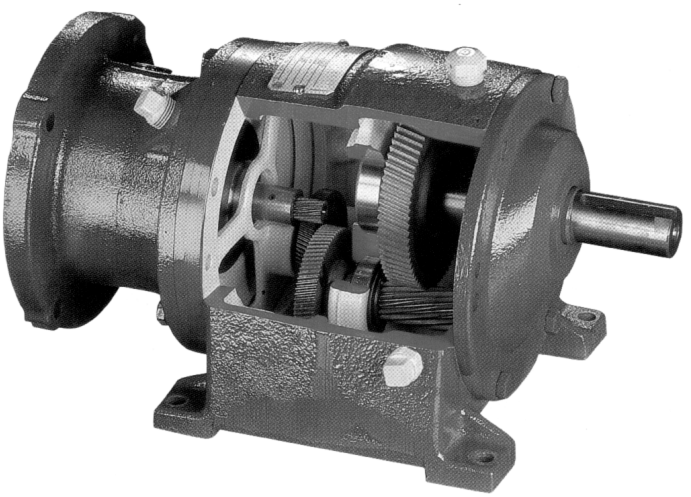
MASTER® APG™ GEARMOTORS, C-FACE AND SEPARATE REDUCERS

SERVICE AND REPAIR FOR SIZES 2 THROUGH 8

For APG Size 1, see manual 499983



WARNING: Because of the possible danger to person(s) or property which may result from improper use of products, it is important that correct procedures be followed. Products must be used in accordance with the Engineering information specified in the catalog. Proper installation, operation and maintenance procedures must be observed. The instructions in the instruction manuals must be followed. Inspections should be made as necessary to assure safe operation under prevailing conditions. Proper guards and other suitable safety devices or procedures as may be desirable or as may be specified in safety codes should be provided, and are neither provided by Master Power Transmission nor are the responsibility of Master Power Transmission. This unit and its associated equipment must be installed, adjusted and maintained by qualified personnel who are familiar with the construction and operation of all the equipment in the system and the potential hazards involved. When risk to persons or property may be involved, a failsafe device must be an integral part of the driven equipment beyond the speed reducer output shaft.

MASTER® POWER TRANSMISSION

3300 Tenth St. / Columbus, IN 47201 / (888) 616-1094
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MASTER APG SERVICE MANUAL
TABLE OF CONTENTS

GENERAL INFORMATION

THE MASTER APG

The MASTER APG is a broad line of high power density, helical geared products adaptable to a wide variety of applications. The MASTER APG is designed in accordance with the standards of the American Gear Manufacturers Association to give trouble-free performance when properly selected, installed and maintained. This instruction manual contains precautions and procedures to observe when installing, operating and maintaining your MASTER APG. Additional information may be obtained from your local MASTER Sales Office, Authorized Distributor or Authorized Service Center.

For information on the MASTER APG Size 1, please refer to the installation, service, and repair manual for that product (P/N: 499983).

GEARHEAD CONFIGURATIONS

The MASTER APG gearhead is produced in three basic configurations:

1. The Single Reduction has one pair or “stage” of gears. The Single Reduction unit is available in ratios of 1.2:1 through 5:1.
2. The Double Reduction uses two pairs of gears in series to provide ratios from 4:1 through 25:1. The Double Reduction gearcase is different from the Single Reduction gearcase.
3. The Triple Reduction is the Double Reduction gearhead with yet another pair of gears housed in a “Triple Adapter” added at the input. The Triple Reduction provides ratios from 31:1 through 129:1

TYPES OF MOUNTING

Each of the three gearhead configurations is available in two types of mounting:

1. Foot Mount is standard. The APG Gearmotor shown on the cover of this manual is Foot Mounted. Some combinations of motor and gearhead require riser blocks under the mounting feet if the drive is to be mounted to a large flat surface and the body of the motor extends below the feet of the gearhead. Suitable riser blocks are supplied as standard parts where needed.
2. Flange Mount units use the same gearcase as the Foot Mount units. The output bearing housing is changed to provide a mounting flange concentric with the output shaft.

TYPES OF INPUT

The three gearhead configurations in either of the two mounting types are each available in three input constructions:

1. The Gearmotor uses a special motor designed to produce a compact package of prime mover and reducer. Couplings and exposed rotating parts at the input are eliminated.
2. The C-Face Reducer has a hollow, integral input coupling to accept the shaft of a standard NEMA C-Face motor. A clamp collar is provided to lock the motor shaft and the input coupling together to prevent fretting corrosion.
3. The Separate Reducer has an extended input shaft to be coupled to a separately mounted prime mover. The input may be through a belt or chain if the input speed required is different from standard motor speeds.

ACCESSORIES

The MASTER APG may be equipped with brakes, clutches, backstops or other accessories. Backstops are available only in the Separate Reducer input construction and are covered in detail in this manual. Other accessories are described in their own manuals.

DATA PLATES AND INFORMATION PLATES

The primary plate is attached to the MASTER APG gearcase. This rectangular stainless steel plate contains vital information about your MASTER APG. Gearmotor and C-face reducer input constructions have an equally important dataplate on the motor. Information plates may be attached to any component to provide operational instructions or precautions. Bolt-on accessories will usually have their own data plates. All plates are to be considered important. The information they contain will be of help to you throughout the life of the drive. Take care not to damage or paint over any of the plates.

When ordering parts or service, or asking a question about your MASTER APG, please provide all the information stamped on both the motor and gearcase dataplates. If your drive has an accessory, such as a brake, provide that information also.

ACCEPTANCE OF SHIPMENT

Thoroughly inspect the equipment before accepting shipment from the transportation company. If any of the goods called for in the bill of lading or express receipt are damaged or missing, do not accept the shipment until the freight or express agent makes an appropriate notation on your freight bill or express receipt. If any concealed loss or damage is discovered later, notify the agent at once and request an inspection. Though MASTER will be happy to assist you with claims for loss or damage in shipment, the transportation company is responsible for reimbursing you for such claims. Claims for loss or damage in shipment must not be deducted from the MASTER invoice, nor should payment of the MASTER invoice be withheld awaiting adjustment for such claims. The carrier, not MASTER, guarantees safe delivery.

If considerable damage or shortage has occurred and the situation is urgent, contact the nearest MASTER Sales Office for assistance.

SAFETY

DANGER

HIGH VOLTAGE AND ROTATING PARTS CAN CAUSE SERIOUS OR FATAL PERSONAL INJURY AND PROPERTY DAMAGE. THE USE OF ELECTRICAL MACHINERY, LIKE ALL OTHER UTILIZATION OF CONCENTRATED POWER AND ROTATING EQUIPMENT, CAN BE HAZARDOUS. INSTALLATION, OPERATION AND MAINTENANCE OF ELECTRIC MACHINERY SHOULD BE PERFORMED ONLY BY QUALIFIED ELECTRICAL AND MECHANICAL MAINTENANCE PERSONNEL FAMILIAR WITH NEMA SAFETY STANDARDS, THE NATIONAL ELECTRICAL CODE AND SOUND LOCAL PRACTICES. THE MANUAL IS TO BE STUDIED THOROUGHLY BY PERSONNEL RESPONSIBLE FOR THE INSTALLATION AND MAINTENANCE OF THIS EQUIPMENT BEFORE INSTALLATION IS BEGUN. PERSONNEL MUST BE FAMILIAR WITH THE POTENTIAL HAZARDS INVOLVED. IF THIS WARNING IS NOT OBSERVED, PERSONAL INJURY AND/OR PROPERTY DAMAGE MAY RESULT. KEEP THIS MANUAL FOR FUTURE REFERENCE.

Many precautions are inserted in this manual to advise personnel of possible hazards. All should be read and understood before any work is begun. Adequate installation, maintenance and safety instructions must be given by the user to personnel responsible for the operation of the equipment. The user is also responsible for the installation of proper guards, signs and safety equipment needed to protect the operating personnel.

WARRANTY

NOTE: SERVICE AND REPAIR UNDER WARRANTY SHOULD BE PERFORMED ONLY BY A MASTER AUTHORIZED SERVICE SHOP. CALL WARRANTY ADMINISTRATION AT 888-616-1094 FOR THE NEAREST LOCATION.

The MASTER APG is warranted under the MASTER "Standard Terms and Conditions of Sale."

Warranty claims on any such apparatus must be submitted to the company within one year from date of installation or within three years from date of manufacture, whichever comes first. The Seller's Warranty applies insofar as the equipment is operated within the rating and service conditions for which it was specifically sold. The warranty does not extend to failures induced by misuse, improper storage or handling, abuse or misapplication.

For warranty service, contact the nearest MASTER Sales Office or Authorized Distributor or call Warranty Administration at 888-616-1094.

UNPACKING

After unpacking and inspecting for possible damage, turn the shafts by hand to be sure there are no obstructions to free rotation. C-Face input devices have a shipping strap around the input shaft which must be cut and removed before the shaft may be turned.

WARNING

KEYWAYS IN SHAFTS HAVE SHARP EDGES. USE APPROPRIATE HAND PROTECTION WHEN HANDING SHAFTS. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY .

Check the packing materials. Save any instruction tags, wiring diagrams or accessory parts and hardware. Inspect the dataplate(s) to verify that the drive matches the intended load, application and power supply. If the drive is to go into immediate service, see "INSTALLATION," below. If the MASTER APG is to be stored for some time before going into service, see "STORAGE," below.

STORAGE

NOTE: Unless an extended warranty has been negotiated prior to sale, time in storage is considered time in service for warranty purposes. If a negotiated extended warranty is in effect, these storage procedures must be followed to permit the submission of a valid warranty claim.

Warranty considerations aside, the following storage procedures should be taken to prevent problems when the drive is eventually placed in service.

LONG-TERM STORAGE GUIDELINES FOR GEAR REDUCERS:

Care must be taken to ensure that gear reducers are placed in service in the best possible condition. During periods of long storage (six months or longer) special procedures must be followed which will protect the reducer and make certain that it will be in good condition when ready to be put into service.

By taking special precautions, problems such as seal leakage and reducer failure due to lack of lubrication, improper lubrication quantity, or contamination can be avoided. The following precautions will protect reducers during periods of long-term storage:

A. Preparation:

1. Select a clean, dry, protected storage area free of vibration and temperature extremes. Set the drive level on its feet with no load on either the input or output shafts. Block as needed to keep weight off the motor fan shroud and motor conduit box (if unit has a motor).
2. Fill the gearbox to the highest designated oil level with a recommended lubricant blended with 2% by volume of *Daubert Chemical Co. Nox-Rust VCI-105 oil. Do not fill the gearbox completely full of oil. Expansion space is needed to avoid pressurizing the gearbox during temperature variations. Rotate the input shaft at least 60 revolutions to ensure a full distribution of the lubricant.
3. All condensate drains and breathers (on motors so equipped) are to be fully operable to allow breathing through points other than bearing fits. Remove the condensate drain plugs located in the motor end shield. Position the motor so the drain is at the lowest point. Totally enclosed fan-cooled XT motors are equipped with automatic drains which should be left in place.

4. All units equipped with heaters must have the heaters connected and operational if the storage conditions are in any way like the anticipated service conditions.
5. Motor windings are to be checked with a megohmeter when the equipment is put into storage. The resistance must be recorded and saved for future reference. See “to put the stored unit into service” for the megohmeter check required upon removal from storage.
6. Apply a thick coating of chassis-type grease, Cosmoline or equivalent protective coating *(Daubert Chemical Co. Nox-Rust X-110 is a suitable coating) on all unpainted surfaces including threads, bores, keyways and shafts.
7. Apply a thick coating of chassis-type grease to all exposed shaft seals.
8. If the unit must be stored outdoors or in damp or unheated areas indoors, cover the entire exterior with a rust preventative. Seal the unit in a moisture-proof container or in an envelope of heavy polyethylene film with a dessicant inside. Shade the enclosure from direct sunlight.
9. Rotate the input shaft at least 60 revolutions once a month to redistribute the lubricant and to prevent brinelling of bearings and drying of seals.
10. Instruction manuals and tags are paper and must be kept dry. Remove these documents and store them in a safe, dry place for future reference at start up.

B. To put the stored unit into service:

1. Remove all protective coatings added for storage.
2. Drain and refill the gearbox with a recommended type and amount of lubricant. Regreasable assemblies and bearings must be purged and filled with new grease.
3. Install the oil level plug in the proper location for the mounting position to be used. Check the motor condensate drain locations to assure the motors will drain properly when mounted in the proposed position. Rotate the motor on the gearhead or rotate the motor end shields on the motor frame if necessary to get the drains in the proper positions.
4. Check all hardware for proper tightness.
5. If the gear unit has been stored for more than three years or in an area with high ambient temperatures, the oil seals must be replaced before being put into service. See the instruction manual for directions on oil seal replacement.
6. Check the motor stator insulation resistance with a megohmeter. Resistance less than one megohm or less than 50% of the resistance reading taken when the motor was put into storage (whichever is the higher resistance), requires the motor winding to be dried in one of the two ways described below. If drying does not restore the winding insulation resistance to the values listed above, the motor must be repaired or rewound.

   Remove the motor from the reducer, place motor in a ventilated oven at not more than 90 degrees C (194 degrees F). Check the insulation resistance every 30 minutes. Bake until the resistance becomes constant.

   Alternate method:

   Lock the motor rotor. Insert a thermocouple in the winding or set up to measure temperature rise by resistance. Apply low voltage, gradually increase voltage until winding temperature reaches 90 degrees C (194 degrees F). Do not exceed! Check winding insulation resistance with megometer. Repeat process if necessary.

   After drying, briefly run the motor not connected to any load to further dry the motor and to check the bearings for noise and smooth operation.
7. When stored motors are found to be wet, a more detailed inspection should be made by removing the motor end shields and visually inspecting for water in the grease or rust on the bearings. If either is found, replace the bearings, clean the end shields thoroughly and relubricate.

*Note: Daubert Nox-Rust VCI-105 oil and Nox-Rust X-110 protective coating can be procured in bulk quantity from:

Daubert Chemical Company, Inc.

4700 S. Central Ave.

Chicago, Illinois 60638

Telephone (708) 496–7350

or in 5-gallon pails from their distributor:

Rock Island Lubricants and Chemicals

1320 First Street

Rock Island, Illinois 61204–5015

Telephone (309) 788–5631

INSTALLATION

A good installation is essential to get the long life and superior performance designed into the MASTER APG. Careful planning and good workmanship at installation will greatly reduce future maintenance problems.

PROPER APPLICATION

Review the dataplates on the MASTER APG gearcase and drive motor to verify that the drive is correct for the intended loads, speeds and electric power supply. The MASTER APG catalog has detailed rating charts and instructions for applying proper service factors for various types of applications. Verify that the MASTER APG has the correct enclosures for your application. Standard enclosures are not suitable for explosion proof or washdown applications.

WARNING

THE USE OF ELECTRICAL EQUIPMENT IN HAZARDOUS LOCATIONS IS RESTRICTED BY THE NATIONAL ELECTRICAL CODE, ARTICLE 500. ORIGINAL EQUIPMENT MANUFACTURERS AND USER CUSTOMERS MUST READ, UNDERSTAND AND APPLY ARTICLE 500 FOR INSTALLATION AND USE OF ALL EQUIPMENT IN SUCH LOCATIONS AND CONSULT LOCAL CODE INSPECTION AND ENFORCEMENT AGENCIES AS NECESSARY TO ENSURE COMPLIANCE. MOTORS LISTED BY UNDERWRITERS LABORATORIES, INC. FOR USE IN SPECIFIC LOCATIONS HAVE BEEN DESIGNED, TESTED AND APPROVED FOR USE IN SUCH LOCATIONS ONLY.

Review the application to determine the signs, guards and any special provisions or devices needed to make the installation safe, practical and legal.

WARNING

MOTORS WITH AUTOMATIC RESET THERMAL PROTECTORS SHOULD BE USED ONLY IN APPLICATIONS WHERE AN UNEXPECTED RESTART WOULD NOT BE HAZARDOUS. IF A MOTOR WITH AN AUTOMATIC RESET THERMAL PROTECTORS HAS TRIPPED TO "OFF", BE SURE TO DISCONNECT AND LOCKOUT THE ELECTRICAL POWER SUPPLY TO THE MOTOR BEFORE WORKING NEAR THE MOTOR OR ANY EQUIPMENT DRIVEN BY THE MOTOR. AN UNEXPECTED AUTOMATIC "RESET" AND MOTOR START COULD CAUSE SERIOUS BODILY INJURY.

Review the application to assure that any accessories on the MASTER APG are correct for the intended use and that the accessories needed are provided. Installations involving holding or overhauling loads such as hoists or conveyors should have a brake or other separate locking device installed.

WARNING

BACKSTOPS ARE NOT RECOMMENDED FOR APPLICATIONS INVOLVING SHOCK AND/OR TORQUE LOADS IN EXCESS OF THE GEARBOX RATINGS. BACKSTOPS ARE NOT RECOMMENDED FOR APPLICATIONS REQUIRING ENERGY ABSORPTION. BACKSTOPS ARE NOT RECOMMENDED ON APPLICATIONS SUCH AS CHAIR LIFTS OR AMUSEMENT RIDES, NOR ON ANY APPLICATION WHERE THE SAFETY OF PERSONS OR PROPERTY IS DEPENDENT ON THE BACKSTOP FUNCTION. OTHER SAFETY DEVICES MUST BE PROVIDED BY THE USER ON SUCH APPLICATIONS.

Review the application for any unusually high or low ambient temperatures and for sources of radiant heat. Abnormally high temperatures will seriously shorten the operating life of any machine. For every 10 degrees C (18 degrees F) rise in temperature above the maximum rated thermal limit, the life of motor insulation, shaft seals and lubricants is reduced by half. The total temperature, not just the temperature rise, is the measure of safe operation.

The MASTER APG and its motor should be shielded from hot surfaces, such as ovens or furnaces, and shaded from direct sunlight to prevent overheating when operating at high loads. The thermal horsepower rating of the gearcase should be checked as described in the MASTER APG catalog. Each motor nameplate carries a maximum ambient temperature rating. Motors should not be operated at ambients in excess of this rating. Applications with frequent starts should be reviewed to be sure the thermal rating of the motor is not exceeded.

Extreme low temperatures require special attention to lubricants, as detailed in the "LUBRICATION" section of this manual. Flexible components such as wiring and lip seals must also be considered to assure they remain flexible in service. The drive should be shielded from the direct discharge of freezer air supply ducts.

Questions about MASTER APG applications should be directed to Applications Engineering at 888-616-1094.

MOUNTING MOTORS TO C-FACE REDUCERS

1. Prepare the reducer by cutting the shipping strap from the input hub and removing the shipping strap retaining plug. Loosen the input shaft clamp collar. The clamp collar must be positioned so that the outside face of the collar is flush with the outside end of the reducer input hub. Check the input hub bore for dirt or damage which may make assembly difficult.
2. Prepare motor by checking the motor shaft extension for dirt or damage. Remove any anti-rust coating that may be on the shaft. Motor frame sizes 56C through 320TC have keys which are pre-installed in the input shaft keyway. Apply a thin, even coating of the anti-seize compound supplied to the entire motor shaft extension and key. Leave no bare areas. Push the motor shaft into the reducer input shaft.

   Motor frame sizes 360TC and larger have a loose key in the input shaft. Install this key in the motorshaft keyway flush with the end of the shaft. Lightly stake the shaft keyway at the motor end of the key to prevent the key from sliding back as the motor is pushed into the reducer input shaft. Apply anti-seize compound as listed above.
3. The MASTER APG C-Face reducer should be firmly anchored to prevent sliding as the motor is mounted. The motor should be rotated on its axis so the motor flange holes line up with the reducer input flange holes. Check to be sure the motor conduit box, grease fittings and condensate drains (where fitted) will be oriented as needed by the reducer mounting position. Motor end shields may have to be removed and rotated in some installations to permit proper positioning.

WARNING

KEEP FINGERS CLEAR OF THE MATING FLANGES ON THE MOTOR AND REDUCER. WHEN ALL PARTS REACH ALIGNMENT, THE MOTOR CAN ENGAGE THE REDUCER VERY RAPIDLY AND WITH GREAT FORCE. ANYTHING BETWEEN THE FLANGES WILL BE SERIOUSLY INJURED.

4. Hoist the motor level and in line with the reducer input bore. Align the motor shaft key with the reducer input bore keyway and push the motor into place. Motor shaft to reducer input bore clearances are tight and good alignment is essential. If the motor resists going into place, raise or lower the motor slightly while maintaining a steady push toward the reducer. Check the clamp collar to be sure it is still loose on the input hub, and flush with the outside end of the reducer input hub. Use care if pushing on the fan housing or conduit box. These parts are easily damaged.

WARNING
KEEP FINGERS CLEAR OF THE MATING FLANGES ON THE MOTOR AND REDUCER. WHEN ALL PARTS REACH ALIGNMENT, THE MOTOR CAN ENGAGE THE REDUCER VERY RAPIDLY AND WITH GREAT FORCE. ANYTHING BETWEEN THE FLANGES WILL BE SERIOUSLY INJURED.

5. Insert and tighten the motor retaining bolts. Torque to the value shown below:

C-FACE MOTOR FRAME SIZE	RETAINING BOLT SIZE	BOLT TORQUE LB-FT
56–140	3/8–16	23
180–286	½–13	55
324–365	5/8–11	110

6. Important! Clamp collar MUST be located so that the outside face of the clamp collar is flush with the outside end of the reducer hub. Clamp collar screw tightening torque is critical to coupling longevity. Tighten the clamp collar screw through the access hole in the adapter with an industrial TORX driver and a torque wrench. T-handle wrenches are unacceptable.

C-FACE MOTOR FRAME SIZE	CLAMP COLLAR BOLT SIZE	ORIGINAL SOCKET-HEAD WRENCH SIZE	NEW TORX DRIVER	BOLT TORQUE LB-FT
56–140	¼–28	3/16	T30	14
18–250	5/16–24	1/4	T45	27
280–365	3/8–24	5/16	T50	47
400	½–20	3/8	T55	100

NOTE: Industrial TORX driver inserts for the APEX TOOL M–480–6 bit holder include:
T30: Apex 480–TX–30–X T50: Apex 480–TX–50–X
T45: Apex 480–TX–45–X T55: Apex 480–TX–55–X

WARNING
REMOVE THE WRENCH AND INSTALL THE SOLID, SNAP-IN SAFETY PLUG PROVIDED AFTER TIGHTENING THE C-FACE REDUCER INPUT HUB CLAMP COLLAR TO THE SPECIFIED TORQUE. FAILURE TO REMOVE THE WRENCH AND INSTALL THE SAFETY PLUG MAY CAUSE BODILY INJURY.

