Shaft (optional for U ratio)	R4801U-A208
	Exhaust Deflector Assembly (with 1" pipe tap exhaust) (optional)	R4800-A123	45	Spindle	
5	Exhaust Deflector	R4800-123		Round Keyed Shaft (standard for P, Q or S ratio)	R4800P-108
• 6	Deflector Front Seal	R4800-210		Round Keyed Shaft (standard for U ratio)	R4801U-108
• 7	Deflector Rear Seal	M0V003AA-739		3/4" Square Drive Shaft (optional for P, Q or S ratio)	R4800P-8
8	Muffler	R4800-175		3/4" Square Drive Shaft (optional for U ratio)	R4801U-8
9	Exhaust Deflector Retaining Ring (2)	R4800-323		1" Square Drive Shaft (optional for U ratio)	R4801U-208
10	Motor Housing	R4800-40		for all P, Q or S ratio spindles	R4800-510
11	Cap Screws (6)	5080-638		for all U ratio spindles	MR-988
12	Lock Washer (6)	8U-58	• 46	Spindle Front Bearing	
13	Rear Rotor Bearing Retainer	R4800-119		for all P, Q or S ratio spindles	R4800-510
• 14	Rear Rotor Bearing	R2-24A		for all U ratio spindles	MR-988
• 15	Rear End Plate	R4800-12	47	Spindle Planet Gear Shaft	
16	Cylinder Dowel	R4800-98		for all P, Q, or S ratio spindles	R4800-190
17	Rotor			for all U ratio spindles	R4801U-191
	for D, M, P or S ratios (9 teeth)	R4800M-53	48	Spindle Planet Gear (3)	
	for K ratio (14 teeth)	R4800K-53		for all P, Q or S ratio spindles (16 teeth)	R4800P-9
	for N ratio (6 teeth)	R4900N2-53		for all U ratio spindles (18 teeth)	R4801U-A9
	for Q ratio (13 teeth)	R4901-53	• 49	Spindle Planet Gear Bearing (2 for each Gear)	
	for U ratio (7 teeth)	R4800U-53		for all P, Q or S ratio spindles	WWU10-510
• 18	Vane Packet (set of 5 Vanes)	R4800-42-5		for all U ratio spindles	R4801U-510
19	Cylinder		• 50	Spindle Rear Bearing	R4800-97
	for non-reversible models	R4800-3		Gear Head Assembly	
	for reversible models	R4840-3		for P ratio	R4800P-A216
• 20	Front End Plate	R4800-11		for Q ratio	R4800Q-A216
• 21	Front Rotor Bearing	R3H-24		for S ratio	R4800S-A216
22	Motor Retaining Washer (2)	R4800-81		for U ratio	R4801U-A216
30	Motor Retaining Ring (for D, K, M or N ratio)	R4800-118	51	Gear Head	
	Spindle Assembly			for P ratio	R4800P-216
	Round Keyed Shaft (standard for M ratio)	R4800M-A108		for Q ratio	R4800Q-216
	5/8" Square Drive Shaft (optional for M ratio)	R4800M-A8		for S ratio	R4800S-216
31	Spindle			for U ratio	R4801U-216
	Round Keyed Shaft	R4800M-108	52	Gear Head Planet Gear (2)	
	5/8" Square Drive	R4800M-8		for P ratio	R4800P-10
• 32	Spindle Front Bearing	R4800-510		for Q ratio	R4800Q-10
33	Spindle Planet Gear Shaft (2)	R4800-191		for S ratio	R4800S-10
34	Spindle Planet Gear (31 teeth) (2)	R4800M-9		for U ratio	R4801U-10
• 35	Spindle Planet Gear Bearing (1 for each Gear)	R4800-654	• 53	Gear Head Planet Gear Bearing (1 for each Gear)	R4800-654
• 36	Spindle Rear Bearing	W44-97	54	Gear Head Planet Gear Shaft	R4800-191
37	Spindle (round keyed shaft)		55	Rotor Pinion (for P ratio only)	R4800-17
	for D ratio	R4800M-108	• 56	Gear Head Bearing	W44-97
	for K ratio	R4800K-108	57	Internal Gear (for P, Q, S or U ratio)	R4800-406
	for N ratio	R4800N-108	58	Internal Gear Key (for P, Q, S or U ratio) (2)	R4800-407
• 38	Spindle Front Bearing (for D, K or N ratio)	R4800-510	59	Gear Case	
39	Spindle Planet Gear Shaft (for K or N ratio) (3)	R4800-191		for D, K, M or N ratio	R4800M-37
40	Spindle Drive Plate Shaft (for D ratio) (2)	R4800-191		for P, Q or S ratio	R4800P-37
41	Spindle Drive Plate (for D ratio)	R4800M-171		for U ratio	R4801U-37
42	Spindle Planet Gear (for N ratio) (33 teeth) (3)	R4900N2-9	60	Grease Fitting	R1-188
42	Spindle Planet Gear (for K ratio) (29 teeth) (3)	R4800K-10	61	Grease Fitting Washer	R3-92A
• 43	Spindle Planet Gear Bearing (1 for each Gear)	R4800-654	62	Spindle Key	107-54

- To keep downtime to a minimum, it is desirable to have on hand certain repair parts. We recommend that you stock one (pair on set) of each part indicated by a bullet (•) for every four tools in service.

