



# INSTALLATION AND MAINTENANCE MANUAL

## AUSTART AT93 TURBINE STARTER



### **K.H. EQUIPMENT PTY. LTD.**

14-16 WESTPOOL DRIVE,  
HALLAM VICTORIA 3803 AUSTRALIA  
PH: +61 3 9796 4766 FX: +61 3 9796 4878

EMAIL: [info@khequipment.com.au](mailto:info@khequipment.com.au) WEB: [khequipment.com.au](http://khequipment.com.au)

Issue: 18/09/2002 Rev. 01

## NOTICE

**THIS MANUAL CONTAINS IMPORTANT SAFETY INFORMATION. IT IS IMPORTANT THAT THE ENTIRE CONTENTS BE STUDIED BEFORE INSTALLATION AND OPERATION. IT ONLY REFLECTS GENERIC INFORMATION RELATING TO A STANDARD AUSTART ATS93 TURBINE STARTER. VARIOUS OTHER OPTIONS ARE AVAILABLE TO PROVIDE INERTIA DRIVE SYSTEMS, HARSH ENVIRONMENT MUFFLERS OR THREADED EXHAUSTS TO MEET SPECIFIC APPLICATION REQUIREMENTS.**

## FOREWORD

This manual contains instructions for the installation, maintenance and operation of your new ATS93 AUSTART Air Starter Motor. It has been designed to provide you with safe and reliable service. However, it is both a pressure vessel and a piece of rotating machinery. Therefore, operators and maintenance personnel must exercise good judgement and appropriate safety practices to avoid damage to the equipment and prevent personal injury. The instructions in this manual are intended for personnel with a general training in the operation and maintenance of air starter equipment. It should be understood that the information contained in this manual does not relieve the operating and maintenance personnel of the responsibility for exercising good normal judgement in the operation and care of air start equipment and their associated systems.

Throughout this manual you will encounter the words WARNING, CAUTION and NOTICE.

These paragraphs are intended to emphasise certain areas where personnel safety and satisfactory starter operation may be compromised should the message be ignored. The definitions of these words are as follows -



*An operating procedure, practice etc. that if not strictly observed, could result in personal injury.*

## CAUTION

*An operating procedure, condition etc. that if not followed could result in damage to, or the destruction of equipment.*

## NOTICE

*An operating procedure, condition etc. that is essential to highlight and observe.*

It is advisable that a safety program be established to address the safety issues detailed within this manual before installing, operating or maintaining this equipment. It is important such a program covers the hazards associated with compressed air.



*Do not install this starter other than in accordance with the instructions detailed in this manual.*

These instructions should be read completely before beginning installation and should be available to personnel responsible for operating and maintaining this equipment. The unit is capable of trouble free operation when properly applied, installed and maintained.

Extra copies of this manual are available from your local Austart Air Starter Distributor or the Factory.

This manual is designed to cover all situations normally experienced when installing, operating and maintaining this equipment. In the event situations are encountered that are not covered by this manual, consult your AUSTART agent or K.H. Equipment Pty Ltd direct.