LIFTING AND MOVING THE MASTER APG

WARNING
CARE MUST BE TAKEN WHEN LIFTING OR MOVING THE MASTER APG TO AVOID BODILY INJURY, PROPERTY DAMAGE AND/OR DAMAGE TO THE MASTER APG. DO NOT USE LIGHT EYEBOLTS WHICH MAY BE PROVIDED ONLY FOR HANDLING THE MOTOR TO LIFT THE MOTOR AND ANY ATTACHED EQUIPMENT SUCH AS GEARHEAD. LIFTING DEVICES MUST NOT BE ATTACHED TO NOR LIFTING LOADS APPLIED TO LIGHT HOUSING COMPONENTS SUCH AS CONDUIT BOXES OR FAN SHROUDS.

Suitable handling equipment of adequate capacity is necessary for the safe installation of the MASTER APG. The charts below can be used as a guide for the lifting capacity needed. Be sure to add capacity for any attached accessories or structure.

APPROXIMATE WEIGHTS OF THE MASTER APG
S = Single Reduction D = Double Reduction
T = Triple Reduction

GEARMOTOR WITH MAXIMUM HORSEPOWER MOTOR ATTACHED - POUNDS

APG	FOOT MOUNTED			FLANGE MOUNTED		
SIZE	S	D	T	S	D	T
3	202	221	97	211	232	108
4	325	349	126	334	366	143
5	476	524	273	491	546	295
6	895	969	406	921	1016	453
7	1706	1845	846	1746	1973	974
8	2066	2370	1497	2105	2491	1618

C-FACE REDUCER WITH MAXIMUM HORSEPOWER MOTOR - POUNDS

APG		FOOT MOUNTED		FLANGE MOUNTED		
SIZE	S	D	T	S	D	T
2	N/A	182	95	N/A	190	108
3	208	227	108	217	238	119
4	333	356	174	342	373	191
5	489	538	299	504	560	321
6	937	1011	470	963	1058	517
7	1404	1543	868	1444	1671	996
8	1484	1742	1561	1524	1863	1689

SEPARATE REDUCER (NO MOTOR OR ACCESSORIES ATTACHED) - POUNDS

APG	FOOT MOUNTED		
SIZE	S	D	T
3	41	59	66
4	48	72	80
5	94	142	160
6	143	218	240
7	340	479	530
6	420	724	790

DRIVE LOCATION, MOUNTING POSITION AND SAFETY GUARDS

WARNING
THE MASTER APG AND ITS CONNECTED EQUIPMENT AND ACCESSORIES MUST BE GUARDED. ROTATING PARTS SUCH AS COUPLINGS, PULLEYS, FANS AND UNUSED SHAFT EXTENSIONS MUST BE PERMANENTLY GUARDED BY THE USER AGAINST ACCIDENTAL CONTACT WITH PERSONNEL AND THEIR CLOTHING. THE SURFACE TEMPERATURE OF THE MASTER APG ENCLOSURE MAY REACH TEMPERATURES WHICH CAN CAUSE DISCOMFORT OR INJURY TO PERSONNEL ACCIDENTLY COMING INTO CONTACT WITH HOT SURFACES. THE USER SHOULD PROVIDE GUARDS TO PREVENT ACCIDENTAL CONTACT WITH HOT SURFACES. GUARDS MUST BE SUFFICIENTLY RIGID TO MAINTAIN ADEQUATE GUARDING IN NORMAL SERVICE.

Review the installation for interferences with adjacent structures and access for maintenance. Lubrication fittings and plugs should be easy to reach. It may be necessary to extend lubrication lines with properly supported pipe nipples and fittings. Fill, drain and vent plugs must be located at the levels shown in the "LUBRICATION" section of this manual. Consult the factory for proper lubricant level and vent locations for mounting positions not shown.

CAUTION

MOTORS INSTALLED VERTICALLY MUST BE PROPERLY GUARDED BY THE USER TO PREVENT FALLING OBJECTS FROM STRIKING ROTATING PARTS. FAILURE TO OBSERVE THIS PRECAUTION MAY RESULT IN DAMAGE TO THE EQUIPMENT.

Electric motors are normally designed for mounting in a horizontal position. If the motor is mounted vertically, additional guards may be needed to prevent foreign objects from falling into the motor openings and striking rotating parts. Suitable guards to shield openings in Reliance motors are available through your local Reliance Sales Office.

Some totally enclosed motors are equipped with condensate drain plugs located in the motor end shields. The motor should be positioned so these plugs are down for drainage and the plugs removed. Automatic drain plugs found on some motors should be left in place.

DRIVE SUPPORTS AND FOUNDATIONS

Foundations or fabricated supports to which the MASTER APG is mounted must be carefully designed to provide sufficient rigidity to maintain alignment with the driven equipment and to withstand the intended operating conditions. The mounting surface in contact with the gearcase feet or mounting flange must be flat to assure uniform loading.

A rigid base plate is recommended for mounting to structural steel. Bolt the gearcase and base plate securely to the steel supports, using riser blocks as needed between the baseplate and the gearcase. Shim as needed to assure a flat surface. If the MASTER APG is to be mounted to a concrete foundation, grout steel mounting pads into the concrete base. Mount the gearcase to the steel pads. Do not grout the reducer directly into a concrete foundation.

LEVELING AND ALIGNMENT

The foot mounted MASTER APG must be supported evenly on all four feet or riser blocks** to prevent distortion or fracture of the gearcase. Use a feeler gauge to determine the correct thickness of steel shims required. All feet must be solidly supported before tightening the mounting bolts.

The flange mounted MASTER APG must also have even support at the flange face. Use a feeler gauge to verify that the flange has solid contact with the mounting surface at all attachment points and is not being "broken" across high spots between bolts. Where practical, flange mount units will benefit from additional support under the gearcase feet.

CAUTION

WHERE BOTH THE FLANGE AND THE FEET ARE SUPPORTED, EXTRA CARE MUST BE USED IN SHIMMING TO ASSURE THAT NO LOADS ARE IMPOSED ON THE ASSEMBLY AS THE MOUNTING BOLTS ARE TIGHTENED. FAILURE TO OBSERVE THIS PRECAUTION MAY RESULT IN DAMAGE TO THE EQUIPMENT.

Good alignment of attached input and output devices is important to avoid excessive overhung and thrust loads on the MASTER APG shafts. Couplings must be well aligned and have adequate clearance along the axis of the connected shafts. Carefully follow the installation instructions provided with the coupling used.

HARDWARE FOR MOUNTING THE MASTER APG

WARNING

THREADED HARDWARE USED TO MOUNT THE MASTER APG MUST BE SAE GRADE 5 OR METRIC CLASS 8.8 OR BETTER. DO NOT USE HARDWARE OF A LOWER GRADE. FAILURE TO OBSERVE THIS PRECAUTION MAY RESULT IN BODILY INJURY.

Bolts, nuts and washers used to mount the MASTER APG must be of first quality and of the material grades specified in the warning above. The use of self-locking hardware and/or proven locking devices is recommended. Hardware should be evenly tightened to 10% of the torque shown in the following charts. Make another check with a feeler gauge to assure level shimming. The hardware is then evenly tightened to the full torque specified. The torques shown are for "lubricated" threads which are defined as any plated thread or a thread containing any amount of oil or wax. Most threaded hardware is lubricated. If in doubt, wipe the threads with a lightly oiled rag.

FOOT BOLT SIZES FOR THE FOOT MOUNTED MASTER APG SINGLE, DOUBLE AND TRIPLE REDUCTION

CASE SIZE	SAE BOLT SIZE	TORQUE LB-FT	METRIC BOLT SIZE	TORQUE LB-FT
2	$^{5}/_{16}$–18	13	M8	19
3	$^{3}/_{8}$–16	23	M10	38
4	½–13	55	M12	67
5	$^{5}/_{8}$–11	110	M16	158
6	¾–10	200	M20	308
7 & 8	$1^{1}/_{8}$–7	600	M30	1067

** Riser Blocks are shipped with unit where needed.

FLANGE BOLT SIZES FOR THE FLANGE MOUNTED MASTER APG SINGLE (S) AND DOUBLE/TRIPLE (D/T) REDUCTION

CASE SIZE	SAE BOLT SIZE	TORQUE LB-FT	METRIC BOLT SIZE	TORQUE LB-FT
S3, S4, S5	½–13	55	M12	67
D/T2	½–13	55	M12	67
D/T3, D/T4	½–13	55	M12	67
S6, S7, S8	5/8–11	110	–	–
D/T5, D/T6, D/T7, D/T8	¾-10	200	M20	308

ATTACHMENTS TO SHAFTS

Use care when installing couplings, sprockets and pulleys on the MASTER APG input or output shafts. Such components should not be hammered into place. Damage to shafts and bearings may result. If parts do not slip onto shafts easily, check for dirt or burrs that may be binding the assembly. Very tightly fitted parts may need to be heated to get them onto the shafts. Keys should be located for maximum engagement between the shaft and the attached part. Sprockets and pulleys should be mounted as close as possible to the gearcase to minimize overhung loads. Retaining hardware for sprockets, pulleys and couplings should be tightened as recommended by the component manufacturer. Chain and belt drives must be aligned to run true. Tighten chains and belts according to the chain or belt manufacturer's instructions. Excessive tension produces rapid chain and belt wear and reduces the bearing life of the MASTER APG.

MOTOR WIRING

DANGER

THE USER IS RESPONSIBLE FOR CONFORMING TO THE NATIONAL ELECTRICAL CODE IN THE INSTALLATION OF WIRING FOR THE MASTER APG. THE USER IS ALSO RESPONSIBLE FOR UNDERSTANDING AND APPLYING ALL OTHER APPLICABLE LOCAL CODES WHICH GOVERN SUCH PRACTICES AS WIRING PROCEDURES, WIRING PROTECTION, GROUNDING, DISCONNECTS AND OVER-CURRENT PROTECTION. BE CERTAIN THE ELECTRICAL POWER IS DISCONNECTED AND LOCKED OUT BEFORE ATTEMPTING CONNECTION TO THE POWER SUPPLY, CHANGING CONNECTIONS OR DOING ANY OTHER WORK NEAR THE DRIVE OR ITS CONNECTED EQUIPMENT. IF THIS PRECAUTION IS NOT OBSERVED, SERIOUS INJURY, FATALITY OR PROPERTY DAMAGE MAY RESULT.

These motor wiring instructions apply to all gearmotor versions of the MASTER APG. However, these instructions apply to the NEMA C-face and separate reducer versions only if a MASTER motor is used. If a motor manufactured by other than MASTER is used, refer to the motor manufacturer for wiring instructions.

All motors should be installed, protected and used in accordance with the National Electric Code and NEMA Standard publication MG-2. Connect the motor to the power supply according to the diagram in the conduit box or on the motor dataplate. Fuses, thermal cutouts and other protective devices should be of the correct size to safely carry the load while reliably interrupting the circuit on overloads. Built-in motor thermals, when installed, are of the proper size to prov ide the required protection.

RECOMMENDED WIRE SIZES BY MOTOR HORSEPOWER AND VOLTAGE

	HORSEPOWER								
VOLTS	1–3	5	7½	10	15	20	25	30	40
230	14	12	10	8	6	4	2	1	00
460	14	14	14	12	10	8	6	6	4
575	14	14	14	14	10	10	8	8	6

	HORSEPOWER		
VOLTS	50	60	75
230	000	0000	300
460	2	1	0
575	4	3	1

MOTOR DIRECTION OF ROTATION

DANGER

POWER MUST BE DISCONNECTED AND LOCKED OUT BEFORE ATTEMPTING TO CHANGE MOTOR ROTATION. BEFORE CHANGING MOTOR ROTATION, CHECK THE MASTER APG, THE CONNECTED EQUIPMENT AND ALL ACCESSORIES FOR THE ONE-WAY MECHANICAL DEVICES, SUCH AS BACKSTOPS. THE DIRECTION OF ROTATION OF ANY SUCH DEVICE MUST MATCH MOTOR ROTATION OR PERSONAL INJURY OR PROPERTY DAMAGE MAY RESULT.

Refer to motor wiring diagram for the proper method of changing the direction of rotation of the motor.

GROUNDING

DANGER

THE METAL EXTERIORS OF MOTORS, GEAR-HEADS GUARDS AND DRIVE ACCESSORIES ARE USUALLY GROUNDED TO LIMIT THEIR POTENTIAL TO GROUND IN THE EVENT OF ACCIDENTAL CONNECTION OR THE CONTACT BETWEEN LIVE ELECTRICAL PARTS AND THE METAL EXTERIORS. HOWEVER, WHEN CAREFUL CONSIDERATIONS OF THE HAZARDS INVOLVED IN A PARTICULAR APPLICATION INDICATE THE MACHINE FRAMES SHOULD NOT BE GROUNDED, OR WHEN UNUSUAL OPERATING CONDITIONS DICTATE THAT A GROUNDED FRAME CANNOT BE USED, THE USER SHOULD MAKE SURE THE MACHINE IS PERMANENTLY AND EFFECTIVELY INSULATED FROM THE GROUND. APPROPRIATE PERMANENT WARNING LABELS OR SIGNS SHOULD BE INSTALLED BY THE USER OR IN THE AREA OF THE EQUIPMENT.

Frames and accessories on motors should be grounded in accordance with the National Electrical Code. Where no other specific grounding point is provided, the motor conduit box mounting screw is recommended.

PRE-START CHECKLIST – Before making the final connection to the driven load, use the following checklist to be sure that:

1. Oil level, air vent and oil drain plugs are in the proper locations for the mounting position used.
2. Lubricants have been checked for the proper type, viscosity and amount for the temperatures and conditions.
3. Hardware has been checked for proper tightness.

DANGER

BE CERTAIN ALL WIRING CONFORMS TO THE WIRING DIAGRAMS AND TO APPLICABLE SAFETY CODES. RECHECK FOR CORRECT COLORS AND NUMBER IDENTIFICATIONS.

4. Electrical connections have been checked and insulated.
5. Alignment of the drive with all couplings, shafts, pulleys, sprockets and connected equipment has been checked. Connection to the driven load is disconnected.

WARNING

MAKE SURE ALL GUARDS ARE IN PLACE, CLEAR OF ALL MOVING PARTS AND SECURELY FASTENED BEFORE START UP.

6. Required guards and signs are in place and secure.
7. Support structure is in place and secure.

WARNING

BEFORE STARTING THE MASTER APG, OBSERVE ALL LOCAL SAFETY CODES. MAKE SURE ALL PERSONNEL AND ALL OBSTRUCTIONS ARE CLEAR OF MOVING PARTS.

8. Personnel are clear.
9. Tools, trash and loose keys, setscrews or other unused rotating parts have been removed from the area. Check C-Face drives to be sure the clamp collar wrench has been removed and that the snap-in safety plug has been installed.
10. Backstop rotation has been checked.

CAUTION

TO AVOID DAMAGE TO THE MOTOR USED WITH A MASTER APG WITH A BUILT-IN BACKSTOP, SEPARATE THE CONNECTION BETWEEN THE MOTOR AND THE REDUCER. TURN THE REDUCER INPUT SHAFT TO VERIFY THE DIRECTION OF BACKSTOP ROTATION. REMOVE ALL KEYS OR OTHER UNSECURED ROTATING PARTS FROM THE MOTOR SHAFT. OPERATE THE MOTOR TO ASSURE IT IS CONNECTED FOR THE ROTATION DESIRED. IF BOTH THE MOTOR AND THE BACKSTOPOPERATE IN THE PROPER DIRECTION, RECONNECT THE MOTOR TO THE REDUCER.

11. With all of the above accomplished, energize the motor to verify proper rotation.
12. SEE THE STARTUP CHECKLIST BEFORE MAKING THE FINAL CONNECTION TO THE DRIVEN EQUIPMENT.

STARTUP CHECKLIST – Before making the final connection to the driven equipment, review the Pre-start Checklist to be sure all work has been completed and all precautions observed, then proceed with this checklist:

1. Be sure the driven equipment is ready to run with all brakes released, blocking removed and loose parts secured.
2. Make the final connection between the MASTER APG and the driven equipment. Check alignment of the connecting coupling or sprocket and secure any shields and guards.
3. If possible, arrange to start the motor slowly to avoid shock loads on the gearing and the connected equipment. Across the line starting of motors should be used with care to prevent overloading gears and driven equipment, especially on applications where the connected load has considerable inertia.
4. Make a last check to be sure personnel are clear, then start the drive.
5. Bring the drive to normal operating speed. Check for excessive vibration, unusual noises or oil leakage. Overheating may take two hours or more to become apparent. If any problems develop, the drive should be shut down. Determine the cause and correct the problem before restarting the MASTER APG. The TROUBLE SHOOTING CHART is a useful aid in diagnosing problems.

LUBRICATION OF THE MASTER APG

WARNING

HOT OIL CAN CAUSE SERVE BURNS. USE EXTREME CARE WHEN REMOVING LUBRICATION PLUGS AND VENTS. DO NOT GET IN LINE WITH THE PLUG. HOT OIL CAN BE BLOWN A CONSIDERABLE DISTANCE SHOULD THE GEARCASE BE PRESSURIZED BY A CLOGGED VENT. WEAR SUITABLE PROTECTIVE CLOTHING AND EYE SHIELDS.

Proper lubrication is essential to the performance and life of the MASTER APG. Proper lubrication consists of:

1. Use of the proper type and viscosity of lubricants.
2. Maintenance of the correct oil level for the mounting position used.
3. Drain, flush and refill at the required intervals.

Cleanliness is also critical to proper lubrication and maintenance. All lubricants used should be clean and fresh. Containers used to handle lubricants should be clean. The area around a lube or vent plug should be wiped down before removing the plug to prevent dirt from getting into the gearbox. Grease fittings should be wiped clean before use.

The MASTER APG is filled at the factory with Mobil SHC 634 oil to the correct oil level for the specified mounting position. The correct oil level is indicated by the red oil level plug. Changes in the mounting position will require relocation of the oil level and vent plugs. Oil may have to be added or drained to get the correct oil level in the new mounting position. See the Mounting Position diagrams diagrams in this section of the manual for the correct plug locations for various mounting positions.

The oil level should be checked before start-up and frequently thereafter, preferably with the gearbox warm. Check the oil level by removing the red plug. The oil level should be at the bottom edge of the threaded hole. If the level is low, add oil slowly through one of the upper plug holes until the oil starts out the level hole. Replace all plugs securely.

WARNING

HOT OIL CAN CAUSE SERVE BURNS. USE EXTREME CARE WHEN REMOVING LUBRICATION PLUGS AND VENTS. DO NOT GET IN LINE WITH THE PLUG. HOT OIL CAN BE BLOWN A CONSIDERABLE DISTANCE SHOULD THE GEARCASE BE PRESSURIZED BY A CLOGGED VENT. WEAR SUITABLE PROTECTIVE CLOTHING AND EYE SHIELDS.

OPERATING TEMPERATURES

WARNING

THE SURFACE OF THE MASTER APG ENCLOSURE MAY REACH TEMPERATURES WHICH CAN CAUSE DISCOMFORT OR INJURY TO PERSONNEL ACCIDENTLY COMING INTO CONTACT WITH HOT SURFACES. THE USER SHOULD PROVIDE GUARDS TO PREVENT ACCIDENTAL CONTACT WITH HOT SURFACES.

Heat generation is a natural characteristic of gear operation. A maximum gearcase temperature approaching 200 degrees F is not uncommon for units operating at rated load in normal ambient temperatures. Applications should be reviewed for thermal limitations as defined in the MASTER APG catalog.

GEARCASE VENT

The gearcase vent plug is provided to balance the air pressure inside the gearcase with the atmospheric pressure outside the gearcase. The vent plug must be clear at all times. Do not paint over.

RECOMMENDED GEARCASE LUBRICANT and OIL CHANGE INTERVALS

Mobil SHC634 is factory supplied in the MASTER APG and is suitable for use at all output speeds and in ambient temperatures from -10 degrees F to +110 degrees F. No initial oil change after break in is needed. The initial factory oil fill is good for up to one year in normal industrial environments. Extremely hot, wet or dirty conditions may require more frequent changes. Consult Application Engineering at 888-616-1094 for advice about unusual applications.

ALTERNATE GEARCASE LUBRICANTS and OIL CHANGE INTERVAL

Though Mobil SHC 634 is highly recommended, it is recognized that some users may prefer other lubricants. If a change to another type of oil is made, the Mobil SHC 634 should be drained and the gearcase flushed with clean mineral spirits to avoid any possible compatibility problems between the SHC 634 and the new oil. Flushing is not required if changing to Mobil SHC 629 for low temperature applications, nor is the oil change interval affected. Oil changes every 1500 hours under normal conditions and every 1000 hours under severe conditions are required for all lubricants other than the Mobil SHC series. See factory approved lubricants.

Use only AGMA R & O oils as alternate lubricants. The proper grades of oil for various temperature ranges are listed below:

NOTE: See Backstop Warning

AMBIENT TEMPERATURE (degrees F)	AGMA GRADE
60 - 110	7
35 - 60	6
10 - 35	5
-30 - 10	MOBIL SHC-629

The following chart lists lubricants which are suitable for use under these conditions:

AGMA 7 (ISO 460)	+60ºF. to +110ºF. #
Mobil SHC-634 (Factory Fill)	
Mobil 600W Cylinder Oil	
Mobil 600W Super Cylinder Oil	
Mobilgear 634	
Amoco 460 Cylinder Oil	
Amoco EP460	
Arco Mineral Gear Oil SAE 140	
Fiske Bros. Lubriplate APG 140	
Gulf Transgear Lube EP 140	
Keystone WG-A	
Phillips Philube 140	
Texaco Vanguard 460	
Chevron FM Lubricating Oil 460X (USDA H-1)	
Chevron Borate 460	
Tribol 800/460***	

AGMA 6 (ISO 320)	+35ºF. to +60ºF. #
Mobil SHC-632	
Mobilgear 632	
Mobil DTE Oil AA	
Amoco Industrial Oil 320	
Arco Pennant Oil 320	
Chevron Borate 320	
Tribol 800/320***	

AGMA 5 (ISO 220)	+10°F to +35 °F. #
Mobil SHC-630 Mobilgear 630 Mobil DTE Oil BB Arco Mineral Gear Oil SAE 90 Fiske Bros. Lubriplate APG 90 Phillips Philube 90 Tribol 800/220***	

AGMA 4 (ISO 150)	-30ºF. to +10ºF. # @
Mobil SHC-629 Tribol 800/150***	

\# Be careful of the pour point of all lubricants used in the ambient temperatures listed. The pour point must be at least 10ºF. below the temperature at which it is to be used.