Maintenance Section



WARNING

Always use protective eyewear when performing maintenance on a motor or operating a motor.

Always turn off the air supply and disconnect the air supply line before installing, removing or adjusting any accessory on this motor, or before performing maintenance on this motor. Failure to do so could result in injury.

Disassembly

General Instructions

1. Do not disassemble the motor any further than necessary to replace or repair damaged parts.
2. 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.
3. Whenever grasping a motor or part in a vise, always use leather-covered or copper-covered vise jaws to protect the surface of the part or motor and help prevent distortion. This is particularly true of threaded members and housings.
4. When removing the Planet Gear Shafts 33, 39, 40 or 47), support the motor end of the assembly and press the Shafts out toward the motor end. The shaft holes through the web are slightly tapered so that the Shafts have a tighter fit in the front web.
5. Do not press any needle bearing from a part unless you have a new needle bearing on hand for installation. Needle bearings are always damaged during the removal process.

Disassembly of the Motor

1. Unscrew and remove one Air Strainer (1) for non-reversible models and two Air Strainers for reversible models from the Backhead (2).
2. Using a 3/16" hex wrench, unscrew and remove the three Backhead Cap Screws (11), Lock Washers (12) and separate the Backhead from the Motor Housing (10). Remove the Backhead Gasket (3).
3. **For Standard Exhaust models**, slide the Exhaust Deflector (4) with the Muffler (8) off the Motor Housing. **For Piped-Away Exhaust Models**, slide the Exhaust Deflector (5) and Muffler (8) off the Motor Housing and remove the Exhaust Deflector Front Seal (6) and Exhaust Deflector Rear Seal (7) from the grooves inside the Exhaust Deflector.
4. Using a 3/16" hex wrench unscrew and remove the three Gear Case Cap Screws (11) and Lock Washers (12).
5. Separate the assembled Gear Case (59) from the Motor Housing and set the assembled Gear Case aside.
6. **For D, K, M or N ratio motors**, remove the Motor Spacer (30) and two Motor Retaining Washers (22). **For all other models**, remove the two Motor Retaining Washers (22).
7. Grasp the pinion of the Rotor (17) and pull the assembled motor out of the Motor Housing. It may be necessary to gently tap the face of the Motor Housing with a plastic hammer to jar the assembly free.
8. Grasp the Cylinder (19) in one hand and using a plastic hammer, sharply rap the spline on the end of the Rotor to remove the Front End Plate (20) and Front Rotor Bearing (21) which will free the Cylinder and Vanes (18). Remove the Cylinder Dowel (16).
9. Jar the Front Rotor Bearing out of the Front End Plate by bumping the End Plate on a wooden block.
10. Using snap ring pliers, remove the Rear Rotor Bearing Retainer (13) from the hub of the Rotor and remove the Rear Rotor Bearing (14) and Rear End Plate (15).

Disassembly of the Gearing

1. **For P, Q, S or U ratio**, grasp the Gear Head Bearing (56) and pull the assembled Gear Head (51) out of the Gear Case (59).
2. **For P, Q, S or U ratio**, using a bearing puller, pull the Gear Head Bearing off the rear hub of the Gear Head.