# AUSTART PRODUCT NUMBERING

STARTER MODEL	FLANGE CODE	PINION CODE	SPECIAL FEATURES
50 AS50	01 SAE 1	09 9TH 3MOD R	B BCB (Beryllium Copper Bronze Pinion)
53 ATS53	02 SAE 2	10 10TH 8/10 R	I Inertia Drive
54 ATS54 ( <i>ATS53 OH</i> )	03 SAE 3	11 11TH 6/8 R	M Mining Spec.(Cast Iron)
55 AS55 ( <i>AS50 OH</i> )	04 SAE 4	12 12TH 8/10 R	P Motor Ports 90°
60 AS60 <i>OBSOLETE</i>		13 12TH 8/10 L	S Short Muffler
61 AS61		14 11TH 6/8 L	T Threaded Exhaust 3"
63 ATS63		15 10TH 8/10 L	U U Configuration
64 ATS64 ( <i>ATS63 OH</i> )		16 9TH 3MOD L	G Threaded Exhaust 2"
65 AS65 <i>OBSOLETE</i>			K Kelly Spinner Muffler
66 AS66			
67 AS67			
68 AS6070			
69 AS69 ( <i>AS67OH</i> )			
70 AS70			
73 ATS73			
74 ATS74 ( <i>ATS73 OH</i> )			
75 AS75 ( <i>AS70 OH</i> )			
78 AS7080			
80 AS80			
83 ATS83			
84 ATS84 ( <i>ATS83 OH</i> )			
85 AS85 ( <i>AS80 OH</i> )			
90 AS90			
93 ATS93			
94 ATS94 ( <i>ATS93 OH</i> )			
95 AS95 ( <i>AS90 OH</i> )			
100 AS100			
103 ATS103			

<u>EXAMPLES OF BASIC STARTER PRODUCT NUMBERING</u>				
630110M	PERKINS	SAE1	10TH	MINING SPEC
630409M	MWM	SAE4	9TH	MINING SPEC
730311	DETROIT	SAE3	11TH	
730314	DETROIT	SAE3	11TH	LH
730311I	DETROIT	SAE3	11TH	INERTIA DRIVE
730314I	DETROIT	SAE3	11TH	INERTIA DRIVE LH
730312M	CATERPILLAR	SAE3	12TH	MINING SPEC

# INSTALLATION AND PREPARATION FOR OPERATION



- Ensure air supply is isolated before installation, removal, maintenance or adjustment of your AUSTART starter.
- Before any starter is taken out of service first bleed the Air Receiver of air and any moisture that may have accumulated by opening up the drain valve. Do not bleed by removing Receiver plugs.
- Remove air hoses to ensure complete safety once the air supply has been isolated and the Receiver has been bled.
- The Air Receiver must be manufactured to an applicable pressure vessel code such as AS 1210, or similar.
- Only use air hoses and fittings that are of adequate size as indicated in the installation schematic (page 6)
- Always carry out a pressure test on the complete starting system according to Clause 8 on Page 5 before beginning operation. Do not begin operations until satisfied the unit has been installed correctly.
- Always use recommended lubricants where prescribed by this manual. Under no circumstances use flammable or volatile liquids.
- Ensure all fasteners are torqued to the values prescribed in this manual. Use thread sealant where indicated.
- To ensure warranty provisions are not invalidated use only genuine AUSTART replacement parts. Non-genuine parts may cause service and performance problems and may affect the safe operation of your starter.

## PRELIMINARY INSTALLATION REQUIREMENTS

*Numbers in Brackets refer to Part Nos, refer to exploded view drawing on page 8*

1. Your Austart Starter is flange mounted. Before installing the starter carefully study the mating position of the Austart Starter and engine flanges to determine whether the air inlet port orientation or Nose Housing (48) geometry will suit your particular installation. If not suitable re-orientate as follows -
  - Carefully loosen the Band Clamp (12) but do not remove. The two housings can now be rotated relating to each other without separation.
  - Re-orientate the Housings to the desired position and torque the Band Clamp (12) to 4 ft lb (6 Nm)
2. Ensure pinion is suitable for engine application ie. correct pitch, diameter and number of teeth.
3. Check flange to ring gear (FRG) spacing is correct and that flange spacers are not required. Pinion should be FRG less 1/8" (3mm) when at rest.
4. Check Austart Starter clears all obstacles and the flange mounts to flywheel housing squarely without using undue force.
5. Ensure the hoses, fittings and starter ports are clean and free from dirt and foreign objects. Ensure they remain so during installation.
6. For optimum Austart Starter performance ensure air supply pipes or hoses have an internal diameter of at least 1" (25mm), refer Installation Schematic on page 6. In the event line length must be longer than 15ft (5m), a size of 1-1/2" (40mm) should be used. Keep the number of fittings and the length of piping to a minimum. Avoid the use of reducing bushes and other fittings that could impede air flow.