*** Tribol lubricants are polyglycol-based synthetic lubricants. They are not petroleum-based oils. Consequently, when switching from petroleum-based lubricants to polyglycol-based (and vice versa) the gearcase must be thoroughly flushed with mineral spirits before installing the desired lubricant.

@ Lubricants listed in the -30ºF. to +10ºF. ambient range are synthetics. Synthetics are the only lubricants which will have the desired viscosity along with the required low pour point.

This list must not be construed as the only lubricants suitable for use in APG gear reducers. For other lubricant vendors, select a reputable manufacturer, paying close attention to the viscosity and pour point of the lubricant to be used.

NOTE: For ambient temperatures below -45ºF. special oil seals are required. Consult the factory.

SPECIAL INSTRUCTIONS FOR SEPARATE REDUCER ADAPTERS

The input shaft bearings of the size 3 through 6 separate reducer adapters are double shielded ball bearings pre-packed at the factory with a lithium based, mineral oil grease. Size 7 and 8 separate reducer adapter bearings are of the tapered roller type and are oil lubricated.

GREASES FOR USE IN SEPARATE REDUCER INPUT SHAFT BEARINGS:

FOR +10 to +110 degrees F AMBIENT:
- Chevron “SRI-2”
- Exxon “Unirex N-2”

FOR -30 to +10 degrees F AMBIENT:
- Shell “Aeroshell 7”
- Shell “Aeroshell No. 16”
- Exxon “Beacon 325”

FREQUENCY: Separate reducer input shaft bearings must be lubricated every 1000 hours of operation or every 6 months, whichever occurs first. Only size 3 thru 6 units mounted in position 1 need regreasing. On all other mounting positions these bearings are oil. Lubricated. Input bearings on size 7 and 8 reducers do not need to be lubricated with grease. The input bearings on these sizes are always oil lubricated. Lubricating with grease. may cause bearing failure on these sizes.

PROCEDURE: Remove the purging plug(s) before regreasing so old grease will not be forced into the gearbox or through the seals. Add new grease of the type recommended until fresh, clean grease exits the purge hole. After lubricating, run the drive for 15 minutes before replacing the purging plugs.

SPECIAL INSTRUCTIONS FOR SEPARATE REDUCER ADAPTERS EQUIPPED WITH BACKSTOPS

The input shaft bearings in separate reducer adapters are to be lubricated the same whether a backstop is fitted or not. However, extra care should be taken with backstop equipped units to be sure the bearings are not over greased while the backstop is greased per the recommended schedule.

Backstops are very sensitive to proper lubrication.

WARNING

SUBSEQUENT STEPS REQUIRE ROTATING PARTS TO BE EXPOSED. DISCONNECT AND LOCKOUT OR TAG POWER SOURCE BEFORE LUBRICATING UNIT. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

Greases with extreme pressure (EP) additives must not be used. EP greases will prevent the backstop from locking properly. Select a grease from the list below, or consult Application Engineering at 888-616-1094 for other greases.

NOTE: The backstop must be removed from the separate reducer adapter if any grease other than Alvania No. 1 is to be used. Both the backstop and the separate reducer must be thoroughly cleaned before regreasing with an alternate grease.

GREASES FOR USE IN BACKSTOPS

For +10 to +110 degrees F AMBIENT:
- > Shell “Alvania No. 1”
- Fiske Bros. “Lubriplate Low-Temp”
- Fiske Bros. “Aero Lubriplate”

For -30 to +10 degrees F AMBIENT
- Shell “Aeroshell No. 7”
- Shell “Aeroshell No. 16”
- Exxon “Beacon 325”

> Factory supplied grease.

CAUTION

GREASE LUBRICATED BACKSTOPS MUST HAVE THE PROPER GREASE FOR THE AMBIENT TEMPERATURE OF THE INSTALLATION. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN DAMAGE TO THE EQUIPMENT.

FREQUENCY: Backstops must be lubricated every 1000 hours of operation or every 6 months, whichever comes first.

PROCEDURE: Remove the purging plugs before regreasing so old grease will not be forced into the gearbox or bearings. Add new grease of the type recommended until fresh, clean grease exists the purging plug. After lubricating, run the drive for 15 minutes before replacing the purging plugs to allow excess grease to be forced out.

NEMA C-FACE ADAPTER LUBRICATION

The NEMA C-Face adapter is equipped with a single ball bearing which is packed at assembly with Chevron SRI-2 grease. Units mounted in position 1* must have this bearing regreased with Chevron SRI-2 grease every 1000 hours or every six months, whichever occurs first.

Note:

1. Units mounted in position 5 (output shaft down) must be regreased per the following tables.
2. Only units mounted in positions 1 and 5 need regreasing. On all other mounting positions these bearings are oil lubricated.

NOTE: Size 2 C-Face units mounted in position 1 need not be regreased.

CAUTION

ZERK FITTINGS ARE USED ONLY IN POSITIONS 1 AND 5. ON ALL OTHER MOUNTING POSITIONS THIS PIPE-TAPPED HOLE MUST HAVE A SOLID PLUG INSTALLED OR OIL LEAKAGE CAN OCCUR THROUGH THE ZERK. FAILURE TO OBSERVE THIS PRECAUTION WOULD RESULT IN DAMAGE TO THE EQUIPMENT.

OUTPUT SHAFT BEARING LUBRICATION

Units equipped with regreasable output shaft bearings should be regreased with Chevron SRI-2 every 2000 hours or once per year, whichever comes first.

MOTOR BEARING LUBRICATION – GENERAL

Follow the motor manufacturer's instructions for lubrication of motors used with separate reducer and NEMA C-Face style MASTER APG drives. Motors used on gearmotor style MASTER APG drives are to be lubricated as follows.

SMALL MOTORS may have no provision for regreasing the bearings. These motors are equipped with double shielded, deep groove ball bearings, factory packed with sufficient lubricant for the life of the bearing under normal conditions. No periodic service is needed.

MOTORS WITH PROVISION FOR REGREASING may be equipped with grease fittings or with plugs which are to be replaced with grease fittings in service. Motors are properly lubricated at assembly. If the motor has been in storage for six months or more, relubricate the bearings before starting the motor.

MOTOR BEARING LUBRICATION – FREQUENCY AND PROCEDURE

Use the following tables to:

Select the application service conditions: Table 1.

Select the lubrication frequency: Table 2

Select a recommended lubricant: Table 3

Lubricate the motor at the required frequency with the required lubricant volume in accordance with the following procedure.

WARNING

SUBSEQUENT STEPS REQUIRE ROTATING PARTS TO BE EXPOSED. DISCONNECT AND LOCKOUT OR TAG POWER SOURCE BEFORE LUBRICATING UNIT. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

Motors may be lubricated with the motor running or stopped. Stopped with the motor still warm is preferred.

1. Locate the grease inlet for each bearing. Clean the area and replace the pipe plug with a grease fitting if the motor is not equipped with grease fittings.
2. Regrease the bearing using a hand operated grease gun loaded with the recommended lubricant.
3. Run the motor for two hours before replacing the grease fitting with the pipe plug. If desired, the grease fitting may also be left in place.

TABLE 1 – APPLICATION SERVICE CONDITIONS

STANDARD CONDITIONS = 8 hours or less per day at normal load in a clean area at less than 100 degrees F.

SEVERE CONDITIONS = More than 8 hours per day or shock loading or vibration or dirt or dust or ambient temperature above 100 degrees F.

EXTREME CONDITIONS – Heavy shock or severe vibration or extremely dirty or wet conditions.

TABLE 2 – MOTOR BEARING LUBRICATION FREQUENCY

MOTOR HP	STANDARD CONDITIONS	SEVERE CONDITIONS	EXTREME[1] CONDITIONS
1800 RPM or less			
Up to 75 HP	6 months	3 months	1 month
100 HP and up	1 year	6 months	1 month
Over 1800 RPM			
All HP ratings	6 months	3 months	1 month

[1] Includes output shaft down position.

TABLE 3 – RECOMMENDED MOTOR BEARING LUBRICANTS

Motors applied in ambient temperatures from –15 degrees F to +120 degrees F may use any of the lubricants listed below. Consult the factory for the proper lubricants for extremely cold or hot environments.

CHEVRON OIL CO. SRI Number 2
EXXON UNIREX N2
SHELL OIL CO. DOLIUM R
TEXACO INC. PREMIUM RB

The factory supplied bearing lubricant is Chevron SRI No. 2 See the warning below if changing lubricant brand.

CAUTION

MIXING LUBRICANTS IS NOT RECOMMENDED DUE TO POSSIBLE LUBRICANT INCOMPATIBILITY. TO CHANGE LUBRICANT FOLLOW THE INSTRUCTIONS FOR LUBRICATION AND REPEAT LUBRICATION AFTER 100 HOURS OF SERVICE. INSPECT FOR SIGNS OF LUBRICANT INCOMPATIBILITY, SUCH AS EXTREME SOUPINESS VISIBLE FROM THE GREASE RELIEF AREA.

CONVERTING FROM A-1 MOUNTING TO A-3 MOUNTING – SIZES 2–8

If the reducer was ordered for the A-1 mounting position, but it is necessary to change to the A-3 position, it will be necessary to add oil to get the correct level in the new mounting position. Make sure that only Mobil SHC 634 is added. Approved lubricants available through Renewal Parts.

In addition, the grease zerk located on top of the C-face adapter for the A-1 position must be replaced with a 1/8 NPT pipe plug to prevent oil leakage from the zerk in the A-3 position.

If the reducer was manufactured prior to January 1, 1996, (date code NY), a kit may be required to locate the vent in a position that will not discharge oil (depending on the ratio, direction of rotation and input speed). It is suggested that you try the vent position recommended in the service manual supplied with the reducer and shown in Figure 1.

If your reducer configuration and operating conditions result in oil discharging out of the vent, you will need to contact MASTER Warranty Administration to order a vent relocation kit. These will be supplied at no charge.

The kit, P/N 411642–48-A, consists of a 3/8 NPT (male to female) street ell, a 3/8 NPT by 1 inch pipe nipple, a 3/8 NPT pipe coupling, a 3/8 to 1/8 NPT reducer bushing and the standard vent plug. The vent kit must be installed in the oil level hole as shown in Figure 2. Note that it will be necessary to remove the kit at the street ell to check for the proper oil level.

Reducers manufactured after January 1, 1996, have been revised to add an additional hole in the gearcase over the low speed gear set. If the reducer was properly ordered for the A-3 mounting position, a street ell will be shipped with the vent. The proper location is shown in Figure 3.

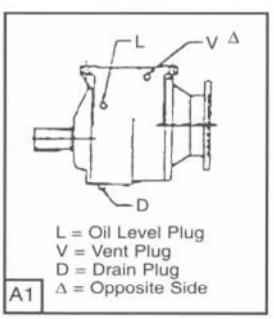


Figure 1

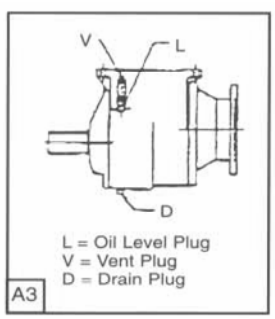


Figure 2

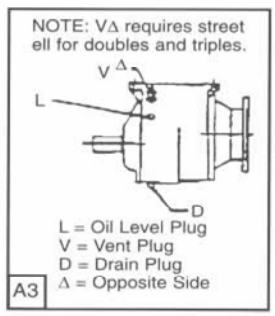
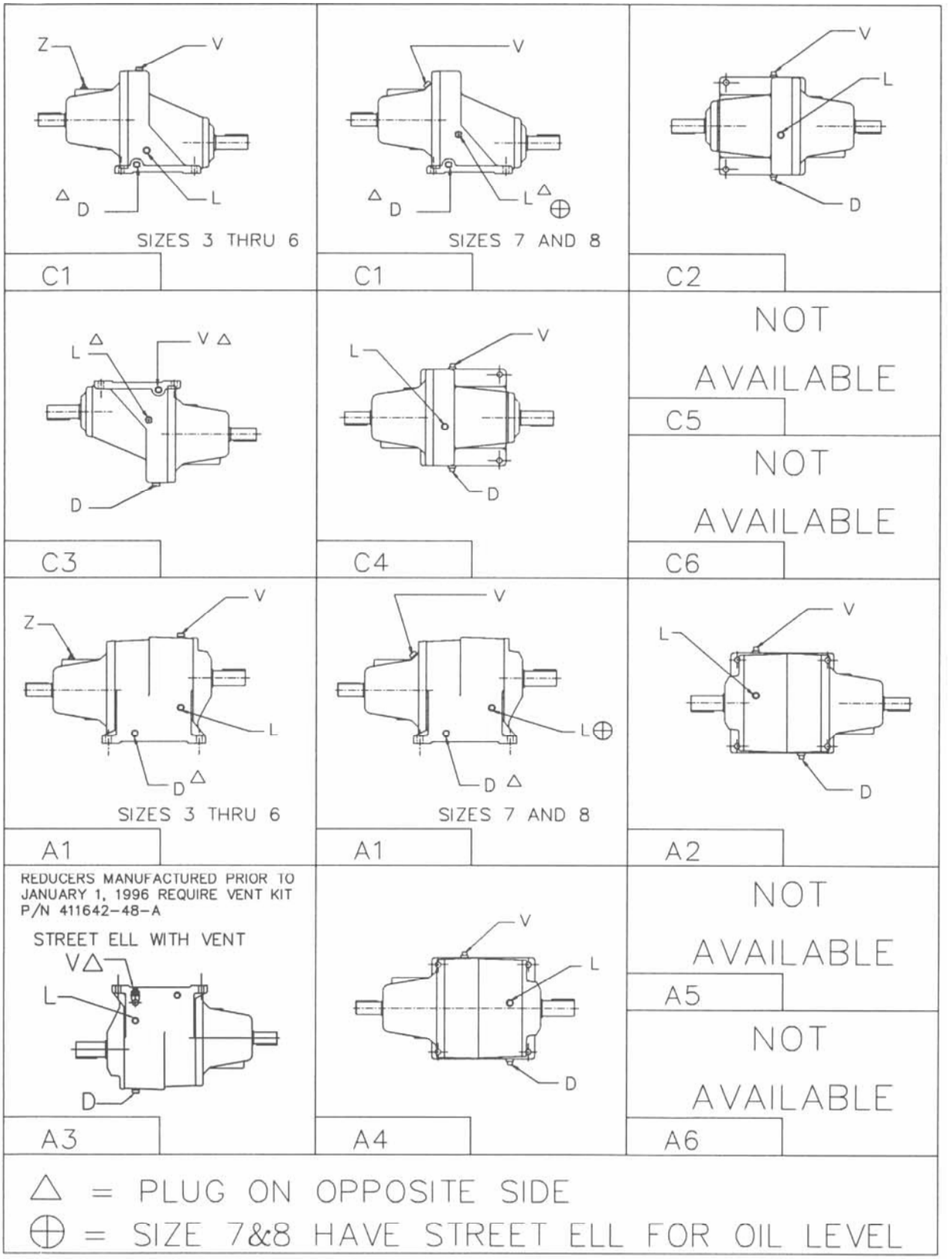


Figure 3

MOUNTING POSITION AND LUBRICATION CHART

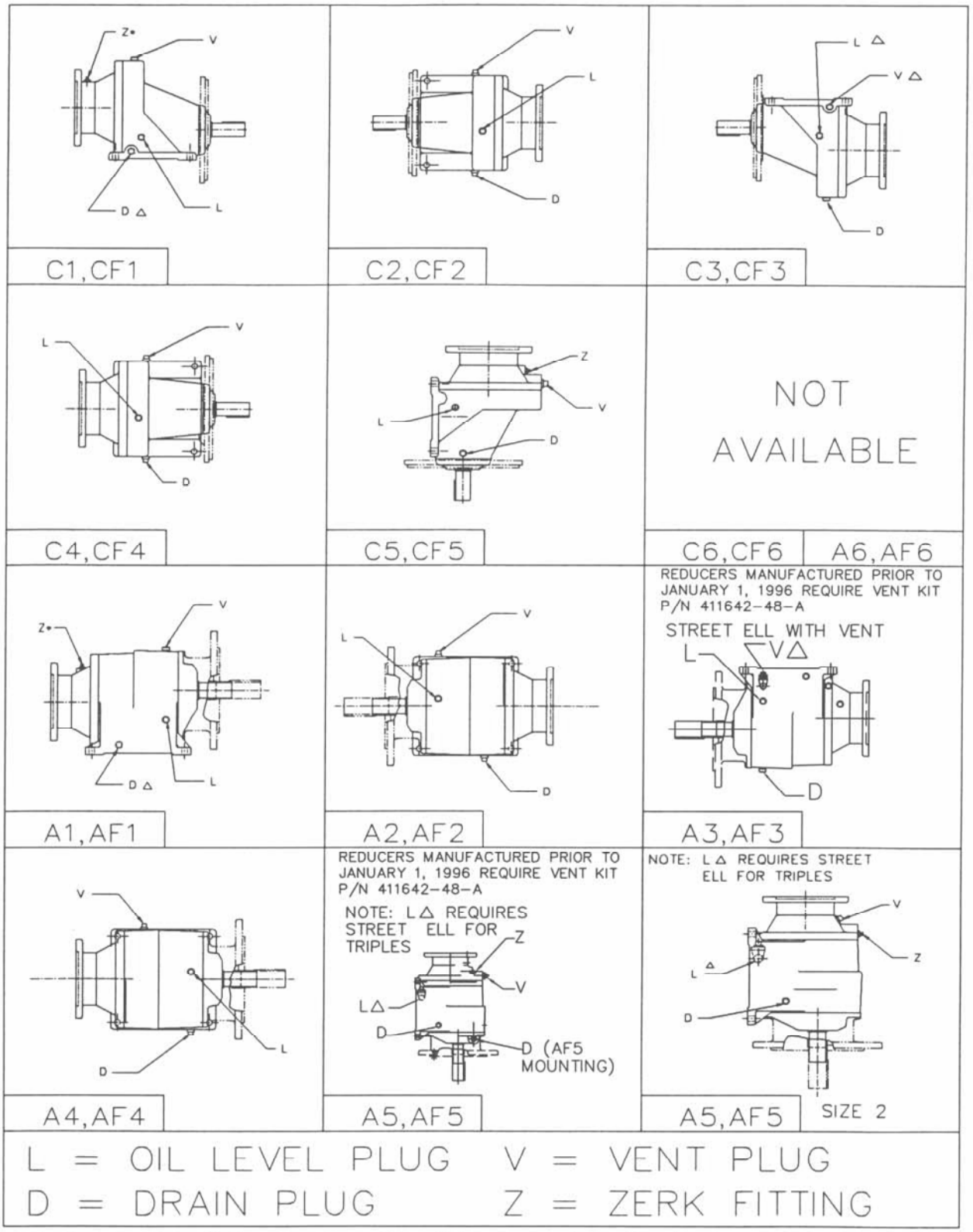
*** SEPARATE REDUCER – INPUT SINGLE/DOUBLE/TRIPLE**



* There is no size 2 separate reducer.

MOUNTING POSITION AND LUBRICATION CHART

*** GEARMOTOR – C-FACE INPUT SINGLE/DOUBLE/TRIPLE**



* Applies to sizes 3 thru 8 only – Size 2 has no zerk in this location. There is no size 2 gearmotor.

TROUBLESHOOTING CHART

PROBLEM	INSPECT FOR …	ACTION
Overheating	1. Overload	Reduce the load or replace the drive with one of adequate rating.
	2. Oil level too high or low	Correct the oil level.
	3. Type or viscosity of oil	Oil must be the type and viscosity specified in the lubrication instructions. Drain and refill with the proper lubricant.
	4. Vent plug stopped up	The vent plug must be open and clean. Clean the vent plug in solvent when servicing the drive.
	5. Bearing adjustment	Shafts should turn freely when disconnected from load. Check end play per this manual. If a shaft has too little or too much end play, the shaft bearings must be reshimmed.
	6. Coupling binding	Adjust couplings to eliminate thrust load on shafts.
	7. Excessive Overhung Load (OHL)	Reduce the OHL by moving the pulley or sprocket closer to the gearcase, by using a larger diameter pulley or sprocket or by adding an outboard support bearing.
	8. Excessive ambient temperature or radiant heat sources or blocked air flow	Check thermal rating per procedure in the catalog. Shield from hot surfaces and direct sunlight. Clean thoroughly with special attention to the motor fan and fan shroud.
	9. Line voltage too high or low or phase problem	Check for rated voltage at all phases at the motor terminals.
Bearing Failure	1. Overload	See Overheating, Item 1 above. Abnormal loading produces flaking cracks and fractures of the bearing.
	2. Excessive Overhung Load	See Overheating, Item 7 above.
	3. Bearing Adjustment (OHL)	See Overheating, Item 5. If a bearing is too loose or not square with the shaft axis an erratic wear pattern may show in the bearing race.
	4. Improper lubrication	Verify correct oil level, oil type and viscosity. Note that some bearings require periodic greasing depending on mounting position and construction as detailed in this manual.
	5. Rust, water and dirt	Make provisions to prevent the entrance of dirt or water. Cover the vent plug before washing down the drive. Lubricate bearings and gears by rotating the input shaft often during long shutdown. Check that condensate drains in the motor are open and in the proper position to drain.
	6. Damage from improper storage or prolonged shutdown	Long periods of storage in damp or unheated areas will rust bearings and gears. The drive must be disassembled for inspection. Rusted parts must be replaced. See “Storage” for proper storage procedures to prevent such damage.
Excessive Noise	1. Unusual or increasing noise	Check all parts and accessories for tightness, including couplings and guards.
Oil Leakage	1. Oil level too high	Drain to correct oil level for mounting position used.
	2. Vent plug stopped up	See Overheating, Item 4
	3. Shaft seal wear or damage	Replace shaft seals. Inspect seal journal under seal for wear or scratches. Replace shaft or wear sleeve. Slight leakage is normal and is required to minimize wear, friction and heat.