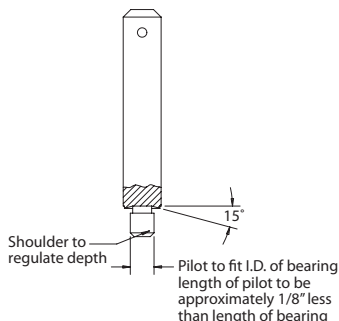
3. **For P, Q, S or U ratio**, support the short hub end of the Gear Head on the table of an arbor press and press the Gear Head Planet Gear Shafts (54) from the Gear Head. Make certain the Shafts are pressed out toward the short hub because the holes in the Gear Head are tapered smaller toward the front of the Gear Head.
4. **For P, Q, S or U ratio**, remove the Gear Head Planet Gears (52) from the Gear Head.
5. **For P ratio**, remove the Rotor Pinion (55).
6. **For P, Q, S or U ratio**, if the Gear Head Planet Gear Bearings (53) must be replaced, press them from the Planet Gears.
7. Holding the Gear Case, push the output end of the Spindle (31, 37 or 45) to move the Spindle Assembly out the motor end of the Gear Case.
8. Using a bearing puller, pull the Spindle Rear Bearing (36, 44 or 50) off the rear hub of the Spindle.
9. Using a bearing puller, pull the Spindle Front Bearing (32, 38 or 46) off the front hub of the Spindle.
10. **For D ratio**, support the short hub end of the Spindle on the table of an arbor press and press the Spindle Drive Plate Shafts (40) from the Spindle. Make certain the Shafts are pressed out toward the short hub because the holes in the gear frame of the Spindle are tapered smaller toward the output end of the spindle shaft. Remove the Drive Plate (41) from the Spindle. **For all other ratios**, support the short hub end of the Spindle on the table of an arbor press and press the Spindle Planet Gear Shafts (33, 39 or 47) from the Spindle. Make certain the Shafts are pressed out toward the short hub because the holes in the gear frame of the Spindle are tapered smaller toward the output end of the spindle shaft. Remove the Spindle Planet Gears (34, 42 or 48) from the Spindle.
11. If the Spindle Planet Gear Bearings (35, 43 or 49) must be replaced, press them from the Planet Gears.
12. **For P, Q, S or U ratio**, insert a hooked tool into the flange end of the Gear Case and catching the spindle end of the Internal Gear (57), pull it from the Gear Case.

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. Take extra care not to damage threads or distort housings.
4. Except for bearings, clean every part and wipe every part with a thin film of oil before installation.
5. Check every bearing for roughness. If an open bearing must be cleaned, wash it thoroughly with a clean suitable solution and dry with a clean cloth. Sealed or shielded bearings should not be cleaned. Work grease into every bearings before installation.
6. Apply a film of O-ring lubricant to every O-ring before installation.
7. When installing the Planet Gear Shafts (25 or 36), support the spindle end of the assembly and press the Shafts in toward the spindle end. The shaft holes through the web are slightly tapered so that the Shafts have a tighter fit in the front web.
8. Unless otherwise noted, always press on the stamped end of a needle bearing when installing a needle bearing into a recess. When installing Spindle Planet Gear Bearings (49), always insert one Bearing into each end of the Gear. **Never use one Bearing as a pressing plug for the second Bearing.** Use a bearing inserting tool similar to the one shown in Dwg. TPD786.

Needle Bearing inserting tool



(Dwg. TPD786)

Assembly of the Gearing

1. **For P, Q, S or U ratio**, if the Spindle Planet Gear Bearings (49) were removed from the Spindle Planet Gears (48), press new Bearings into the Gears using a needle bearing inserting tool. Press one Bearing in from each end of the Gear until they are flush with the face of the Gear. If any Gears are damaged, install a complete new set of Gears. Do not mix old Gears with new Gears in the same motor.
2. **For K, M or N ratio**, if the Spindle Planet Gear Bearings (35 or 43) were removed from the Spindle Planet gears (34 or 42), press new Bearings into the Gears using a needle bearing inserting tool. If any Gears are damaged, install a complete new set of Gears. Do not mix old Gears with new Gears in the same motor.
3. **For D ratio**, support the web at the output end of the Spindle (37) on the table of an arbor press and position the Spindle Drive Plate (41) inside the web making certain that the pin holes are in alignment. The holes in the webs of the Spindle are tapered and smaller toward the output end of the Spindle. Press both Spindle Drive Plate Shafts (40) through the rear web and Drive Plate into the front web until the Shafts are flush with the face of the rear web.
4. **For all other ratios**, support the web at the output end of the Spindle (31, 37 or 45) on the table of an arbor press and position a Spindle Planet Gear with Bearings in the web. The holes in the webs of the Spindle are tapered and smaller toward the output end of the Spindle. Press a Spindle Planet Gear Shaft (33, 39 or 47) through the rear web and Bearings into the front web until the Shaft is flush with the face of the rear web.
5. **For all ratios except D ratio**, repeat Step 2 with the remaining Spindle Planet Gears and Bearings.
6. Stand the Spindle, output end upward, on the table of an arbor press and using a piece of tubing that will clear the Spindle, press the Spindle Front Bearing (32, 38 or 46) onto the Spindle.
7. Invert the Spindle and without applying pressure to the Spindle Front Bearing, press the Spindle Rear Bearing (36, 44 or 50) onto the short hub of the Spindle.
8. **For P, Q, S or U ratio**, align one of the exterior slots on the Internal Gear (57) with the two Internal Gear Keys (58) located opposite the Grease Fitting (62) in the Gear Case (59). Push the Internal Gear into the Gear Case until it stops against the gear teeth in the Case.
9. Apply lubricant to the gearing and shaft and insert the assembled Spindle, output end leading, into the end of the Gear Case with the largest opening. Push the assembly into the Gear Case until the Spindle Front Bearing seats in the gear case bearing recess.
10. **For P, Q, S or U ratio**, if the Gear Head Planet Gear Bearings (53) were removed from the Gear Head Planet Gears (52), press new Bearings into the Gears using a needle bearing inserting tool. If any Gears are damaged, install a complete new set of Gears. Do not mix old Gears with new Gears in the same motor.
11. **For P, Q, S or U ratio**, support the web at the spline shaft end of the Gear Head (51) on the table of an arbor press and position a Gear Head Planet Gear with a Bearing in the web. The holes in the webs of the Gear Head are tapered and smaller toward the spline shaft end of the Gear Head. Press a Gear Head Planet Gear Shaft (54) through the rear web and Bearing into the front web until the Shaft is flush with the face of the rear web.