# INSTALLING THE STARTER AND PIPEWORK

Refer to the Starter Installation Schematic drawing on page 6

1. The air supply line should ideally exit from the top or side of the Air Receiver.

## CAUTION

*Do not connect Air Supply Line to the bottom of the Air Receiver. Moisture and system contaminants collect at the receiver bottom and can damage the Austart Starter internals if allowed to pass through. Periodically drain moisture from the Air Receiver using a drain valve connected at the Receiver bottom.*

2. Install a 100 mesh 'Y' Strainer. A 'Y' Strainer installed before the Relay Valve will provide protection to the Valve and Austart Starter from contaminants that may have accumulated in the Air Receiver.

## NOTICE

*Ensure the inlet side of the 'Y' Strainer faces the Receiver, ie the direction arrow points away from the Receiver.*

3. Connect the RV1500 Relay Valve directly on to the 'Y' Strainer using a 1" Short Nipple.

## NOTICE

*Ensure the inlet side of the Relay Valve connects to the exit side of the 'Y' Strainer.*

4. Mount the Starter Control Button SC25 onto the vehicle dash-board or appropriate control panel and connect to the Air Receiver using a minimum of 1/4" (6mm) line.

## NOTICE

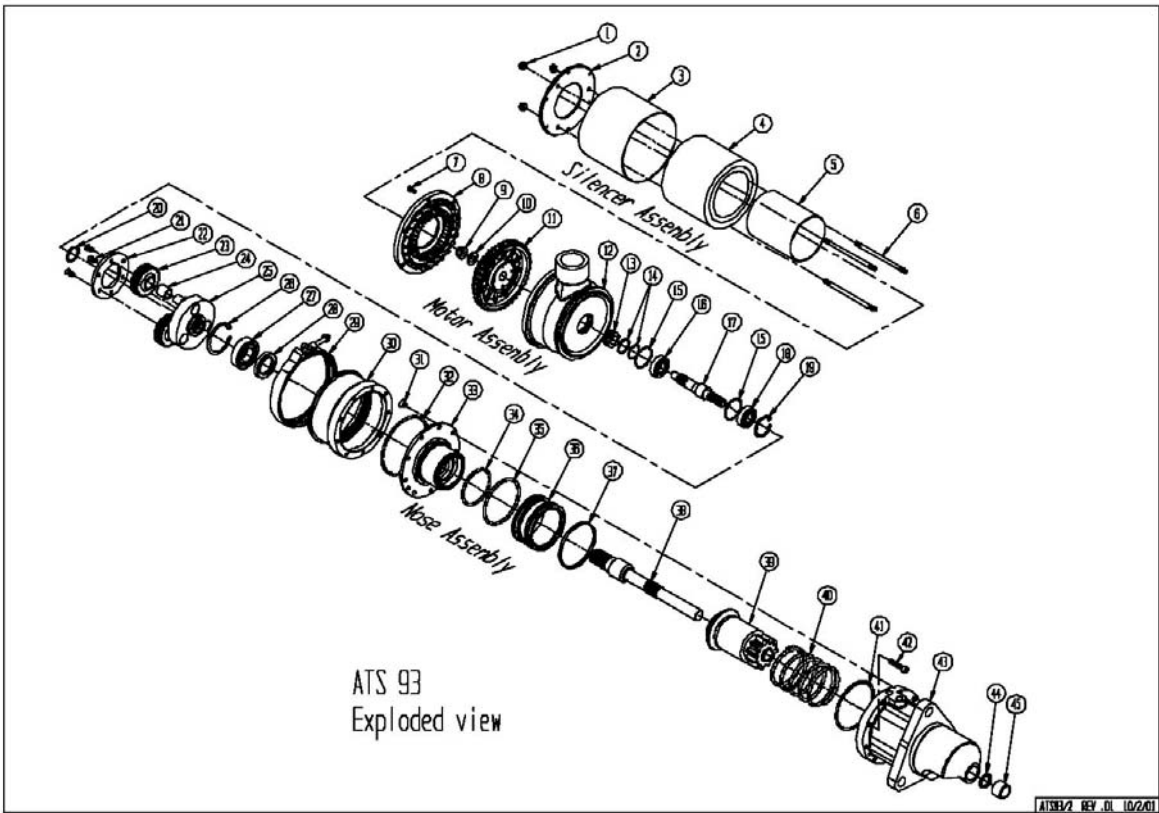
*Ensure the inlet side of the Starter Control Button connects to the line from the Receiver. Any Safety "Switches" should be installed in this line between the Starter Control Button and the Air Receiver.*