PROBLEM	INSPECT FOR …	ACTION
	5. Pipe plugs leaking	Drain oil. **WARNING** **HOT OIL CAN CAUSE SEVERE BURNS. IF VENT IS STOPPED UP, HOT OIL CAN BE BLOWN A CONSIDERABLE DISTANCE WHEN A PLUG IS REMOVED.** Remove leaking plug and clean all threads well with solvent. Apply anti-seize type thread sealant (Loctite thread sealant with Teflon is recommended.) Install plug. Refill with the proper oil to the correct level.
	6. Gearcase joints leaking	Tighten bolts to torques shown in Hardware Torque Tables. If not effective, remove the leaking part. Clean mating surfaces. Apply new sealant and reassemble. Give sealant adequate time to cure before refilling the gearbox with oil and returning to service.
Gear Wear	1. Gear tooth wear or failure	Refer to factory
	2. Excessive backlash	Gearset must be replaced
	3. Gear misalignment	Check contact pattern of gear teeth. Teeth should contact over at least 75% of the gear width. The pattern should be near the center of the tooth. Check bearing condition and shaft end play. Adjust bearings as needed.
	4. Overload	See Overheating; Item 1
	5. Improper lubrication	See Bearing Failure; Item 4
	6. Bearing adjustment	See Bearing Failure; Item 3
	7. Coupling Binding	See Shaft Failure; Items 1 & 2
Shaft Failure	1. Type of coupling used	Rigid couplings between rigidly supported shafts can impose severe shaft loads. Use couplings with the necessary flexibility and axial float.
	2. Coupling binding	Realign the equipment and adjust coupling as needed.
	3. Excessive Overhung Load (OHL)	See Overheating, Item 7.
	4. High energy loads or extreme, frequent shocks.	Install shock absorbing couplings or replace the drive with one of adequate rating for the shock loads.
Does Not Start The Load	1. Overload	Reduce the load or replace the drive with one of adequate rating. Check for locked load by running drive disconnected from load.
	2. Proper power supply	Voltage at the motor terminals at each phase must be within 10% and frequency within 5% of the values stamped on the dataplate.
	3. Power supply disconnected or connected wrong	Check fuses, disconnects and wiring for continuity and proper size. Check wiring connections against wiring diagram supplied. Check motor direction of rotation.
	4. Backstop installed backwards or brake locked.	Check backstop direction of rotation. Check brake wiring connections. Check fuses, disconnects and wiring for continuity and proper size. Check wiring connections against wiring diagram supplied. Check motor direction of rotation.

REPAIRING THE MASTER APG

REPAIRING THE MASTER APG

Unlike some high power density geared products, the MASTER APG is designed to be repaired. Lifting, pressing and pulling equipment and tools found in the average maintenance department are sufficient to repair most sizes of the MASTER APG. However, many users wisely take advantage of the maintenance and repair assistance available from their local MASTER Authorized Service Shop. The user should also consider whether the drive should be overhauled or replaced with a new drive. Small drives are often more economically replaced than repaired. Repairs to drives still under warranty should be done only by an authorized representative of MASTER. See “WARRANTY”.

REPLACEMENT PARTS

An adequate stock of renewal parts is an integral part of a sound maintenance program to protect against costly downtime. All parts in the MASTER APG are subject to exact specifications and tests necessary to assure proper and safe performance, including many parts usually considered “hardware.” We recommend that the parts on the following list be purchased only from Master. To assure the continued reliable operation of your MASTER APG:

1. Bearings
2. Threaded Fasteners
3. Dowel Pins
4. Shaft Keys
5. Shaft Seals
6. Lockrings
7. Pinion Cross Pins
8. Clamp Collars

Replacement parts for your MASTER APG may be obtained through MASTER Renewal Parts at 888-616-1094.

To help MASTER get you the parts you need, please put the following information on your order:

1. All data from all nameplates on the drive, including the gearcase, motor and any accessories.
2. The reference numbers and descriptions of the parts being ordered as shown on the Parts List and the specific illustration for your drive in this manual. Reference to this manual number and to page numbers will help.

When selecting parts to replace, keep these suggestions in mind:

1. If a gear has failed, the mating gear is very likely to be damaged, though the damage may not be visible. Gears must be replaced in mating pairs. Keys, pins and/or threaded fasteners locking the gears to the shafts must be replaced with new parts.
2. Shaft seals should always be replaced with new seals whenever the gearbox is torn down for service. The seal journal or sleeve should be inspected for wear or damage and replaced if needed.
3. Should a gear or bearing fail, abrasive steel particles are often thrown throughout the gearcase. Tremendous separating forces may be generated, sufficient to bend shafts or fracture the gearcase. All bearings, gears, shafts and housing components should be carefully inspected for damage.
4. Master Renewal Parts can prepare kits including all of the parts likely to be needed to perform basic types of repairs. Inquire when placing your parts order.

REPAIR PRACTICES

The MASTER APG is a precision device and must be treated as such during repair. The work area should be clean and free of clutter. Use the proper tools for the job at hand. Adequate lifting and pressing equipment must be available. Parts as removed should be placed where they will not be nicked or otherwise damaged. Parts should be carefully inspected as they are removed and before washing. Some types of damage and wear are more easily seen before washing. Parts should only be washed in clean solvent. Parts should again be inspected after washing.

WARNING

WHEN USING SOLVENTS, THE USER IS RESPONSIBLE FOR UNDERSTANDING AND APPLYING ALL APPLICABLE LOCAL CODES GOVERNING THEIR USE. DO NOT USE GASOLINE OR OTHER HIGHLY FLAMMABLE AND/OR TOXIC SOLVENTS. PRECAUTIONS FOR HANDLING CHEMICALS OF THIS TYPE SHOULD BE OBSERVED. THESE PRECAUTIONS INCLUDE: FOLLOW THE MANUFACTURER’S RECOMMENDATIONS.

Gear teeth, keyways in shafts, edges on gearcase parts, etc. can all be very sharp and capable of inflicting serious cuts. Pressing and hammering operations can produce flying chips. Hot oil can be splashed when the gearcase is drained. Suitable protective clothing and proper eye and face protection should be worn when working on the MASTER APG or any other machinery.

TOOLS AND EQUIPMENT NEEDED

Tools, equipment and materials needed for repair of the MASTER APG will vary depending on the unit size and type, but may include:

1. Magnetic base dial indicator
2. Metric and inch size wrenches and sockets
3. Torque wrenches
4. Pin punches
5. Lockring pliers
6. Heavy duty grease gun
7. Bearing and gear pullers
8. Hydraulic press (10 ton minimum)
9. Lifting equipment
10. Pry bars
11. Soft faced and hard faced hammers
12. Plastic electrical tape
13. Proper Lubricants (See “LUBRICATION,” page 9)
14. Metric and inch hex keys for hex socket bolts.
15. RTV Silicone Rubber Sealant or Loctite Gasket Eliminator 515
16. Wood or plastic blocks or wedges
17. 0–1" micrometer and 0–1" depth gauge
18. Set of feeler gauges

THREADED FASTENERS AND PIPE PLUGS

WARNING

THREADED FASTENERS USED ON THE MASTER APG ARE CAREFULLY SELECTED FOR TYPE, GRADE AND FEATURES. DO NOT SUBSTITUTE OTHER THREADED FASTENERS. REPLACE DAMAGED THREADED FASTENERS ONLY WITH PARTS OBTAINED FROM MASTER. FAILURE TO OBSERVE THIS PRECAUTION MAY RESULT IN BODILY INJURY.

Unless otherwise specifically noted, all threaded fasteners are to be tightened to the torques shown in the Hardware Torque Tables in the back of this manual. Tighten bolts evenly in a crisscross pattern until all are snug, then tighten to 50% of the torque shown. Finally, tighten to 100% torque, still using the crisscross pattern. This procedure reduces the possibility of warping flanges or misaligning parts.

WARNING

THE MASTER APG HAS A MIXTURE OF INCH SIZE AND METRIC SIZE THREADED HARDWARE. IN GENERAL, THREADED FASTENERS ON AND INSIDE THE GEARCASE ARE METRIC. OTHER THREADED HARDWARE IS USUALLY INCH SIZE. TAKE CARE TO SELECT THE PROPER TOOL FOR THE HARDWARE TO BE LOOSENED OR TIGHTENED. TAKE CARE TO REPLACE HARDWARE IN THE HOLES FROM WHICH THEY CAME. SERIOUS PROPERTY DAMAGE AND/OR PERSONAL INJURY COULD RESULT FROM MISMATCHING THREADED HARDWARE WITH TAPPED HOLES OR USING THE WRONG SIZE TOOL.

PRECAUTIONS AND TIPS ABOUT COMMON REPAIR PROCEDURES

PARTS HANDLING AND CLEANING: Gear teeth and seal journals are especially prone to damage during repair operations. Parts must be handled with care, not allowed to bang together or to hit other hard surfaces. Parts from the larger sizes of the MASTER APG are very heavy. Proper lifting equipment and practices are necessary to prevent part damage.

With the exception of shielded ball bearings and oil seals, all gearcase, input device and non-electrical motor parts can be washed in a circulating wash tank. Do not wash shielded ball bearings in such a tank or flood them in any other fashion. Such washing removes the grease lubricant in the bearing and leaves behind any dirt or chips which may be suspended in the wash solvent. Shielded ball bearings should only be wiped off, taking care to not force dirt and old grease through the shields. If the bearing is suspected of being contaminated, it should be replaced. Oil seals should be replaced whenever the drive is torn down for any reason.

INSPECTION AND REPAIR OF MATING FLANGES AND TENONS: After teardown, clean all mating flanges and tenons to remove sealant. The sealant used at the factory is Loctite Gasket Eliminator 515. Also suitable is room temperature vulcanizing (RTV) silicone rubber. Both can be removed easily with a sharp scraper or rubbed off with a coarse cloth after softening by soaking with mineral spirits.

Inspect all mating surfaces for any damage resulting from the teardown procedure. Use a large flat file to smooth any nicks or raised areas back down to the original surface. Check with a good steel straightedge. Failure to properly prepare mating surfaces for reassembly will cause gear misalignment and/or oil leakage in the repaired unit.

SEALING JOINTS: Use RTV Silicone Rubber Sealant or Loctite Gasket Eliminator 515. Loctite Gasket Eliminator 515 is available from the Loctite Corporation, an industrial supply house, or an automotive supply store. RTV is available under many brand names, types, and colors. Any such material sold for high temperature automotive use is suitable for use on the MASTER APG. Sufficient RTV is supplied with many MASTER APG parts kits to reseal all the joints involved in a major overhaul.

RTV or Loctite Gasket Eliminator 515 is best used sparingly. A $^{1}/_{8}$" bead is sufficient to seal the largest flange on the largest MASTER APG . Flat mating flanges, such as the triple adapter to gearcase joint, are best sealed by applying the bead evenly all around one flange face in the space between the bolt holes and the inside (oil side) edge of the flange. Tenon joints, such as the output bearing housing joint on the single stage gearcases, are sealed by applying the bead all around the male tenon. Some joints may require a combination of both techniques, depending on the specific shape of the flange.

Loctite Gasket Eliminator 515 which squeezes out of a joint can be wiped off immediately because it will not cure outside the joint. Joints sealed with Loctite Gasket Eliminator 515 should be allowed to cure for at least one hour before being exposed to oil.

RTV which squeezes out of a joint is best left to thoroughly cure. It can be peeled off or cut away if the appearance is objectionable. RTV sealed joints should be allowed to cure for at least a half hour before being exposed to oil. This is sufficient time for a skin to form, preventing oil from penetrating the joint. RTV may also be used as a thread sealant for pipe plugs. A small amount applied to the threads of the plug before installing will reduce the torque required to produce a good seal and will make the plug easier to remove later.

REMOVING AND INSTALLING BEARINGS AND GEARS requires the proper tools to prevent damage. For example, large sizes of the MASTER APG require over 30 tons of press capacity to change the output gear. The user may wish to contact his local MASTER Service Center for assistance.

Bearings must be removed and installed by pressing only on the inner race with a pressing tool of the proper size. Bearings removed by pulling on the outer race are to be considered scrap. Screw type gear pullers should be used with care to avoid damaging the gear teeth. Bearings and gears are best mounted by heating the part to not over 300 degrees F and dropping into place on the shaft.

WORKING WITH SHAFT OIL SEALS: Shaft oil seals are easily damaged by dirt, exposure to solvents and rough handling. The steel parts of the seal are nearly as subject to damage as the rubber seal lip. The steel cases are easily bent. Seals should be kept wrapped and out of the immediate work area until just before installation.

Seals should be installed with bullet type seal sleeves and slide hammers. However, seals can be worked into place on the seal journal or sleeve without special tools if care is taken to be sure the seal garter spring is not popped out of place. Shaft extensions with sharp keyways, gears or any other surfaces which might damage the seal lip during installation should be taped. The seal lip and seal journal should be prelubricated with the same oil to be used in the gearcase. The seal can be driven home with a soft mallet and a smooth faced cylinder with an outside diameter as large or larger than the seal diameter. The seal must be installed square to the shaft. A thin coat of RTV on the seal outside diameter will help assure a leak free installation.

PREPARING THE MASTER APG FOR REPAIR

WARNING
TO ENSURE THAT DRIVE IS NOT UNEXPECTEDLY STARTED, TURN OFF AND LOCK OUT OR TAG POWER SOURCE BEFORE PROCEEDING. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

Remove the MASTER APG from the driven equipment. Remove any attached couplings, sprockets or pulleys and their keys from the input and output shaft extensions. C-Face motors may be removed or kept with the drive as desired. Clean the entire drive thoroughly and move it to the work area.

Inspect the input and output shafts for nicks, set screw marks or other damage. Smooth the shaft extensions as needed with a fine toothed file. Wrap the shaft extensions with one or two smooth layers of plastic electrical tape, covering the shaft from the end to past the end of the keyway. The tape will help protect hands as well as the shaft.

WARNING
HOT OIL CAN CAUSE SEVERE BURNS. USE EXTREME CARE WHEN REMOVING LUBRICATION PLUGS AND VENTS. DO NOT GET IN LINE WITH THE PLUG. HOT OIL CAN BE BLOWN A CONSIDERABLE DISTANCE SHOULD THE GEARCASE BE PRESSURIZED BY A CLOGGED VENT. WEAR SUITABLE PROTECTIVE CLOTHING AND EYE SHIELDS.

Drain the oil from the gearcase. Use extreme care if the drive is still warm. Hot oil will cause severe burns. Remove the highest plug first to relieve any possible pressure in the gearcase and to speed draining. Drain the oil from the lowest plug. Do not save or reuse oil from a damaged gearbox. Such oil is likely to be contaminated with metal particles and damaged by severe overheating.

REMOVING AND INSTALLING THE INPUT DEVICE

The MASTER APG may have a motor, a C-face adapter or a separate reducer adapter as the input to the gearcase. The procedure to remove or replace the input is the same for all input devices. Take care when working with the input device to avoid gear damage. Pull the input device straight back until the tenon is disengaged and the gears can be seen, then swing the input device to bring the gears out of mesh.

WARNING
EQUIPMENT BEING REMOVED MAY BE TOO HEAVY TO CONTROL MANUALLY. SUPPORT IT BY EXTERNAL MEANS. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

1. Support the input device so it will not fall when it is removed. Secure slinging is recommended.
2. Remove the bolts holding the input device to the gearcase. Note that Sizes 7 and 8 have one stud in the bolt pattern on the same side as the gearcase feet.

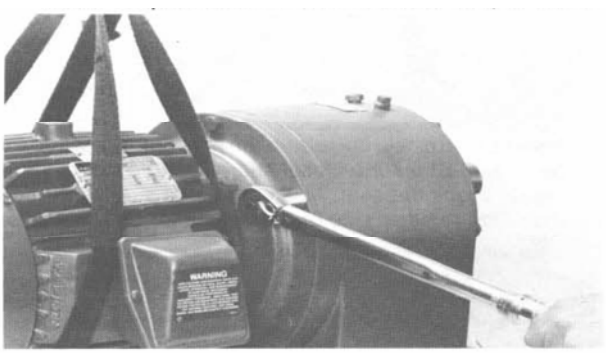
3. Insert a sharp cold chisel into the pryoff slot cast into the gearcase. Strike the chisel sharply with a heavy hammer to break the seal. As soon as one side separates, move to the other side of the gearcase. Use the chisel

4. Use slender pry bars to complete the separation of the input device from the gearcase. Single and double reduction units (up through 25.6:1 ratio) have a tenon fit to the gearcase. Triple reduction units (ratios from 31:1 and higher) have two dowel pins aligning the triple adapter to the gearcase. The triple adapter will come off with the input device. Be prepared to catch the “Y” stage pinion assembly as the input on a triple reduction unit is withdrawn. See “Triple Adapter Repair” for removal of the triple adapter from the input device.

INSTALLING THE INPUT DEVICE

The input device is installed after all other repair work is done and is the last major step before relubricating the drive and placing it back into service.

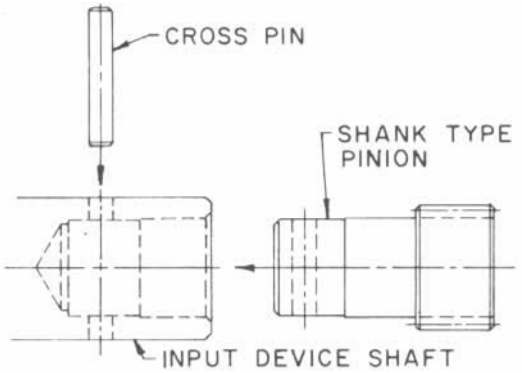
1. Support the input device securely, but so it can easily be moved into alignment.
2. Apply a $^1/_8$" bead of Loctite Gasket Eliminator 515 or RTV silicone sealent around the mating flange on the gearcase or triple adapter. Run the bead inside the bolt holes and dowel pins.
3. On Sizes 7 and 8, be sure the mounting stud is in place in the gearcase input flange on the side near the feet. Refer to the Parts Identification Drawings.
4. Guide the input device into place, keeping the input pinion clear of its mating gear as long as possible. At least one of the gears (preferably both) must be free to rotate so the gear teeth can align and mesh without forcing. The gearcase output shaft should be free to rotate. If the input device is a brakemotor, use the manual release to free the brake. If the input device is a separate reducer adapter, be sure the input shaft is free to rotate. C-face adapters should have the shipping strap removed from the input shaft before assembly.
5. Secure the input device retaining hardware and tighten to the torque shown in the Hardware Torque Table.



6. The MASTER APG is now completely assembled. Check all hardware for the proper torque according to the Hardware Torque Tables. Grease all bearings as called for in the “Lubrication” section. If practical, refill with oil to the proper level for the mounting position used. See “Lubrication.” Where the mounting position makes proper filling in the shop difficult, tag the unit with a “DO NOT RUN BEFORE LUBRICATING” sign and delay final oil fill until after installation. A rebuilt MASTER APG should be treated as a new drive. See “Installation” for prestart and startup checklists.

REMOVING AND INSTALLING THE FIRST STAGE PINION

A shank type first stage pinion is a common feature of all models of the MASTER APG, regardless of the style of input device. The first stage pinion is interference fit into an axial bore in the shaft of the input device. The pinion is further secured by a cross pin driven through the shaft and the pinion shank.



TYPICAL FIRST STAGE PINION ASSEMBLY

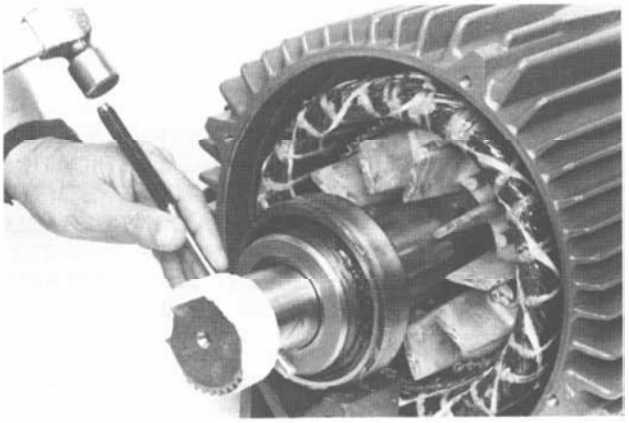
For ease of handling, the shaft assembly containing the pinion should be removed from the input device before attempting to remove the pinion. While the pinion is out, the axial bore and the cross pin hole in the shaft should be cleaned well and examined for wear, damage or corrosion. Do not reuse an input device shaft unless both the axial bore and the cross pin hole are in good condition.

Once removed, the cross pin must always be discarded and replaced with a new pin.

A variety of methods may be used to remove the pinion from the shaft bore. The following procedures are suggested. Contact the factory if difficulty is encountered.

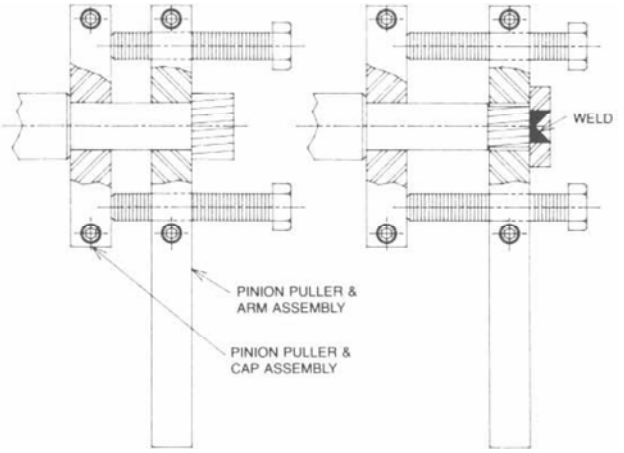
REMOVING THE CROSS PIN

1. Protect the pinion teeth by wrapping with several layers of plastic tape.
2. Support the shaft below the pin with a wooden block to reduce the risk of damaging the shaft or bearings. This support is especially important on the smaller sizes.
3. Use a pin drift of the proper size to drive the cross pin out. Discard the used pin.