10. **For P ratio**, insert the Rotor Pinion (55) into the center of the Gear Head. This must be done before installing the second Gear in the Gear Head. It cannot be installed after a second Gear is secured in position.
11. **For P, Q, S or U ratio**, repeat Step 9 with the remaining Gear Head Planet Gear and Bearing.
12. **For P, Q, S or U ratio**, stand and support the assembled Gear Head on the table of an arbor press with the spline shaft end downward and press the Gear Head Bearing (56) onto the hub of the Gear Head.
13. **For P, Q, S or U ratio**, apply lubricant to the gear head gearing and while engaging the spline of the Gear Head with the gearing of the Spindle and Internal Gear, slide the assembled Gear Head into the Gear Case.

Assembly of the Motor

1. Push the Rear End Plate (15), flat face leading, onto the short hub of the Rotor (17).
 2. Push the Rear Rotor Bearing (14) onto the short hub of the Rotor into the recess of the Rear End Plate and install the Rear Rotor Bearing Retainer (13) in the groove on the shaft of the Rotor to retain the Bearing and End Plate.
 3. Place a Vane (18) in each vane slot in the Rotor and place the Cylinder (19) down over the Rotor and Vanes and against the Rear End Plate. Make certain the holes in the Cylinder and End Plate can be aligned. If they don't align, invert the Cylinder.
 4. Press the Front Rotor Bearing (21) into the bearing recess of the Front End Plate (20).
 5. Press the Front Rotor Bearing, Front End Plate leading onto the spline end of the rotor shaft until the End Plate contacts the Cylinder.
 6. Use a 1/8" rod approximately 12" long to align the cylinder dowel holes in the Front End Plate, Cylinder and Rear End Plate. Insert the end of the rod at the Rear End Plate end into the dowel hole in the Motor Housing. Slide the assembled motor along the rod into the Motor Housing until it stops against the bottom of the motor bore.
 7. Remove the assembly rod and install the Cylinder Dowel (16) in its place.
 8. Install the two Motor Retaining Washer (22), the concave face of both Washers trailing, over the hub of the Front End Plate.
 9. **For D, K, M or N ratio**, install the Motor Spacer (30) over the rotor shaft and into the Motor Housing against the Motor Retaining Washers.
 10. Install the assembled Gear Case against the Motor Housing. It may be necessary to rotate the Spindle by hand to properly engage the gearing with the spline on the Rotor.
 11. Secure the Gear Case to the Motor Housing with the three Gear Case Cap Screws (11) and Lock Washers (12).
 12. **For Models with Piped-Away Exhaust**, install new Exhaust Deflector Seals (6 and 7) in the internal grooves at each end of the Exhaust Deflector (5).
 13. Slide the Muffler (8) over the rear of the Motor Housing until it stops against the body of the Housing.
 14. Slide the Exhaust Deflector over the rear of the Motor Housing and Muffler until it stops against the forward Exhaust Deflector Retaining Ring (9).
 15. Position the Backhead Gasket (3) against the rear face of the Motor Housing.
- For Series 4800 Non-reversible Motors**, position the Gasket to block off the holes in the quadrant marked with an "R" if forward rotation is desired, or to block off the holes in the quadrant with an "F" if reverse rotation is desired.
- For Series 4840 Reversible Motors**, position the Gasket so that each gasket inlet port aligns with a group of three holes through the housing rear wall.
16. Place the Backhead against the Gasket. Install the three Backhead Cap Screws (11) and Lock Washers (12) to secure the Backhead and Exhaust Deflector to the Motor Housing.
 17. Install one Air Strainer (1) for non-reversible models and two Air Strainers for reversible models in the Backhead (2).

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