5. Determine the practicality of running the 1" air supply hose or pipe from the exit of the Relay Valve to the inlet of the Austart Starter after the Austart Starter is mounted. It may be easier to fit the hose before the Austart Starter is mounted in position.

6. Once the Austart Starter is mounted, fit the remaining 1/4" (6mm) control lines from the Austart Starter to the Starter Control Button and Relay Valve respectively (Refer page 6).

7. Make all hose or pipe connections leak proof using a suitable thread sealant.

8. Once the connections have been made pressurise the system and check for leaks using "soapy" water or similar solution.

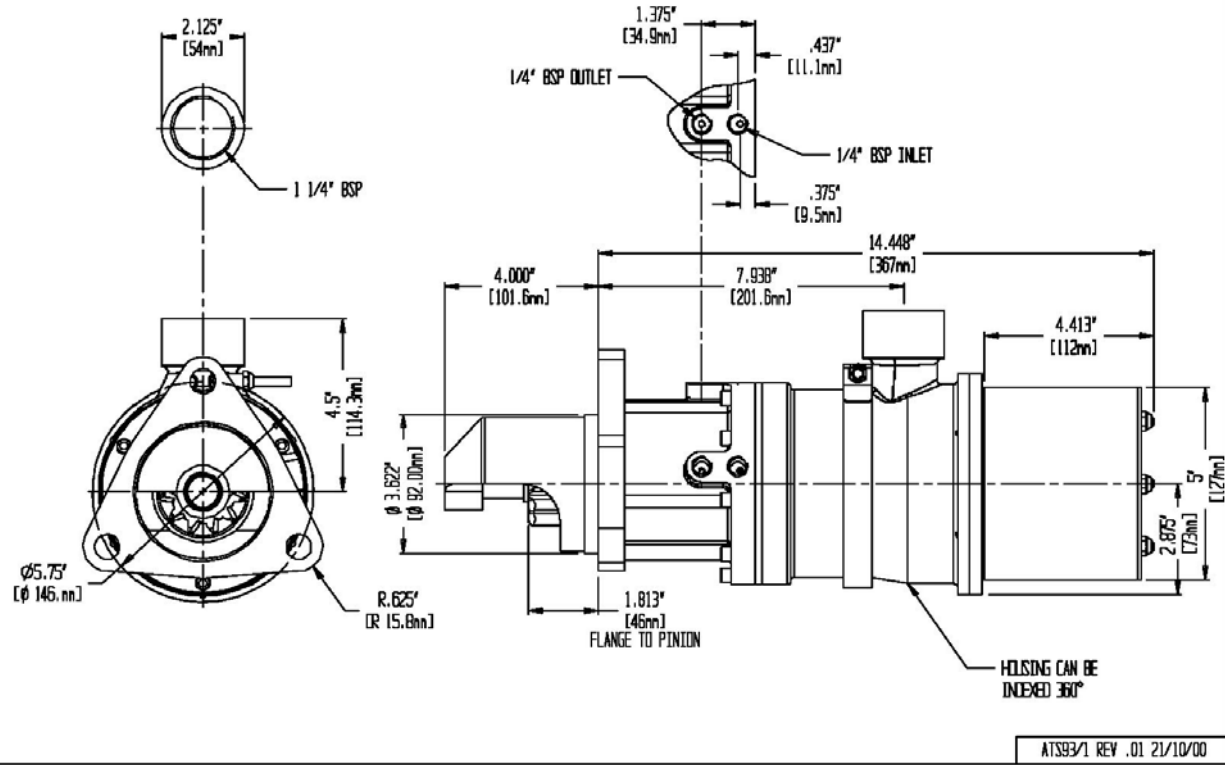


<b>AUSTART ATS-93</b>									
General Build List Aluminium Housings									
ITEM	PART NO.	EXT.	DESCRIPTION	QTY	ITEM	PART NO.	EXT.	DESCRIPTION	QTY
1	3029	000	NUT	3	29	7322	000	BAND CLAMP	1
2	9306	100	END COVER MUFFLER	1	30	8317	100	GEAR CASE	1
3	9307	100	OUTER SLEEVE	1	31	8024	000	COUNTERSUNK SCREW	2
4	9308	500	FOAM INSERT	1	32	8023	000	O RING	+ 1