REMOVING THE PINION

Pinions are removed from ¼ HP through 10 HP gearmotors and the smaller sizes of the separate reducer adapters by means of a pinion puller. On ratios where the pinion diameter is smaller than the input shaft a washer has to be welded to the end of the pinion. See examples below:

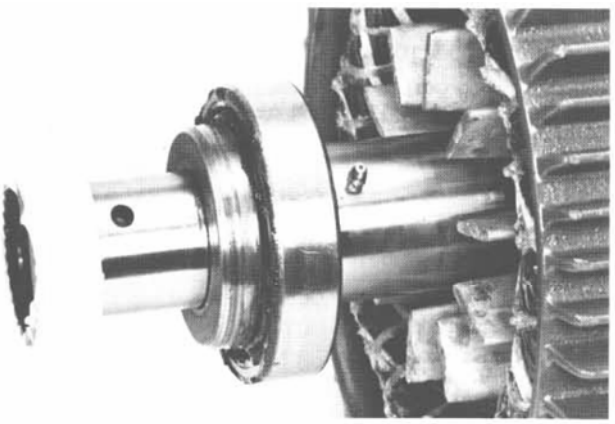


Pinion removal kits may be obtained from your MASTER Parts Distributor. To help you get the kit you need, please provide data from all name-plates on the drive, including the gearcase, motor and accessories.

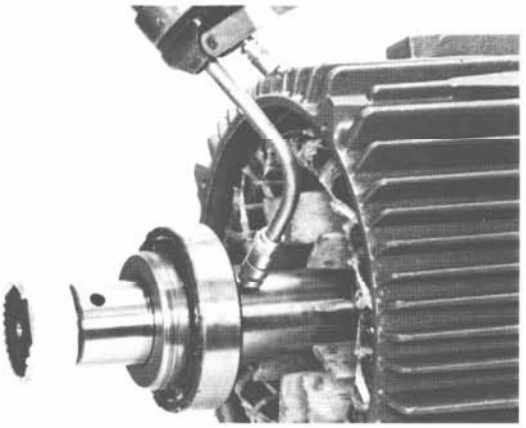
¼ H.P. THRU 5 H.P. KIT NUMBER IS 079130–02-J
5 H.P. AND 10 H.P. KIT NUMBER IS 079130–02-M

Grease Gun Method of Pinion Removal:

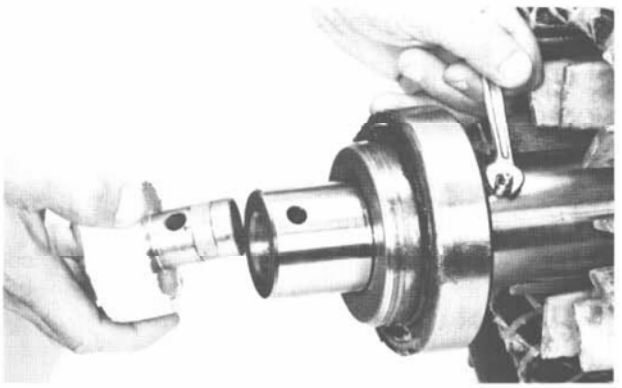
The shafts of 15 HP through 200 HP gearmotors are drilled and tapped for grease fittings, as are the larger sizes of the separate reducer adapters. A ¼–28 grease fitting is threaded into the tapped hole. In gearmotors, the tapped hole may be located ahead of or behind the motor bearing. The tapped hole in separate reducer shafts may be found on either side of or under the bearing closest to the pinion.



A heavy duty grease gun is used to remove the pinion with hydraulic pressure.

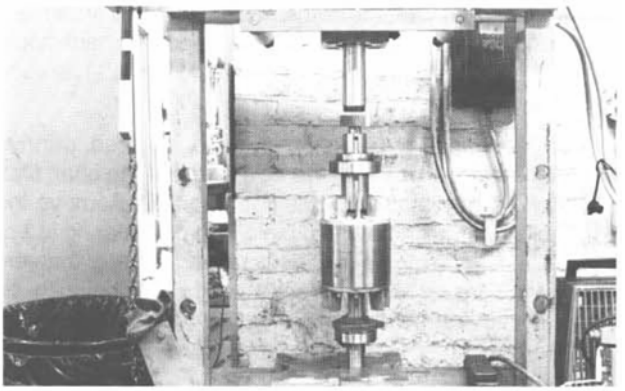


After the pinion is removed, the grease fitting should be removed.



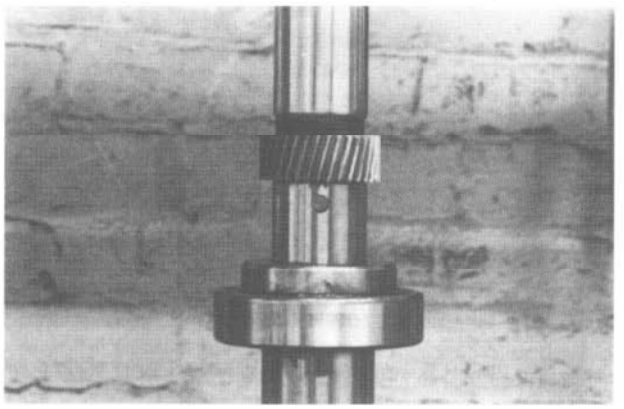
INSTALLING THE PINION

1. Lubricate the pinion shank with a thin coat of high quality antiseize compound.
2. Center the input device shaft assembly in a press. Position the shaft assembly so the cross pin hole can be sighted through while operating the press.



3. Set the pinion in the shaft bore. Rotate the pinion to align the cross pin hole in the pinion with the crosspin hole in the shaft.

4. Press slowly while sighting through the crosspin hole in the shaft. Press until the pinion bottoms or until the cross pin holes line up. Avoid overpressing.



REPLACING THE CROSS PIN

1. Protect the pinion teeth from a missed hammer blow.
2. Support the shaft opposite the pin.
3. Drive a new pin in place.

REPAIRING THE SEPARATE REDUCER INPUT

NOTE: See "Removing and Installing the Input Device" and "Removing and Installing the First Stage Pinion" before proceeding.

SEPARATE REDUCER ADAPTER TEARDOWN

1. Remove the shaft key (1) and wrap the shaft extension with plastic tape. Wrap the pinion (9) teeth with plastic tape.
2. Remove the bearing clamp (12) retaining hardware (11). Remove the bearing clamp (12). Use a soft mallet on the keyed extension end of the shaft (2) to drive all the internal parts out the flange end of the housing (16). Work carefully. Remove the backstop key (6 or 18) as it becomes accessible on units equipped with backstops. On Sizes 7 and 8, remove the bearing cup (21) as soon as it clears the bore.
3. If the bearings or backstop must be replaced, remove the bearing (3 or 27) at the keyed end of the shaft first. Remove the retaining rings (7 and/or 15). Remove the backstop (5). Remove the pinion (9) end bearing (13 or 20) last. If the pinion outside diameter is larger than the bearing inside diameter, the pinion will have to be removed before the bearing can be removed. See "Removing and Installing the First Stage Pinion" in this manual.
4. Remove the input oil seal (17) from the housing (16). The oil seal should be replaced with a new seal whenever the unit is torn down for any reason. On Sizes 7 and 8, remove the bearing cup (26). Remove all pipe plugs (4, 14, 23).
5. Clean and inspect all parts. Be sure the housing is cleaned of all old grease. The backstop should be thoroughly cleaned, then rinsed in clean solvent. Inspect the shaft for wear at the seal journal and in the area under the backstop.

SEPARATE REDUCER ADAPTER ASSEMBLY

1. Study the Parts Identification Drawing for the size of separate reducer adapter you have.
2. Assemble all components on the shaft. Start by pressing the bearing on the pinion end. Add the other components and complete the shaft assembly by pressing the bearing on the shaft extension end. Be sure to install the retaining rings (7 and/or 15) and grease shields (24). Check the direction of rotation of the backstop to be sure it is installed in the proper direction for your application. If the backstop is not installed properly before installing the bearing (3 or 27), the whole unit will have to be torn down to correct the backstop.
3. Put some stiff grease in the backstop keyway to hold the backstop key (6 or 18) in place in the backstop keyway. On Sizes 7 and 8, install the bearing cup (26) in the housing and seat solidly.
4. Slide the shaft assembly into the housing, taking care to align the backstop key with the keyway in the housing. On Sizes 7 and 8, the grease shield (24) must be rotated to aligned with the pipe plug holes (23).
5. Sizes 3 through 6: Install the bearing clamp (12) and hardware (10 or 11). Tighten the screws to the torque specified in the Hardware Torque Tables. Spin the shaft to check for smooth rotation with little drag.

   Sizes 7 and 8: Install the bearing cup (21), seal (19), bearing clamp (12), and hardware (11). Tighten the screws to the torque specified in the Hardware Torque Tables. Use a soft mallet to drive the shaft both ways to seat the bearings. Spin the shaft to be sure the bearings are seated and square. Use a dial indicator to measure the total shaft endplay. Select a shim pack to provide the endplay shown in the table below:

SHAFT ENDPLAY CHART FOR SIZE 7 AND 8 SEPARATE REDUCER ADAPTERS

INPUT RPM	NORMAL DUTY (+20F to +110F)	LOW TEMP DUTY[1] (-30F to +20F)
100–750	.000–.002	.000–.002
750–1800	.002–.004	.001–.003
1800–2500	.003–.005	.002–.004

[1] Also includes operation less than 4 hours per day.

Remove the bearing clamp (12), insert the shims (22) and retorque the bearing clamp screws. Check the endplay. Reshim if needed. Spin the shaft to check for smooth rotation with little drag.

SEPARATE REDUCER ADAPTER PARTS IDENTIFICATION DRAWING

REF. NO.	PART DESCRIPTION	FIG. 1 SIZES 5, 6 QTY.	FIG. 2 SIZES 3, 4 QTY.	FIG. 3 SIZES T7–T8 QTY.	FIG. 4 SIZES S7–D7 S8–D8 QTY.
1	INPUT SHAFT KEY	1	1	1	1
2	INPUT SHAFT	1	1	1	1
3	BALL BEARING	1	1	–	–
4	PIPE PLUG	1	1	0/2	0/2
5	BACKSTOP	0/1	0/1	0/1	0/1
6	BACKSTOP KEY				
7	RETAINING RING	1	1	–	–
8	CROSS PIN	1	1	1	1
9	PINION	1	1	1	1
10	HEX SOCKET HEAD				
11	HEX HEAD SCREW	4	4	4	4
12	CLAMP	1	1	1	1
13	BALL BEARING	1	1	–	–
14	PIPE PLUG	1	1	–	–
15	RETAINING RING	–	1	–	–
16	SEPARATE ADAPTER				
17	INPUT OIL SEAL	1	1	1	1
18	BACKSTOP KEY	–	–	1	1
20	BEARING CONE	–	–	1	1
21	BEARING CUP	–	–	1	1
22	BEARING SHIMS	–	–	AS REQ.	AS REQ.
23	PIPE PLUG	–	–	2	2
24	GREASE SHIELD*	–	–	0/1	0/1
26	BEARING CUP	–	–	1	1
27	BEARING CONE	–	–	1	1
28	COOLING FAN	–	–	–	1
29	FAN COVER	–	–	–	1
30	SCREW	–	–	–	4
31	WASHER	–	–	–	4
32	SPACER	–	–	–	4
33	SET SCREW	–	–	–	2
34	VENT PLUG	–	–	1	1
35	REDUCER BUSHING	–	–	1	1
36	DRIVE SCREW	–	–	2	2
37	VENT BAFFLE	–	–	1	1

* USED ONLY ON SIZE 7 & 8 UNITS WITH BACKSTOPS

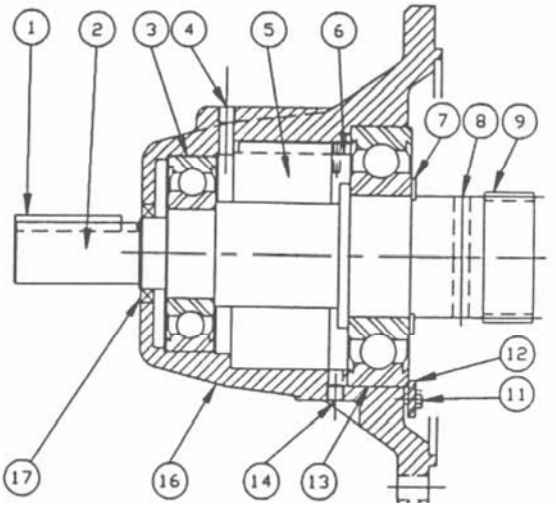


FIGURE 1 - FOR MASTER APG SIZES 5 AND 6

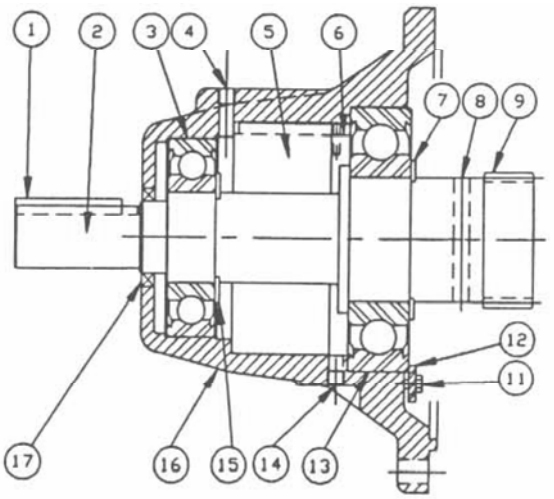


FIGURE 2 - FOR MASTER APG SIZES 3 AND 4

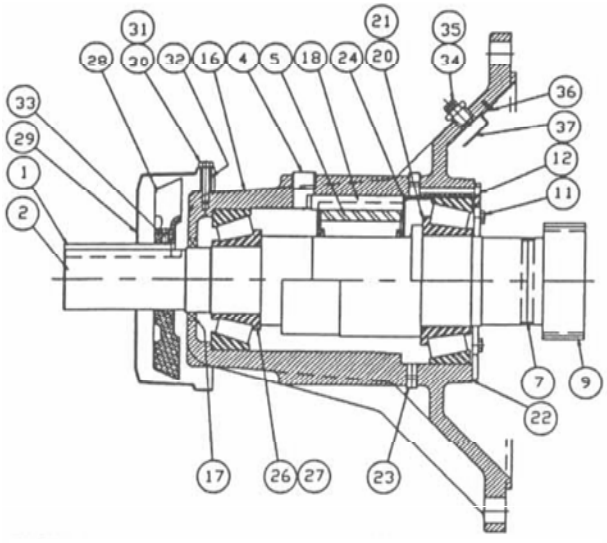


FIGURE 4 - FOR MASTER APG SIZES S7-D7-S8-D8

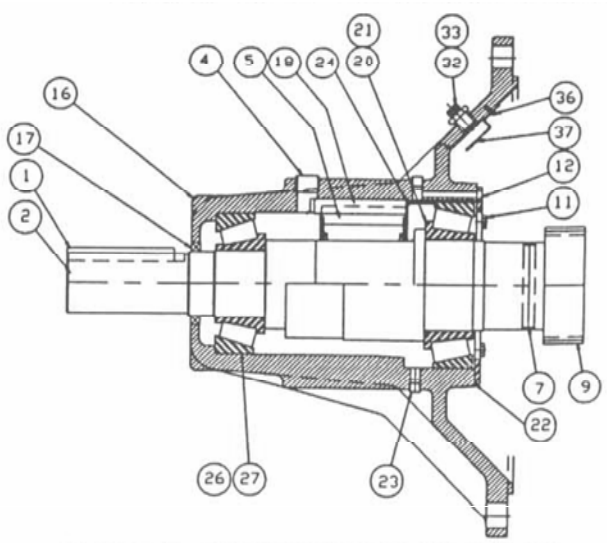


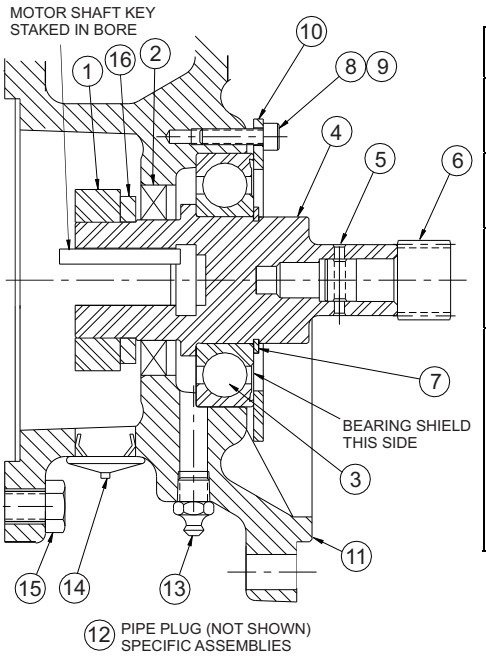
FIGURE 3 - FOR MASTER APG SIZES T7-T8

7. Install a new input oil seal (17). Use a smooth faced cylinder slightly larger than the outside diameter of the seal to press or drive the new seal flush with the end of the housing.
8. See the “Special Instructions” in the “Lubrication” section of this manual for proper lubrication for the separate reducer adapter with and without backstop.

Check torque on all hardware before installing on gearcase.

WARNING
CHECK THE DIRECTION OF ROTATION ON BACK-STOP EQUIPPED UNITS AGAIN BEFORE RETURNING TO SERVICE. FOLLOW THE PRESTART AND STARTUP CHECKLISTS IN THIS MANUAL.

C-FACE ADAPTER PARTS IDENTIFICATION DRAWINGS FOR MASTER APG SIZES 2–8



REF. NO.	PART DESCRIPTION	QTY.
1	CLAMP COLLAR	1
2	OIL SEAL	1
3	BALL BEARING	1
4	INPUT SHAFT	1
5	CROSS PIN	1
6	PINION	1
7	RETAINING RING	1
8	HEX HEAD SCREW	0 OR 4
9	HEX SOCKET CAP SCREW	0 OR 4
10	CLAMP	1
11	C-FACE ADAPTER HOUSING	1
12	PIPE PLUG	1
13	GREASE FITTING	1
14	SNAP-IN HOLE PLUG	1
15	HEX HEAD SCREW	4 OR 8
16	CLAMP COLLAR SPACER	1

Important! Clamp collar MUST be located so that the outside face of the clamp collar is flush with the outside end of the reducer hub. Clamp collar spacer insures proper location. Collar screw tightening torque is critical to coupling longevity. Tighten the clamp collar screw through the access hole in the adapter with an industrial TORX driver and a torque wrench. T-handle wrenches are unacceptable.

NOTE: Industrial TORX driver inserts for the APEX TOOL M-480–6 bit holder include:
T30: Apex 480-TX-30-X
T45: Apex 480-TX-45-X
T50: Apex 480-TX-50-X
T55: Apex 480-TX-55-X

C-FACE MOTOR FRAME SIZE	CLAMP COLLAR BOLT SIZE	ORIGINAL SOCKET-HEAD WRENCH SIZE	NEW TORX DRIVER	BOLT TORQUE LB-FT
56–140	¼–28	3/16	T30	14
18–250	5/16–24	¼	T45	27
400	½–20	3/8	T55	100
280–365	3/8–24	5/16	T50	47

ASSEMBLY OF MOTOR TO C-FACE REDUCER

Removal of motors from C-face reducers or rotation of motor conduit box location with relation to 12:00–3:00–6:00–9:00 o’clock positions

1. Removal of motor from C-face reducer:
   A. Remove plastic caplug from hole in side of C-face adaptor.
   B. Loosen clamp collar clamp screw.
   C. Remove four bolts which attach motor to C-face adaptor.
   D. Using two pry bars, carefully insert tips of pry bars into motor/C-face adaptor joint and pry off using equal pressure on each side.
2. Rotation of motor conduit box position:
   A. Remove plastic caplug from hole in side of C-face adaptor.
   B. Loosen clamp collar clamp screw.
   C. Remove four bolts which attach motor to C-face adaptor.
   D. Using two pry bars, carefully insert tips of pry bars into motor/C-face adaptor joint and move motor just enough to allow it to be rotated.
   E. Rotate motor to give desired conduit box position.
   F. Reattach motor mounting bolts and tighten to recommended torque listed on page 46 of this manual.
   G. Retighten clamp collar clamp screw to recommended torque listed below:
   H. Reinstall caplug into hole in side of C-face adaptor.

C-FACE MOTOR FRAME	CLAMP COLLAR BOLT SIZE	ORIGINAL HEX WRENCH	NEW TORX DRIVER	BOLT TORQUE LB-FT	LB-IN
56–140	¼–28	3/16	T30	14	168
18–250	5/16–24	¼	T45	27	324
280–365	3/8–24	5/16	T50	47	564
400	½–20	3/8	T55	100	1200

REPAIRING THE C-FACE ADAPTER

NOTE See “Removing and Installing the Input Device” before proceeding.

C-FACE ADAPTER TEARDOWN

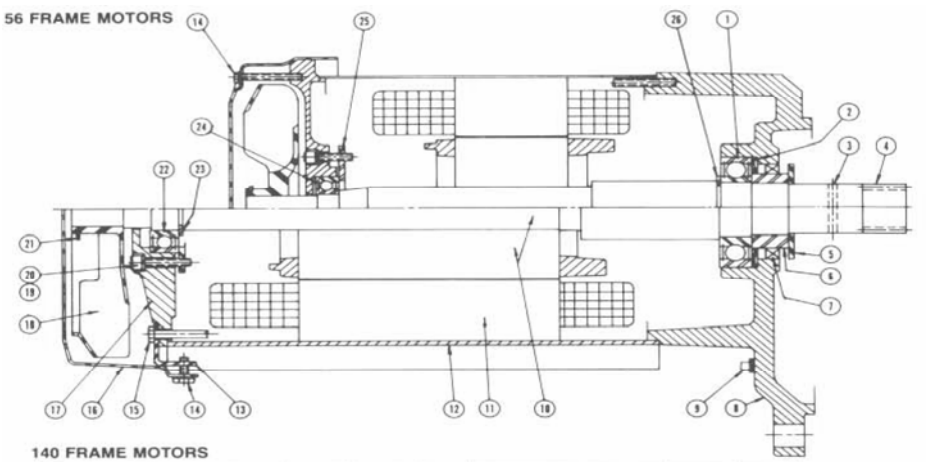
1. Remove the clamp collar (1). Remove the bearing clamp (10). Slide the input shaft (4) assembly out of the housing (11).
2. Remove the oil seal (2). The oil seal should always be replaced with a new seal.
3. Use a pin drift to drive out the cross pin (5). Use a close fitting rod through the input shaft to press the pinion (6) out.

4. Remove the retaining ring (7). Press the bearing (3) off the input shaft (4).
5. Remove the grease fitting (13). Clean and inspect all parts to determine what needs to be replaced. Use extra care when cleaning the single shielded bearing. Dirt and old grease are difficult to remove from the area between the ball retainer and the shield. Flush the grease channel from the grease fitting to the bearing bore thoroughly.

ASSEMBLY OF THE C-FACE ADAPTER

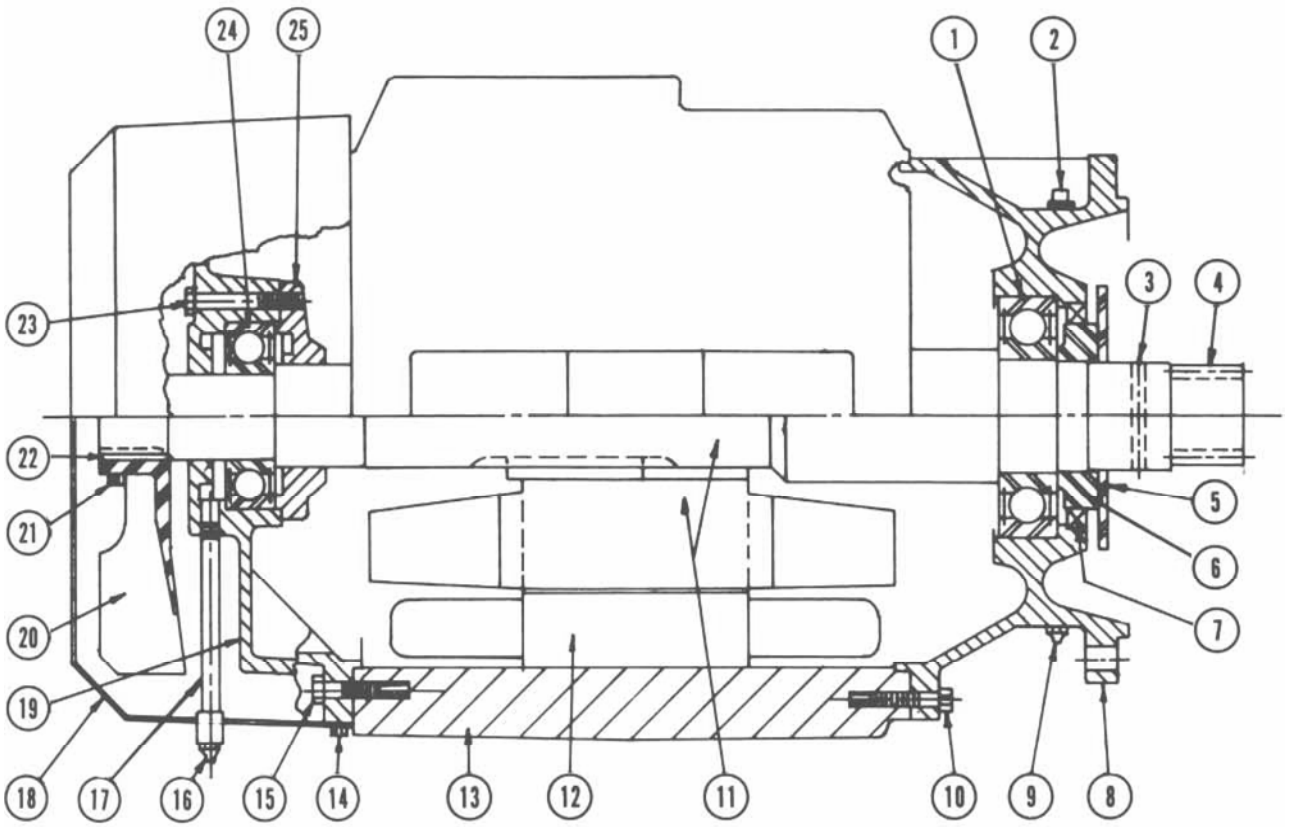
1. Press bearing (3) on the input shaft (4) with the bearing shield facing the pinion end of the shaft. Be sure the bearing is solid against the shaft shoulder. Install the retaining ring (7).
2. Press the pinion (6) into the shaft. Before pressing, take care to line up the cross hole in the pinion with the cross hole in the input shaft so the cross pin can be driven through.
3. Protect the pinion by wrapping with several layers of plastic tape. Rest the input shaft extension on a wood block while driving the cross pin through.
4. Press a new oil seal (2) into the housing (11) from the motor side. The seal garter spring must face the gear-case. The seal is to be flush to 1/16" below flush with the motor side of the housing and square with the input shaft.
5. Smoothly wrap the clamp collar end of the input shaft with a layer of plastic tape to prevent cutting the oil seal lip as the input shaft assembly is installed.
6. Pack the ball bearing about half full of grease. Wipe grease over the motor end of the shaft, over the tape applied in Step 5. See “Lubrication” for proper greases.
7. Insert the input shaft assembly into the bearing bore in the housing, taking care to work the seal over the shaft without dislodging the seal garter spring. Use a soft mallet to be sure the bearing is fully seated.
8. Install the bearing clamp (10) and screws (8 or 9). Tighten the screws to the torque specified in the Hardware Torque Table.
9. Install the grease fitting (13). Remove all protective tape from the input shaft. Install clamp collar spacer (16) then clamp collar (1), but do not tighten the clamp screw.
10. See “Input Device Removal and Replacement” for assembly of the C-Face adapter to the gearcase. See “Mounting Motors to C-Face Reducers” in the “Installation” section for motor mounting.

GEARMOTOR INPUT – PARTS IDENTIFICATION DRAWING
56 AND 140 FRAME MOTORS



REF. NO.	PART DESCRIPTION	56 FR. MOTOR QTY.	140 FR. MOTOR QTY.	REF. NO.	PART DESCRIPTION	56 FR. MOTOR QTY.	140 FR. MOTOR QTY.
1	BALL BEARING (B.E.)	1	1	14	FAN SHROUD SCREW	2	4
2	WAVE SPRING	1	1	15	THROUGH BOLT	4	4
3	PIN	1	1	16	FAN SHROUD	1	1
4	PINION	1	1	17	FRONT END (F.E.)		
5	DEFLECTOR	0 OR 1	0 OR 1		SHIELD	1	1
6	SEAL SLEEVE	1	1	18	FAN	1	1
7	OIL SEAL	1	1	19	LOCKWASHER	2	2
8	BACK END (B.E.) SHIELD	1	1	20	BEARING CLAMP		
9	PLUG	1	1		SCREW	2	2
10	SHAFT AND ROTOR			21	FAN CLAMP	1	1
	ASSEMBLY	1	1	22	BALL BEARING (F.E.)	1	1
11	STATOR AND WINDING	1	1	23	LOCKRING (F.E.)	–	1
12	MOTOR FRAME	1	1	24	.025 SHIM	2	–
13	FAN SHROUD BRACKET	–	4	25	BEARING CLAMP	1	1
				26	LOCKRING (B.E.)	1	0

GEARMOTOR INPUT – PARTS IDENTIFICATION DRAWING
180 THROUGH 360 FRAME MOTORS



REF. NO.	PART DESCRIPTION	QTY.	REF. NO.	PART DESCRIPTION	QTY.	REF. NO.	PART DESCRIPTION	QTY.
1	BALL BEARING (B.E.)	1	11	SHAFT AN D ROTOR		19	FRONT END (F.E.)	
2	PLUG	1		ASSEMBLY	1		SHIELD	1
3	PIN	1	12	STATOR AND WINDING	1	20	FAN	1
4	PINION	1	13	MOTOR FRAME	1	21	FAN CLAMP	1
5	DEFLECTOR	0 OR 1	14	FAN SHROUD BOLT	4	22	FAN KEY	1
6	SEAL SLEEVE	1	15	HEX HEAD BOLT (F.E.)	4	23	BEARING CLAMP	
7	OIL SEAL	1	16	GREASE FITTING	1		SCREW	3
8	BACK END (B.E.) SHIELD		17	GREASE TUBE	1	24	BALL BEARING (F.E.)	1
9	GREASE FITTING	1	18	FAN SHROUD	1	25	BEARING CLAMP	1
10	HEX HEAD BOLT (B.E.)	4						

REPAIRING THE GEARMOTOR INPUT

NOTE: See "INPUT DEVICE REMOVAL AND REPLACEMENT" for instru ctions for removing the motor from a gearmotor.

GENERAL INFORMATION

The motor used for the gearmotor version of the MASTER APG is designed to provide a compact, high power density package when mated to the MASTER APG gearcase.

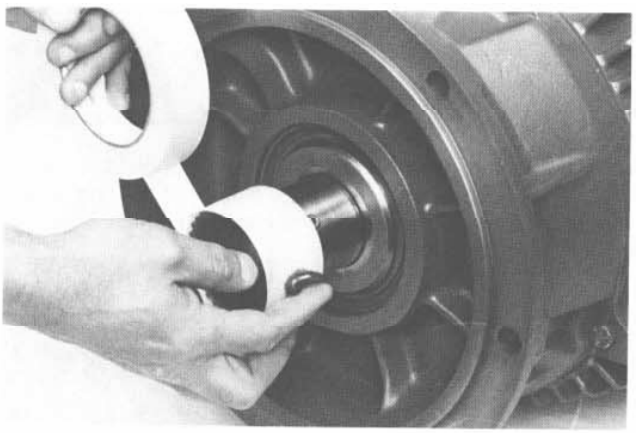
All MASTER APG gearmotors share common design features:

1. The fan end motor bearing is clamped to take all thrust from the gearing.
2. All motors are "TEFC" (Totally Enclosed, Fan Cooled) construction suitable for a wide variety of applications.
3. The motor shaft is also the input shaft to the gearcase and carries the first stage pinion.
4. The motor end shield opposite the fan is called the "back end" or "B.E." shield, and will be referred to as the B.E. shield in this manual. On the MASTER APG, the B.E. shield forms the input face of the gearcase and carries the input shaft oil seal. The motor end shield on the fan end of the motor is called the "fan end" or "F.E." shield and will be so called in this manual.

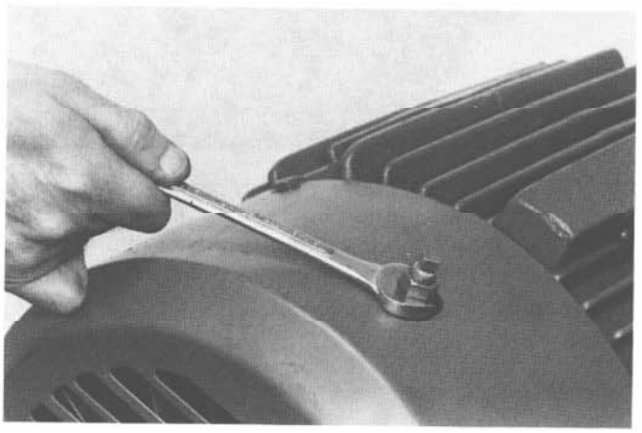
MOTOR TEARDOWN

NOTE: The photos show a 256 frame motor, but are typical of all 180 frame and larger motors. 56 and 140 series frame motors have structural differences, but the sequence of repair operations is the same as shown. The Part Reference Numbers in ( ) in the following instructions refer to the Parts Identification Drawing for 180 through 400 series frame motors.

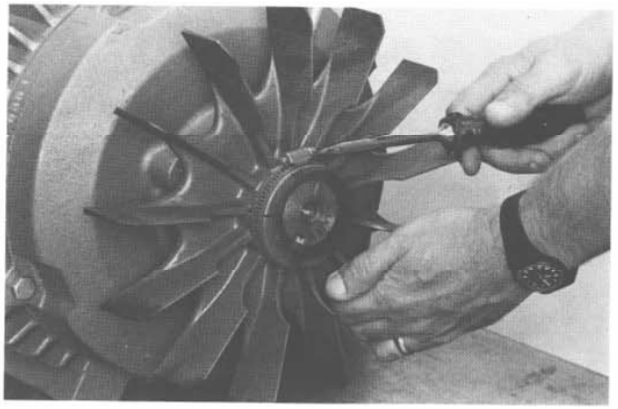
1. Wrap several layers of plastic tape around the pinion (4) and apply grease over the tape to protect the pinion and oil seal (7) during repairs.

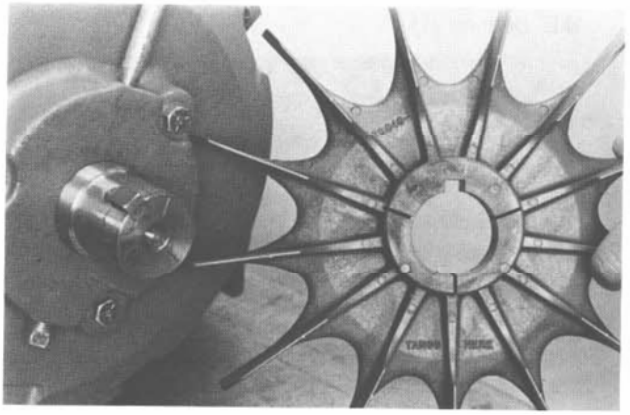


2. Remove grease fittings (9 and 16) and extension tubes (17), if so equipped, at both ends of the motor.

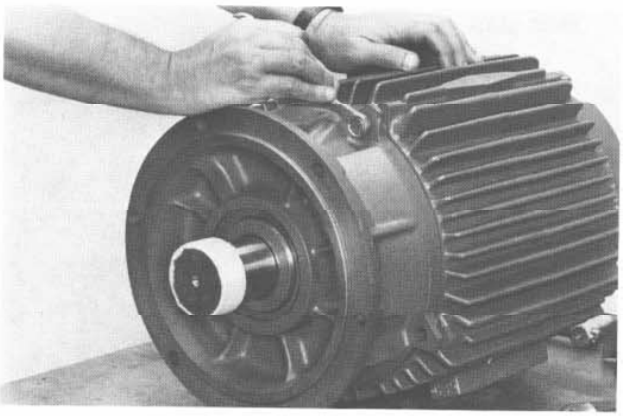


3. Remove the fan shroud (18), the fan clamp (21), the fan (20) and key (22). On small motor fans, the key is molded integral with the fan and the fan clamp is a lockring. Take care to not crack the fan. Wood blocking and wide faced pry bars will help.

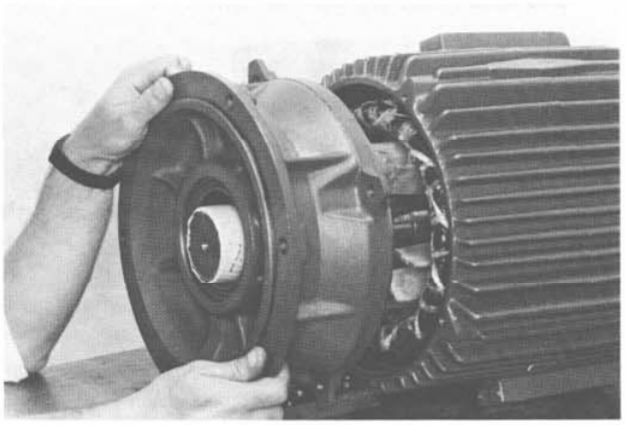




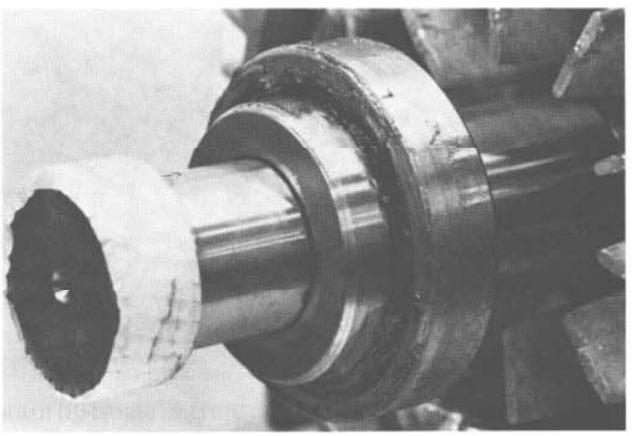
4. Remove the bolts (10) holding the B.E. shield (8) to the motor frame (13).



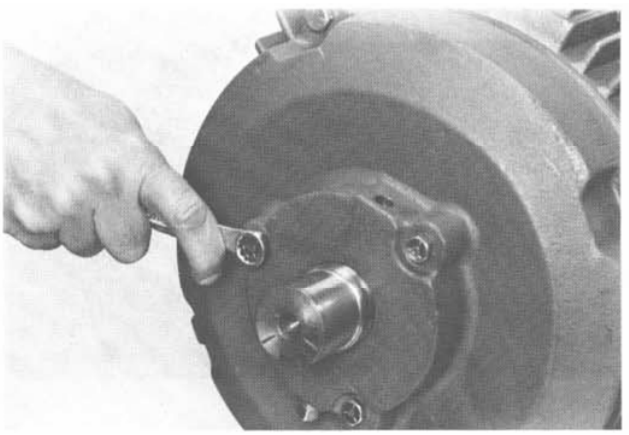
5. Use a soft mallet to loosen the B.E. shield to motor frame tenon. Slide the B.E. shield off. Take care to pull straight back to avoid bumping the oil seal on the pinion or shaft.



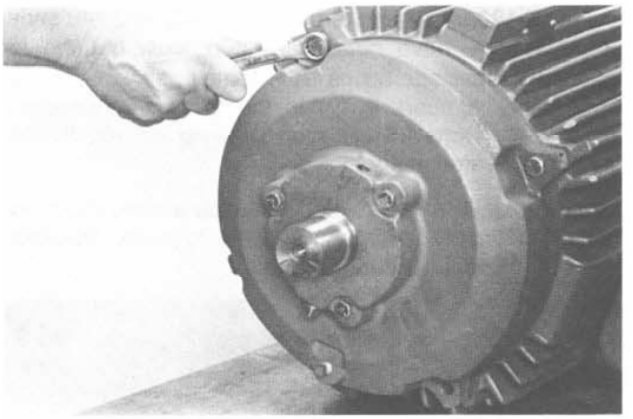
6. Check the condition of the oil seal sleeve (6). It must be replaced if grooved or otherwise damaged. Inspect the B.E. bearing (1).



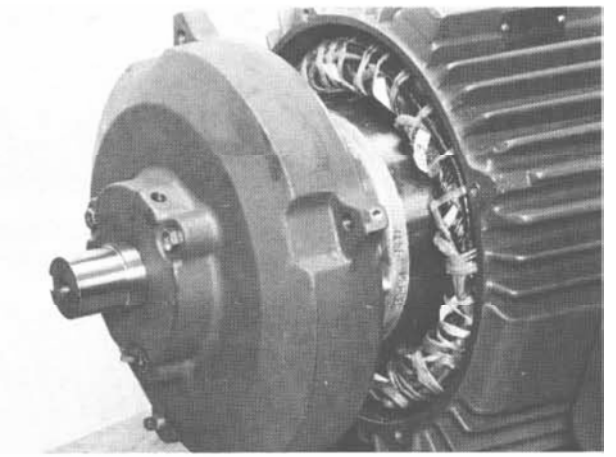
7. Loosen, but do not remove, the F.E. bearing clamp bolts (23).



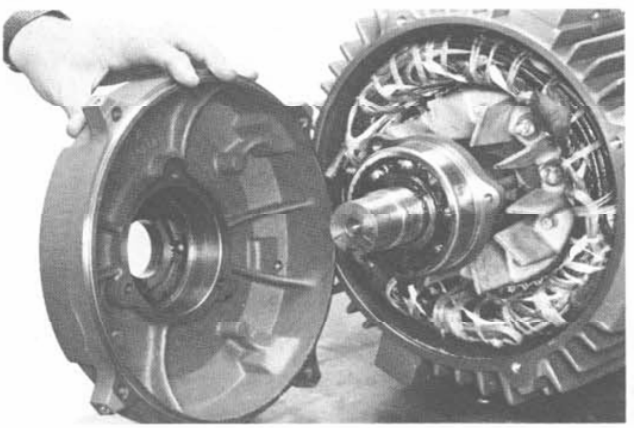
8. Remove the bolts (15) holding the F.E. shield to the motor frame (13).



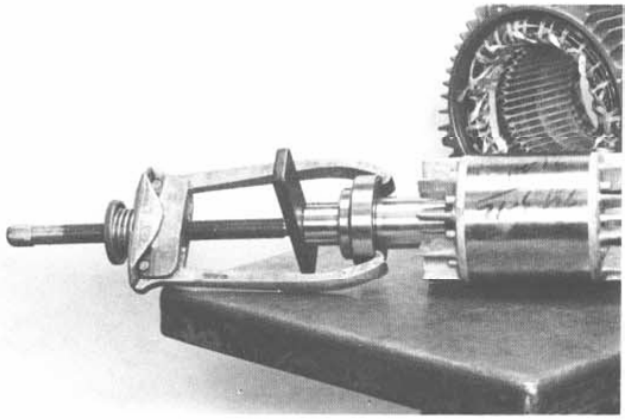
9. Use a soft mallet to loosen the F.E. shield to motor frame tenon. Slide the F.E. shield back. The motor shaft and rotor assembly will come along.