5	9309	900	INNER SLEEVE ASSY	1	33	8025	300	BEARING HOUSING	1
6	9310	100	STUD	3	34	8026	000	O RING	+ 1
7	9311	000	SCREW	6	35	7033	000	O RING	+ 1
8	9321	300	END COVER	1	36	8028	100	PISTON	1
9	7301	000	SPECIAL NUT	1	37	8029	500	SEAL	+ 1
10	7304	000	WASHER	1	38	8030	100	DRIVE SHAFT	1
11	9314	300	TURBINE ROTOR	1	39	8031	XXX	DRIVE ASSY	1
12	9302	900	TURBINE HOUSING	1	40	6734	000	SPRING	1
13	7312	100	SEAL SLEEVE	1	41	7023	000	O RING	+ 1
14	7313	000	PISTON RING	2	42	8035	000	SCREW	6
15	7309	000	O RING	+ 2	43	8034	XXX	NOSE HOUSING	1
16	6611	000	BEARING	+ 1	44	8036	000	SEAL	+ 1
17	9303	100	ROTOR SHAFT	1	45	8037	000	BEARING	+ 1
18	7004	000	BEARING	+ 1					
19	6612	000	CIRCLIP	+ 1					
20	7018	000	CIRCLIP	+ 1					
21	6305	000	COUNTERSUNK SCREW	3					
22	8306	100	RETAINER	1					
23	8307	100	PLANET GEAR	3					
24	8315	000	BEARING	+ 3					
25	8316	900	SPIDER HUB ASSY	1	9340	900		SERVICE KIT <small>CONSIST AS MARKED</small>	+ A.R.
26	8020	000	CIRCLIP	+ 1					
27	8021	000	BEARING	+ 1					
28	7022	000	SEAL	+ 1					