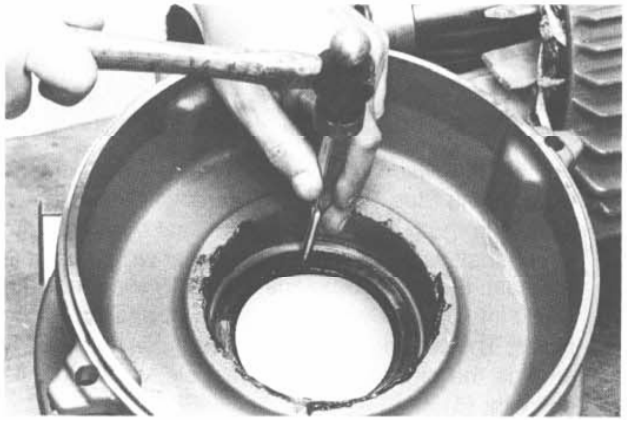
10. Remove the F.E. bearing clamp bolts (23), and slide the F.E. shield (19) off the bearing. Inspect the F.E. bearing (24). Slide the motor shaft and rotor assembly out of the stator. Take care to not hit the motor windings.



11 Replace the bearings and seal sleeve if needed. If the pinion (4) is bigger in diameter than the motor shaft extension diameter, the pinion will have to be removed before the B.E. bearing and seal sleeve can be changed. See “Removing and Installing the First Stage Pinion” in this manual. The rubber oil deflector (5) is only used with large diameter pinions. It should be removed by stretching over the pinion before pinion or bearing removal is begun. Take care to not damage the pinion bore in the motor shaft. Use a protective plate, as shown, across the pinion bore if using a bearing puller.



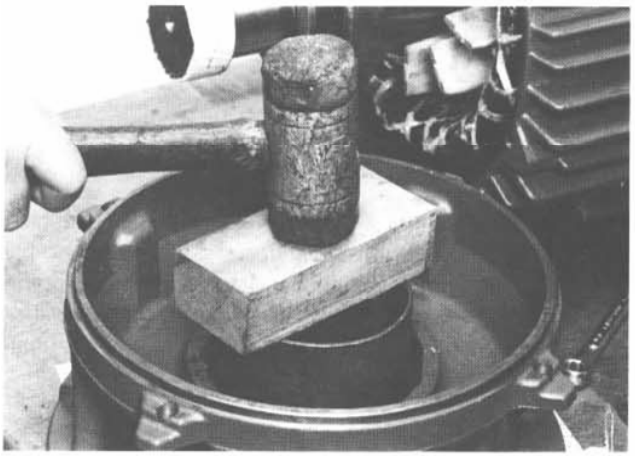
12. Remove and discard the oil seal (7). The seal should always be replaced at teardown.



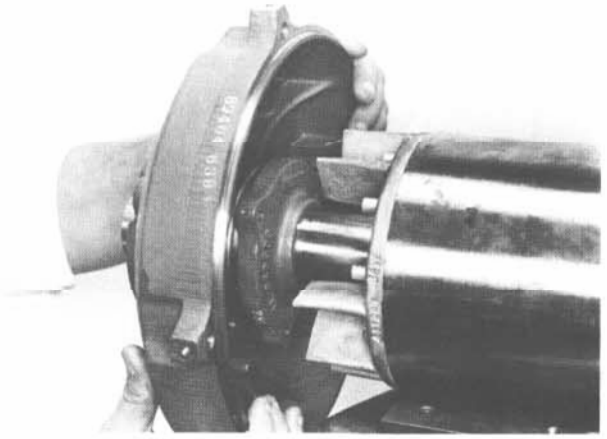
13. Clean and inspect all parts. Blow the stator and winding out with compressed air. Do not clean the winding with solvents unless the solvents are specifically approved for such use. End shields should be cleaned well in a wash tank. Use a small brush or pipe cleaner to be sure all old grease is removed from grease passages. Bearings should not be immersed in solvent. If the bearing is to be reused, wipe old grease off the outside of the bearing and clean no further.

ASSEMBLY OF THE MOTOR

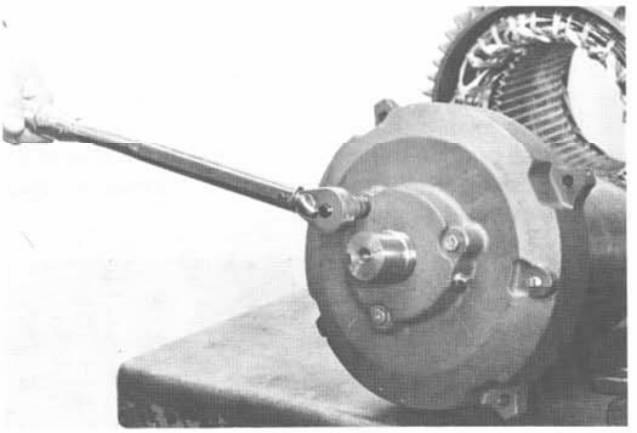
1. Replace the oil seal in the B.E. shield. Use a smooth faced, heavy walled cylinder larger than the outside diameter of the seal but smaller than the outside diameter of the bearing. Insert the seal with the garter spring toward the gearcase side of the B.E. shield. Press or drive the seal in from the motor side of the B.E. shield. Seat the seal flush with the bearing shoulder in the B.E. shield.



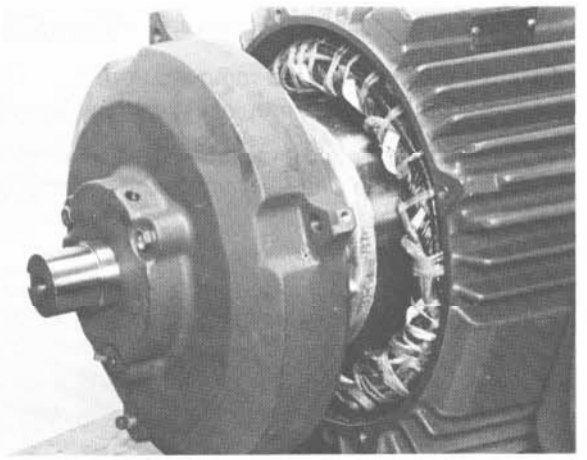
2. If the pinion has been removed from the motor shaft, see “Removing and Replacing the First Stage Pinion.”
3. Slip the F.E. shield into place on the bearing. Align the bearing clamp and start the bearing clamp screws.



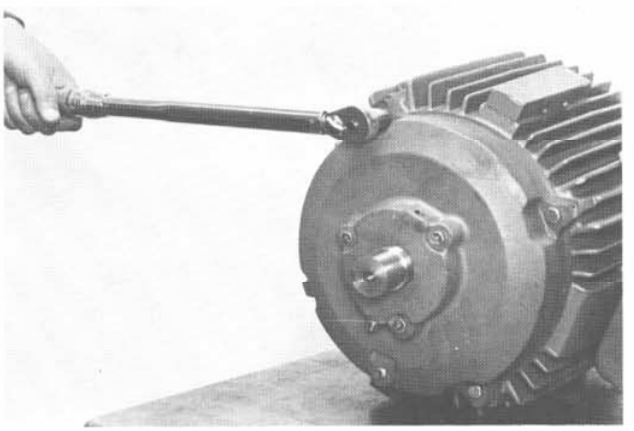
4. Tighten the bearing clamp screws to the torque specified in the Hardware Torque Tables.



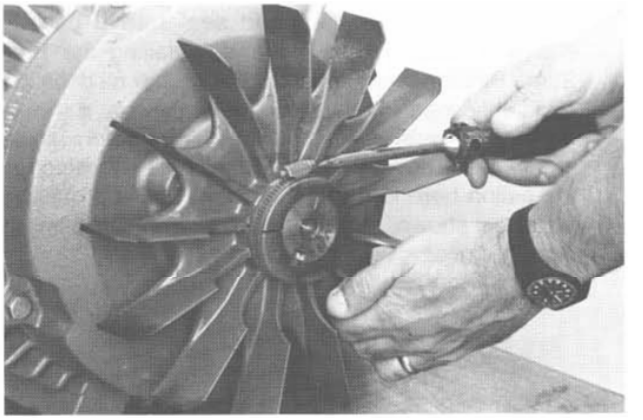
5. Insert the rotor and shaft assembly with the F.E. shield attached into the motor stator and frame assembly. Take care not to hit the end turns of the winding. Rotate the F.E. shield so the grease fittings will be accessible in the installation and so any condensate drains fitted will be down.



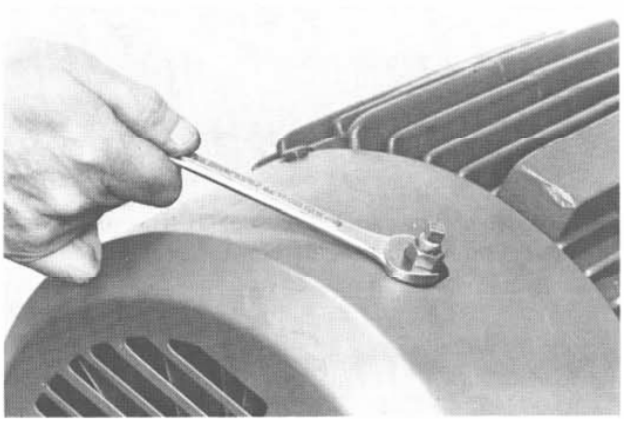
6. Tighten the F.E. shield retaining bolts to the torque specified in the Hardware Torque Tables.



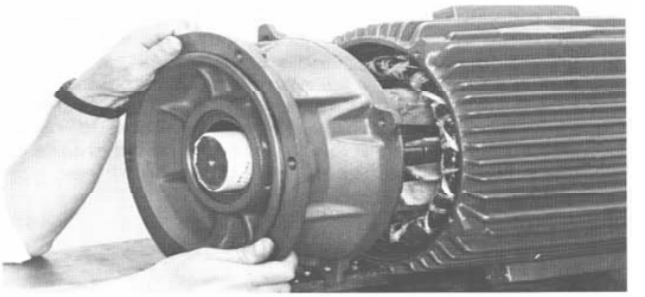
7. Install the fan key, fan and fan clamp. Locate the screw on the hose type clamp opposite the fan key to maintain balance.



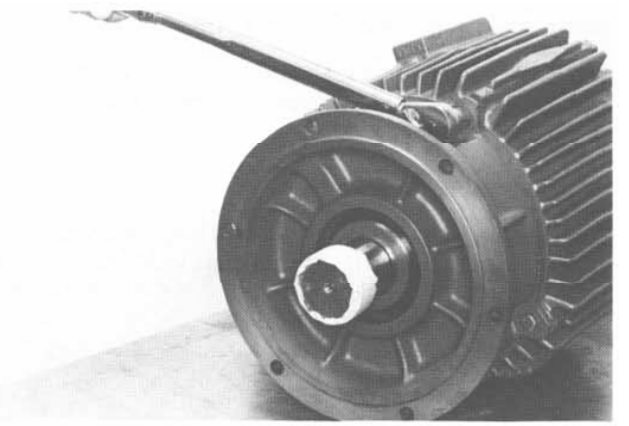
8. Install the fan shroud and grease fittings on the fan end of the motor.



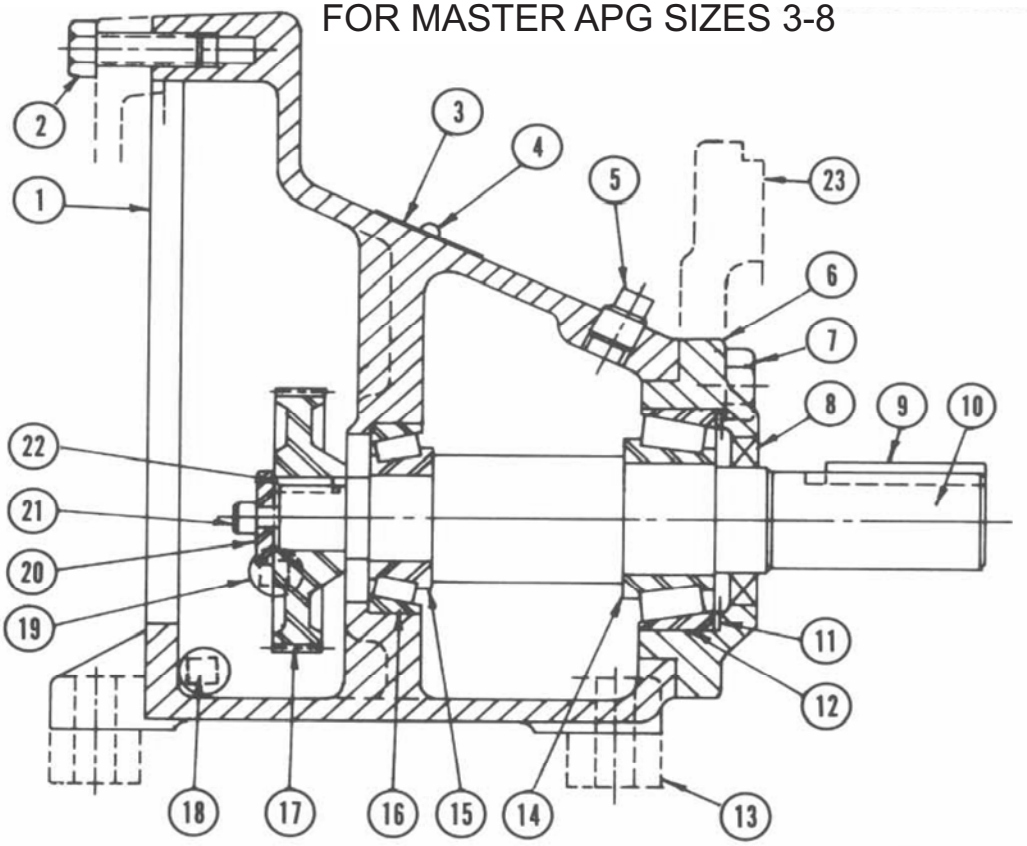
9. Be sure the pinion is taped and greased the same as was done in Step 1 of "Motor Teardown." Coat the oil seal lip in the B.E. shield and the seal sleeve on the motor shaft with the same grease that will be used to regrease the motor bearings. Carefully slide the B.E. shield into place. Do not let the new oil seal bump the pinion. The bearing provides a good guide to smoothly engage the oil seal with the seal sleeve. Install the deflector (5).



10. Rotate the B.E. shield so the grease fittings will be accessible in the installation and so any condensate drains will be down. Note the position of the gearcase flange holes. Install the B.E. shield retaining bolts and torque to the value specified in the Hardware Torque Table. Recheck all accessible hardware for tightness. The motor is now assembled and ready to be lubricated. See “Motor Bearing Lubrication” in the “Lubrication” section of this manual.



SINGLE REDUCTION GEARCASE PARTS IDENTIFICATION FOR MASTER APG SIZES 3-8



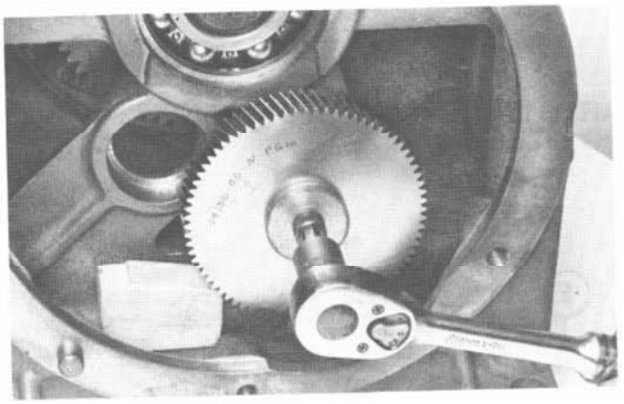
REF. NO.	PART DESCRIPTION	QTY.	REF. NO.	PART DESCRIPTION	QTY.
1	GEARCASE	1	13	RISER BLOCK	0 OR 4
2	HEX HEAD SCREW	6	14	OUTBOARD BEARING CONE	1
3	NAMEPLATE	1	15	INBOARD BEARING CONE	1
4	NAMEPLATE PIN	2	16	INBOARD BEARING CUP	1
5	VENT PLUG ASSEMBLY	1	17	”Y” GEAR	1
6	STANDARD BEARING HOUSING	0 OR 1	18	LUBRICANT PLUG	4
7	HEX HEAD SCREW	4	19	OIL LEVEL PLUG (RED)	1
8	OUTPUT SHAFT SEAL	1	20	”Y” GEAR RETAINER WASHER	1
9	OUTPUT SHAFT KEY	1	21	SOCKET HEAD CAP SCREW	1
10	OUTPUT SHAFT	1	22	”Y” GEAR KEY	1
11	BEARING SHIMS	AS REQ.	23	FLANGED BEARING HOUSING	0 OR 1
12	OUTBOARD BEARING CUP	1			

REPAIRING THE SINGLE REDUCTION GEARCASE

NOTE: The output bearing housing on the MASTER APG may be either standard or flanged. Teardown and assembly is the same for both.

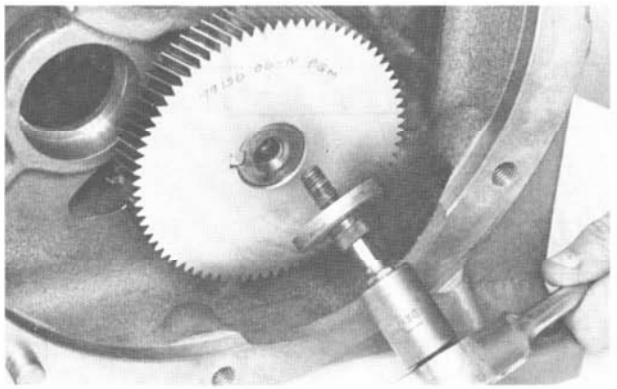
TEARDOWN

1. Place the gearcase foot down on the workbench. Use a wood or plastic wedge between the inside bottom of the gearcase and the "Y" gear (17) to prevent the output shaft from turning.



NOTE: A Double Reduction gearcase is shown.

2. Remove the socket head cap screw (21) and gear retaining washer (20). The "Y" gear (17) should slide off the output shaft (10). Remove the "Y" gear key (22).



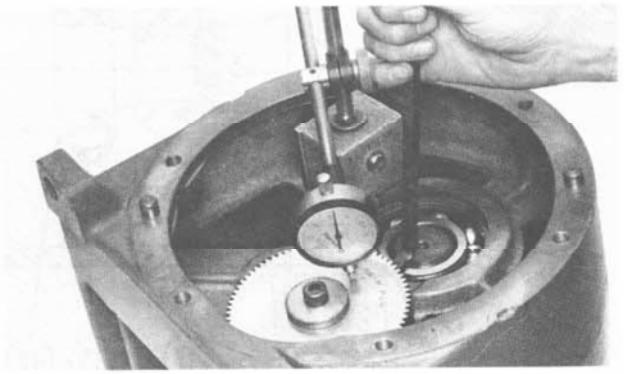
NOTE: A Double Reduction gearcase is shown.

3. Place the gearcase on the workbench with the output shaft (10) extension up. Wrap the output shaft extension with plastic tape. Remove the hex head screws (7) holding the output bearing housing (6 or 23).
4. The output bearing housing is sealed to the gearcase with Loctite Gasket Eliminator 515 or RTV silicone sealant. Use a chisel and hammer to break the seal, as was done to remove the input device.
5. With the output bearing housing removed, the output shaft can be lifted out. The output shaft bearing cones (14 and 15) are press fit on the output shaft. Proper press tools and press capacity will be needed to replace them. The output bearing cups (12 and 16) are slip fit into the gearcase and bearing housing. The cups should be removed for proper cleaning and inspection.
6. Inspect all parts for wear or damage, replacing parts as needed. The output shaft oil seal (8) should always be replaced with a new seal.

ASSEMBLY OF SINGLE REDUCTION GEARCASE

1. Insert the inboard bearing cup (16) into the gearcase. Tap with a soft mallet to be sure it is fully seated.
2. Place the output shaft, complete with bearing cones (14 and 15) installed, into the gearcase.
3. Insert the outboard bearing cup (12) into the output bearing housing. Tap with a soft mallet to be sure it is fully seated.
4. Install the bearing housing with just two diametrically opposite bolts. Pull the bolts snug. Tap both ends of the output shaft with a soft mallet while rotating the shaft to seat the bearings.
5. Measure the end play of the output shaft. This is most easily done by mounting a dial indicator against one end of the shaft, then pushing the shaft both ways to record the limits of shaft travel. Select shims to make a shim pack .001 to .003 inches less in thickness than the shaft endplay measured.

   NOTE: If pry bars are used to move the shaft, as shown, be sure the bars are not against the gear teeth.



NOTE: A Double Reduction gearcase is shown.

6. Remove the bearing housing. Remove the outboard bearing cup (12) from the bearing housing. Place the bearing shims (11) in the bearing housing and replace the bearing cup, seating it firmly on the shims.
7. Replace the bearing housing and check for .001 to .003 inches of end play in the output shaft, using the same procedure as used in Step 5. Spin the output shaft to check for any binding or roughness. Adjust shimming as needed.
8. Once the end play is correct, remove the bearing housing and apply a $^{1}/_{8}$" bead of Loctite Gasket Eliminator 515 or RTV silicone rubber around the tenon. Replace the bearing housing and tighten the bolts to the torque shown in the Hardware Torque Tables.

* 9. Put the gear key (22) in the output shaft. Slip the gear over the shaft and key. Note that the extended hub of the gear goes toward the bearing. Install the gear retainer washer (20) and socket head cap screw (21). Tighten the screw to the torque specified in the Hardware Torque Tables. Turn the shaft slowly through several revolutions to check for binding or roughness.