- XXX DENOTES OPTIONS AVAILABLE

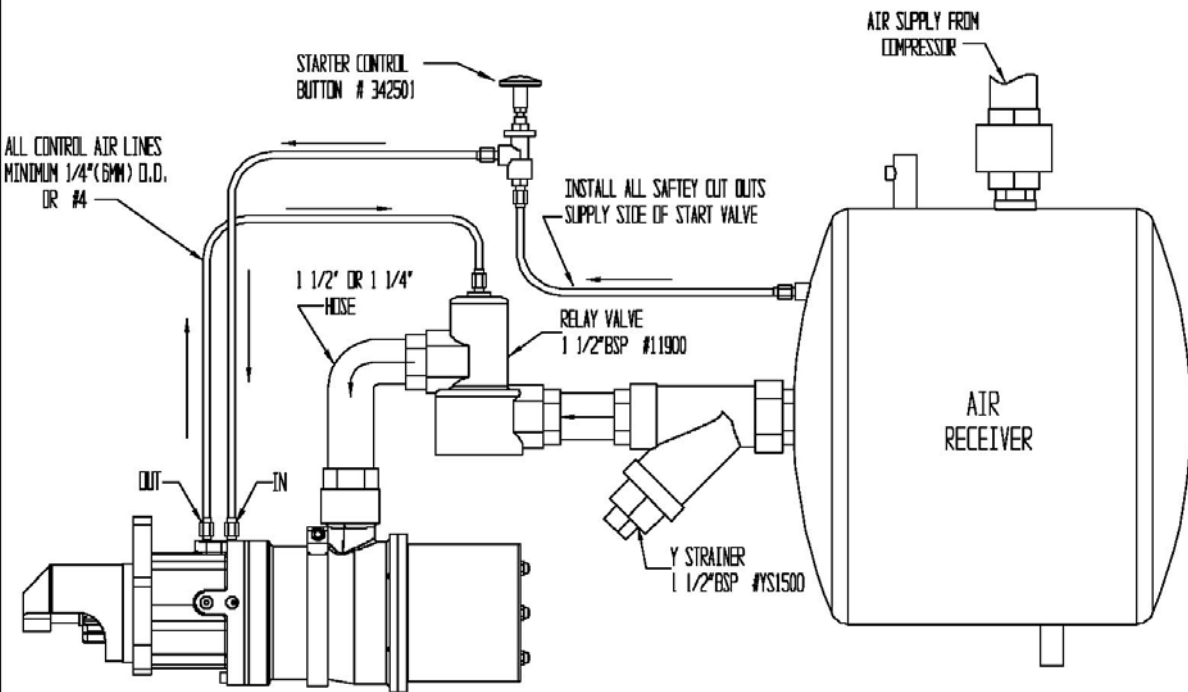
AUS93/3 (A) Rev.03 30/08/00

# ATS-93



## AUSTART TURBINE STARTER INSTALLATION SCHEMATIC

## MODEL ATS93



ISS93.REV.01

# MAINTENANCE



## DISASSEMBLY

*Refer to the Cross Sectional and the Exploded View drawings on pages 8 & 10*

Begin by removing the two Band Clamps (7) & (31), and separate the three Sub-Assemblies; the Nose Assembly, the Motor Assembly and the Silencer Assembly. Gently tap the assemblies with a soft hammer if necessary.

The Sub-Assemblies may now be dismantled separately. Disassembly of any of these three Sub-Assemblies is detailed in the exploded view on page 8 and is basically in the order shown. Refer also to the following instructions:

### Nose Assembly

1. Remove Retainer (24), Planet Gears (25) and Bearings (26). If necessary gently tap the three Countersunk Screws (23) to loosen them.
2. Remove nine Screws (44) and separate the Gear Case (32) by gently tapping it with a soft hammer if necessary.
3. Remove the two Countersunk Screws (33). The Bearing Housing (35) should spring apart from the Nose Assembly. Gently tap the Nose Housing (45) with a soft hammer to assist it to separate if necessary.
4. Remove Spring (42), Drive Assembly (41) and Piston (38).
5. Remove Circlip (22) using circlip pliers and Spider Hub Assembly (27).
6. Support Bearing Housing (35) in the vertical position and gently press out Drive Shaft (40) from Bearing (29).
7. Remove Circlip (28) using circlip pliers and press out Bearing (29) and Seal (30).
8. Remove Nose Bearing (47) and Seal (46) from Nose Housing (45).

### Motor Assembly

1. Remove Special Nut (10) and Washer (11). Difficulty may be experienced and it will be necessary to restrain the Turbine Rotor (12) from turning by using a ring spanner (wrench) on the special flats provided.
2. Remove Circlip (21) using circlip pliers and press out Rotor Shaft (19) through Rotor (12) as an Assembly.
3. Press out Seal Sleeve (15) and Bearing (18) from Turbine Housing (13).
4. Press off Bearing (20) from the Rotor Shaft (19).

### Silencer Assembly

Remove the three Nuts (1) and Assembly will easily come apart.



# INSPECTION

Refer to the Cross Sectional and the Exploded View drawings on pages 8 & 10

1. Visually inspect all parts removed during disassembly for excessive wear or damage. Replace any damaged or questionable parts.
2. Pay particular attention to the vanes on End Cover (8) and Turbine Rotor (12) and look for cracks, chipping, warpage or excessive wear patterns. Rotor (12) should fit tightly on to the Rotor Shaft (19). Replace any damaged or questionable parts. Remove burrs.
3. Also pay particular attention to all gear teeth looking for cracked or broken teeth and excessive wear. Check the pinion on the Drive Assembly (41) for evidence of unusual contact patterns resulting from misalignment or improper engagement. Remove any burrs or replace if questionable.
4. Check all bearings are free to rotate and do not have excessive play between races. If in doubt replace questionable bearings.

## CAUTION

*Do not wash shielded bearings that are to be reused in solvent or blow with compressed air as it may remove internal lubrication. Bearings that are to be reused should be cleaned by wiping the end shields with a clean cloth.*

5. Clean all other parts that are going to be reused with commercially approved solvents.

## WARNING

*Ensure cleaning operations are carried out in a properly vented area away from open flames.*

6. It is recommended that when servicing your Austart Turbine Starter always replace complete repair kit contents.

# REASSEMBLY

Refer to the Cross Sectional and the Exploded View drawings on pages 8 & 10

Reassembly of any of the three Sub-Assemblies detailed in the exploded view on *page 8* is basically in the reverse order shown. Refer also to the following instructions:

## Nose Assembly

1. Begin by pressing the Bearing (47) and Seal (46) into Nose Housing (45) using a press with an appropriate pressing tool.
2. Drive home the Seal (30) into the Bearing Housing (35) until it bottoms.

### CAUTION

*Ensure the Seal (30) is fitted the correct way, ie with the tapered leading edge engaged first. Liberally grease the exposed side of the Seal (30) with Lithium based grease such as Valvoline VALPLEX EP Grease or similar.*

3. Using a press drive home the Bearing (29) into the Bearing Housing (35) until it bottoms. Then insert Shaft (40) into the Bearing (29) and press home. Ensure the Bearing Housing (35) is adequately supported during this operation. Finally fit Circlip (28) using circlip pliers.
4. Slip on Spider Hub Assembly (27) onto Shaft (40) and fit Circlip (22) using circlip pliers.
5. Fit O-Rings (34) and (36) onto Bearing Housing (35).
6. Fit O-Ring (37) and Wiper Seal (39) onto Piston (38).
7. Liberally grease Piston (38), the inner portion of the Bearing Housing (35) and Shaft (40) where it extends, then gently slide Piston (38) onto the Bearing Housing without damaging O-Ring (36).
8. Slide Drive Assembly (41) onto Shaft (40) and then fit Spring (42) over Drive Assembly (41).

9. Liberally coat the inner regions of Nose Assembly (45) and Bearing (47) with grease and assemble Nose Assembly over Piston (38) taking care not to damage Wiper Seal (39). Rotate the Nose Assembly until the two countersunk screw holes line up between the nine main stud holes.

10. Squeeze together Bearing Housing (35) and Nose Assembly (45) being careful not to damage O-Ring (37), then insert Countersunk Screws (33).
11. Slide Gear Case (32) onto Bearing Housing (35) ensuring O-Ring (34) is not damaged by smearing oil on the O-Ring (34) to allow Gear Case (32) to easily slide over.
12. Line up set screw holes and install nine Setscrews (44).
13. Invert the built up Nose Assembly and restrain in the vertical position. Install the three Planet Gears (25) and gear Bearings (26) onto the Spider Hub Assembly (27).

Coat gear bearings with grease before assembly.

### CAUTION

*Ensure Planet Gears are installed with the boss side of the Gear facing the Spider Hub.*

14. Install Retainer (24) to the Spider Hub Assembly (27) and install the three Countersunk Screws (23).
15. Liberally pack gear teeth with suitable grease such as Valvoline Valplex EP or similar.
16. The Nose Assembly is now ready to accept the Motor Assembly.

## Motor Assembly

1. Begin by lightly oiling the internal bore of the Turbine Housing (13) with hydraulic oil and fitting inner O-Ring (14).
2. Evenly press home Bearing (18) until it bottoms. Ensure O-Ring (17) is not damaged or dislodged.
3. Install Piston Rings (16) onto Seal Sleeve (15). Rotate Piston Rings (16) so that the gaps are 180° apart.
4. Lightly grease the outside of the Piston Rings (16) on the Seal Sleeve (15) and push home into the Turbine Housing (13) until it bottoms.
5. Press Bearing (20) onto Rotor Shaft (19) using a press and liberally grease top of bearing.
6. Install 2<sup>nd</sup> O-Ring (17) into Turbine Housing (13) and insert Rotor Shaft (19) and Bearing (20) as an assembly. This should be achieved with an even push fit.
7. Install Circlip (21) with circlip pliers.
8. Fit Turbine Rotor (12) onto Rotor Shaft (19) extension.
9. Lightly oil thread on Rotor Shaft (19) extension and install Washer (11) and Special Nut (10). Tighten Nut against the Turbine Rotor (12) to a torque of 25-30 ft lb.(30-40 Nm) Prevent the Rotor from turning by using a ring spanner (wrench) on the special flats provided.

## Assembling Nose and Motor Assemblies

1. Apply grease to Planet Gears (25) and Gear Case (32). Carefully line up spline of Motor Assembly Shaft (19) with the Planet Gears (25) on the Nose Assembly and slide the Nose Assembly home.
2. Line up the Nose Assembly and Motor Assembly air inlet ports and install Band Clamp (31). Tighten Band Clamp (31) to 4 ft lb (6 Nm).
3. Test the operation of the Drive Assembly (41) by introducing air pressure at the control line inlet port. The Drive Assembly should move freely forward when air pressure is applied and back once the pressure has been relieved. Investigate if this movement is not smooth.
4. The Nose/Motor Assembly is now ready to accept the Silencer Assembly.

## Adding Silencer Assembly

1. Install Silencer Assembly to the Turbine Housing (13). Install Band Clamp (7). Tighten Band Clamp (7) to 4 ft lb (6 Nm)
2. The Austart Air Starter is now assembled and ready for installation. Refer Installation and Operation section of this manual.

# WARRANTY POLICY

All Austart Products supplied by K.H. Equipment Pty. Ltd. (herein called "the Manufacturer") is warranted to be free from any defect in workmanship and material under conditions of normal use and service for engine starting applications for a period of 12 months from the date of purchase by the first user. Normal wear and tear is excluded from the warranty cover.

The Manufacturer will replace or repair at their works, without cost, any Austart Starter or parts found to be defective or at their discretion choose to refund the purchase price less a reasonable allowance for depreciation in exchange for the starter or part should the item prove impossible to repair or replace.

This warranty shall not apply to any Austart Starter or parts which have been altered or repaired or purchased outside the Manufacturer and its assigned agents nor to equipment or parts that have been subject to misuse including overloading, neglect, accident or damage, nor to any part or parts improperly applied or installed.

This warranty is in lieu of all other warranties and conditions statutory or otherwise expressed or implied and of all other obligations or liabilities on the Manufacturer's part. The Manufacturer's maximum liability is limited to the purchase price of the starter and is not liable for any consequential damage, loss or expense.

Repeat engine starting attempts must be delayed for 15 seconds to allow all Austart Starter and engine components to stop rotating to avoid damage or adverse wear of components.

---

**DISTRIBUTED BY**