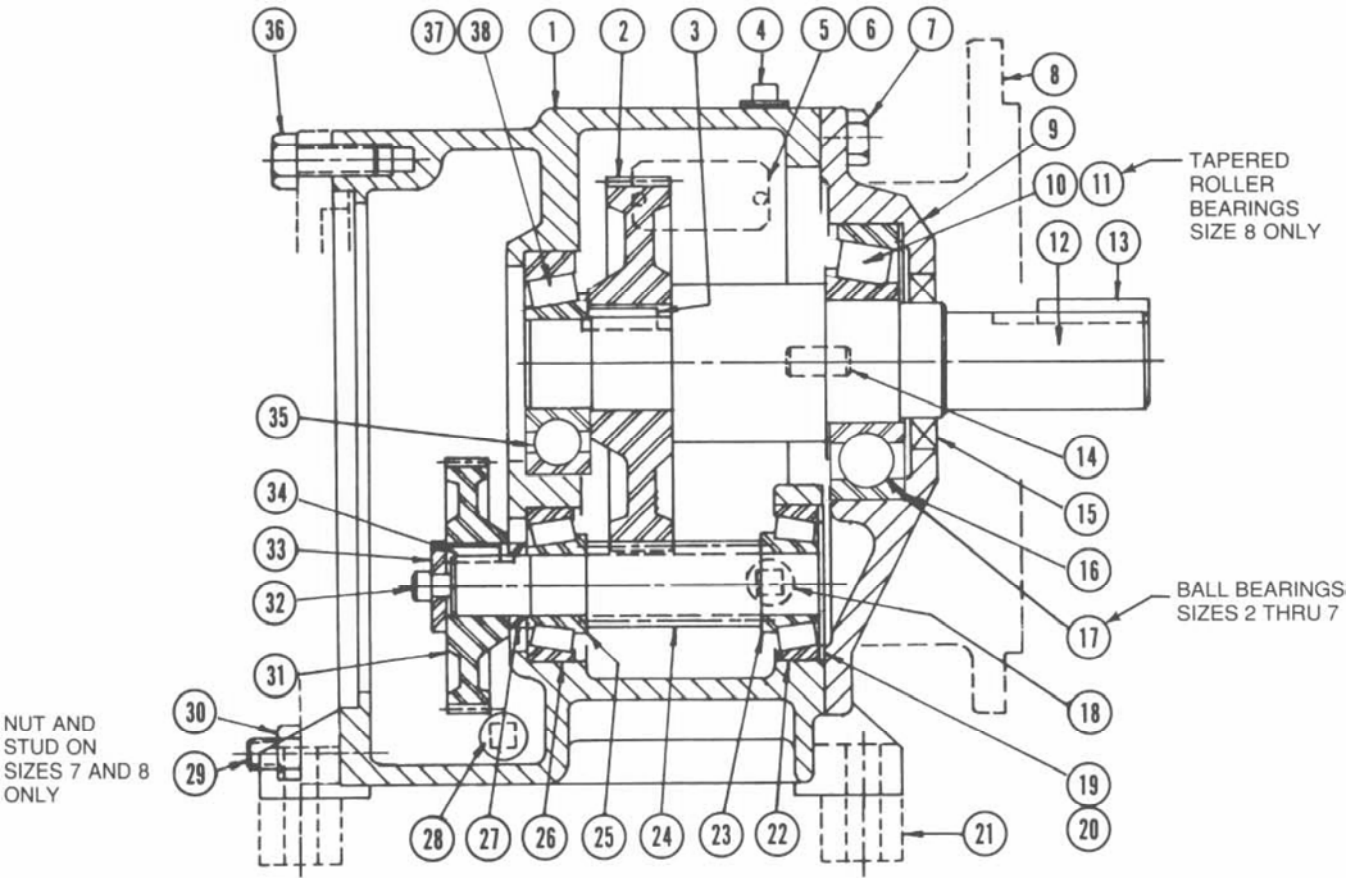
10. The output shaft extension should be taped, clean and lubricated with the oil to be used in the gearcase. Lubricate the shaft seal (8) lip with more of the same type of oil and slide the seal over the shaft. The seal garter spring goes toward the shaft bearing. Gently work the seal lip over the seal journal, taking care to not unseat the seal garter spring. Drive or press the seal flush to 1/16" below flush with the output bearing housing, using a smooth, cylindrical driver against the outside edge of the seal. The seal must be installed square with the shaft. The gearcase assembly is complete. See the appropriate sections of this manual for assembly of the input device and lubrication instructions.

***NOTE: Some reducers with special features may include an interference fit gear (17), rather than a slip fit.** In those cases it will be necessary to use a bearing puller to remove the gear. Exercise care not to damage gear teeth in this process.

Reinstallation of the gear will require the use of a press. Care must be taken to support the shaft to prevent the pressing load being transmitted thru the bearings.

If you are unsure if your reducer has an interference fit, contact the factory with the Identification Number of your reducer.

DOUBLE REDUCTION GEARCASE PARTS IDENTIFICATION DRAWINGS FOR MASTER APG SIZES 2–8



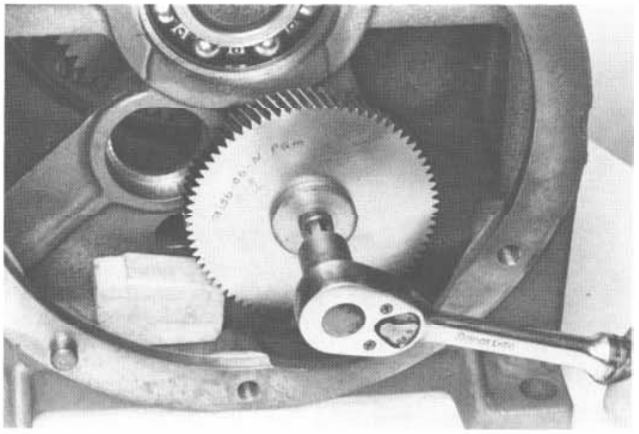
REF. NO.	PART DESCRIPTION	SIZE 2–6 QTY.	SIZE 7 QTY.	SIZE 8 QTY.	REF. NO.	PART DESCRIPTION	SIZE 2–6 QTY.	SIZE 7 QTY.	SIZE 8 QTY.
1	GEARCASE	1	1	1	20	"YZ" BEARING SHIMS	AS REQ.	AS REQ.	AS REQ.
2	"Z" OUTPUT GEAR	1	1	1	21	RISER BLOCK	0 OR 4	0 OR 4	0 OR 4
3	"Z" GEAR KEY	1	1	1	22	"YZ" SHAFT			
4	VENT PLUG ASSEMBLY	1	1	1		BEARING CUP	1	1	1
5	NAMEPLATE	1	1	1	23	"YZ" SHAFT			
6	NAMEPLATE PIN	2	2	2		BEARING CONE	1	1	1
7	HEX HEAD SCREW	6	6	6	24	"YZ" PINION SHAFT	1	1	1
8	FLANGED BEARING HOUSING	0 OR 1	0 OR 1	0 OR 1	25	"YZ" SHAFT BEARING CONE	1	1	1
9	STANDARD BEARING HOUSING	0 OR 1	0 OR 1	0 OR 1	26	"YZ" SHAFT BEARING CUP	1	1	1
10	OUTPUT BEARING CUP	–	–	1	27	"Y" GEAR SPACER	1	1	1
11	OUTPUT BEARING CONE	–	–	1	28	LUBRICANT PLUG	2	2	2
12	OUTPUT SHAFT	1	1	1	29	INPUT STUD	–	1	1
13	OUTPUT SHAFT KEY	1	1	1	30	HEX NUT	–	1	1
14	DOWEL PIN	2	2	2	31	"Y" GEAR	1	1	1
15	OUTPUT SHAFT OIL SEAL	1	1	1	32	SOCKET HEAD CAP SCREW	1	1	1
16	OUTPUT BEARING SHIMS	AS REQ.	AS REQ.	AS REQ.	33	"Y" GEAR RETAINER	1	1	1
					34	"Y" GEAR KEY	1	1	1
17	OUTPUT BALL BEARING	1	1	–	35	OUTPUT BALL BEARING	1	1	–
18	OIL LEVEL PLUG (RED)	1	1	1	36	HEX HEAD SCREW	6	5	5
19	.025 THICK BEARING SHIM	1	1	1	37	OUTPUT BEARING CUP	–	–	1
					38	OUTPUT BEARING CONE	–	–	1

REPAIRING THE DOUBLE REDUCTION GEARCASE

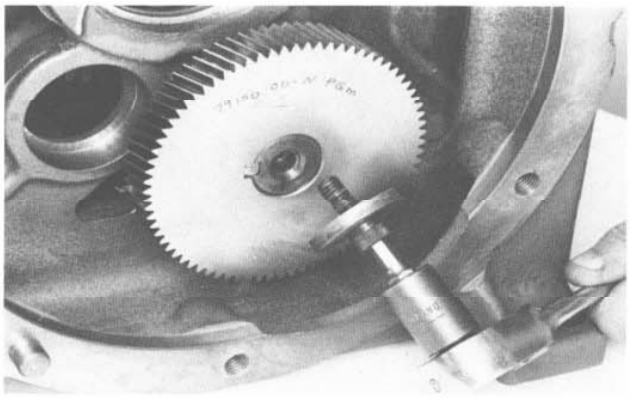
NOTE: The output bearing housing on the MASTER APG may be either standard or flanged. Teardown and assembly is the same for both.

TEARDOWN

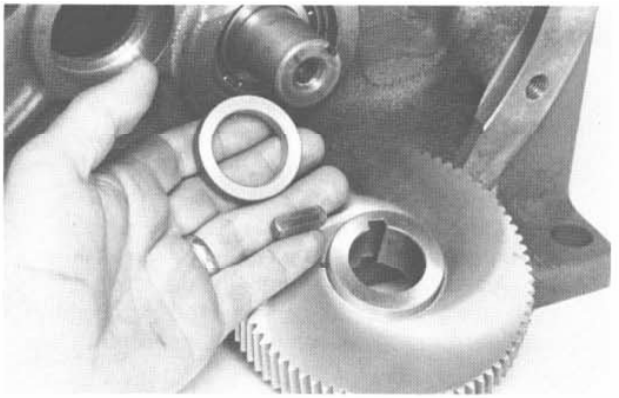
1. Place the gearcase foot down on the workbench. Use a wood or plastic wedge between the inside of the gearcase and the "Y" gear (31) to prevent the "Y" gear from turning.



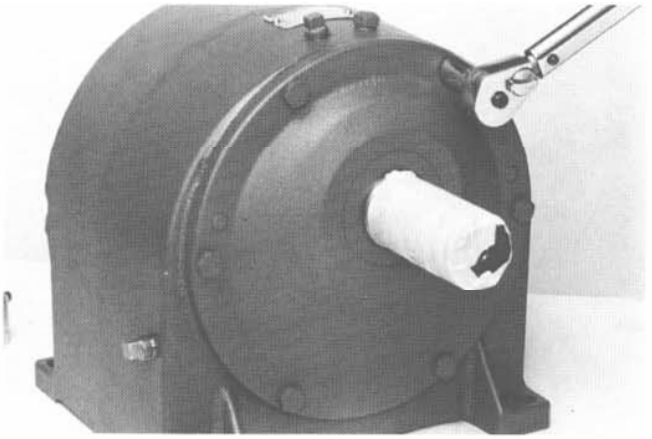
2. Remove the socket head cap screw (32) and the gear retaining washer (33).



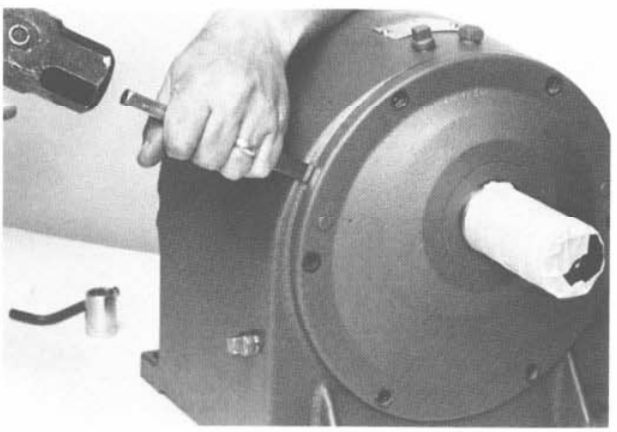
*3. The "Y" gear (31) should slide off the "YZ" pinion shaft (24). Remove the gear key (34) and the gear spacer (27). The "Y" gear in some ratios will not come all the way off the shaft until the "YZ" pinion is free to move forward. In these cases, leave the "Y" gear in place until Step 6.



4. Wrap the output shaft (12) extension with plastic tape. Remove the bolts (7) holding the output bearing housing (8 or 9).



5. The output bearing housing is sealed to the gearcase with Loctite Gasket Eliminator 515 or RTV silicone sealant. Use a chisel and hammer at the cast-in pry off slots to break the seal, as was done to remove the input device. Larger sizes may be easier to work on if placed on the input end of the gearcase.

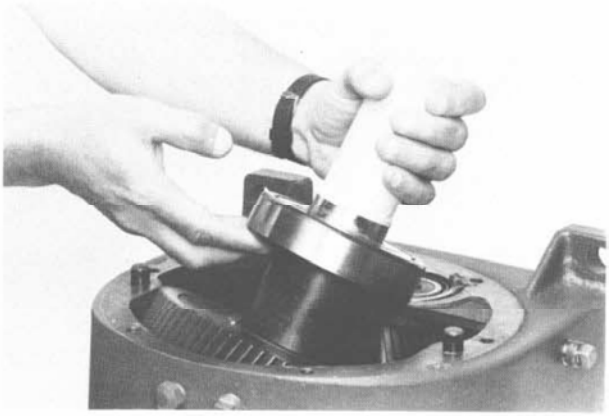


* See note on interference fit gearing at the end of this section.

6. With the output bearing housing removed, the output shaft (12) assembly can be lifted out. The assembly is heavy and must be cocked so the gear will clear other internal parts.

   MASTER APG Sizes 3 through 7 have shielded ball bearings on the output shaft. MASTER APG Size 8 has tapered roller bearings. The output shaft bearings are a heavy press fit on the output shaft. Proper press tools and press capacity will be needed to replace them. The output bearings are slip fit into the gearcase and bearing housing. The bearing cups in the Size 8 should be removed for proper cleaning and inspection.

   NOTE: Shielded ball bearings are not to be washed or flushed with solvent. If the bearing is contaminated, replace it.



7. Remove the "YZ" pinion shaft (24) by pushing on the extension on the input end. If the "Y" gear would not come out in Step 3, it can now be removed as the "YZ" pinion is withdrawn. The shims (19 and 20) and outboard bearing cup (22) will come out with the shaft. Note that the outermost shim (19) is .025 inches thick. This shim will have to be replaced in this outermost position at assembly.

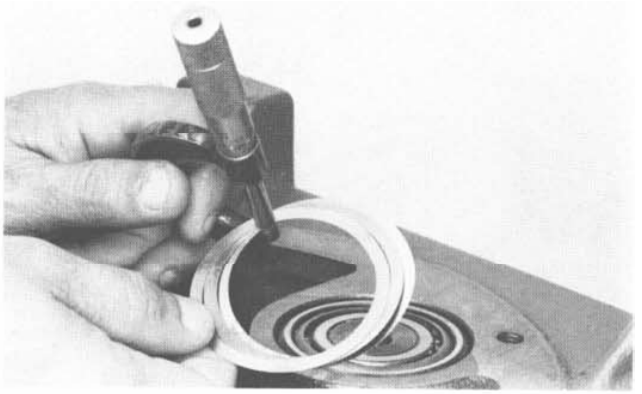
8. Clean and inspect all parts for wear or damage. The output shaft oil seal (15) should always be replaced.

ASSEMBLY OF THE DOUBLE REDUCTION GEARCASE

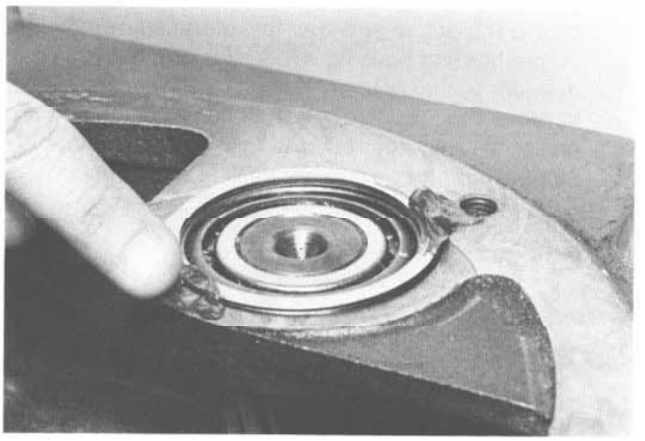
1. Insert the "YZ" pinion shaft bearing cup (26) into the gearcase. Tap with a soft mallet or hammer handle to be sure it is fully seated.
2. Place the "YZ" pinion shaft (24), complete with bearing cones installed, into the gearcase. The "Y" gear of some ratios will have to be installed at the same time. See Step 13.

3. Install the outboard "YZ" pinion shaft bearing cup (22). Tap the cup and the shaft with a soft mallet as the shaft is spun to be sure the bearings are seated. Use a depth micrometer as shown to measure from the gearcase face to the bearing cup.

4. Select a shim pack equal to the depth dimension measured minus .001 to .003 inches. Check the shim pack thickness with a micrometer. One of the shims (19) must be .025 thick.

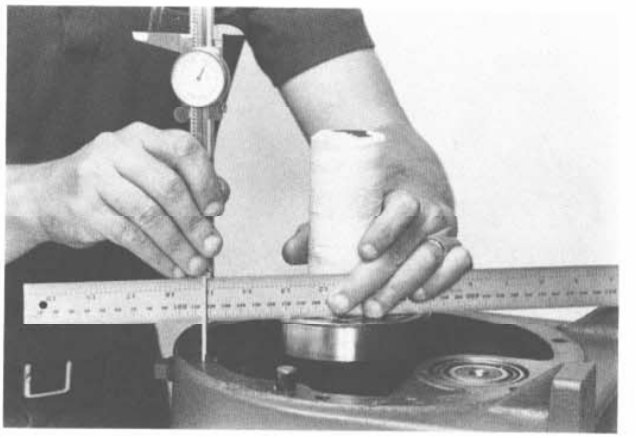


5. Place the shim pack over the bearing cup with the .025 shim outboard. The shim pack may be held in place with a small amount of stiff grease or RTV sealant.

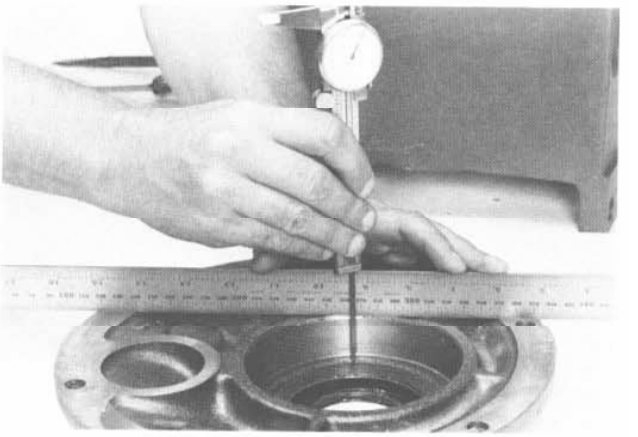


6. Only the Size 8 requires the bearing cup (37) to be placed in the gearcase bore before installing the output shaft (12) assembly. All other sizes have ball bearings on the output shaft. Install the output shaft assembly, carefully engaging the output gear (2) with the “YZ” pinion shaft (24) teeth.

7. Put the outboard bearing cup (10) in place on the Size 8. Tap the shaft and bearings to be sure they are fully seated. Use a metal straightedge and a depth micrometer or vernier caliper as shown to get the dimension from the outer edge of the outboard bearing to the face of the gearcase.



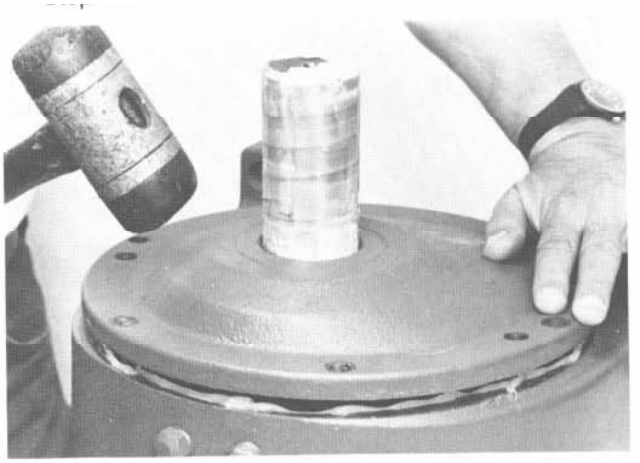
8. Use the same method to get the dimension from the bearing housing face to the shoulder of the bearing bore.



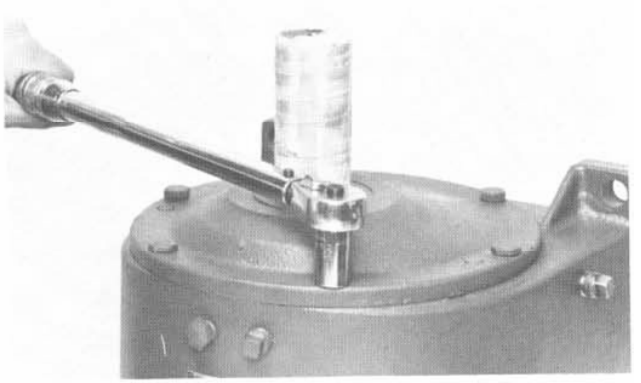
9. Subtract the dimension obtained in Step 7 from the dimension of Step 8. For Sizes 1 through 7, assemble a shim pack with a thickness .005 to .010 less than the result. For Size 8, select a shim pack .001 to .003 less than the result. Check the shim pack thickness with a micrometer. Insert the shim pack (16) into the bearing housing bore. Retain with a small amount of stiff grease or RTV sealant.

10. Carefully set the output bearing housing (7 or 8) into place, checking to be sure the bearing shims remain in place. Tap the bearing housing over the aligning pins.

    NOTE: Though the output shaft oil seal (15) is shown in place in the photo, it is recommended that it be left out until all other components are assembled. See Step 17.

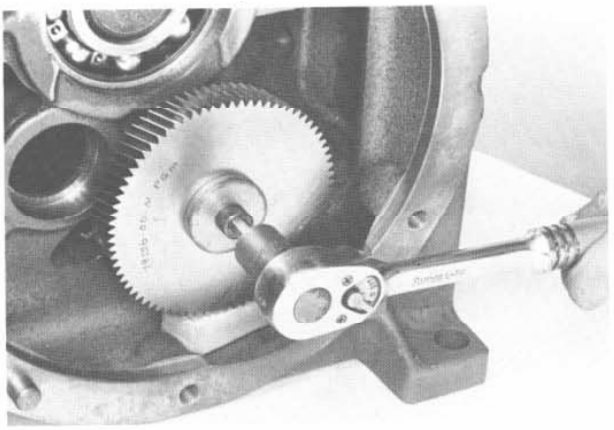


11. Tighten the bearing housing bolts (7) to the torque specified in the Hardware Torque Tables, page 46.

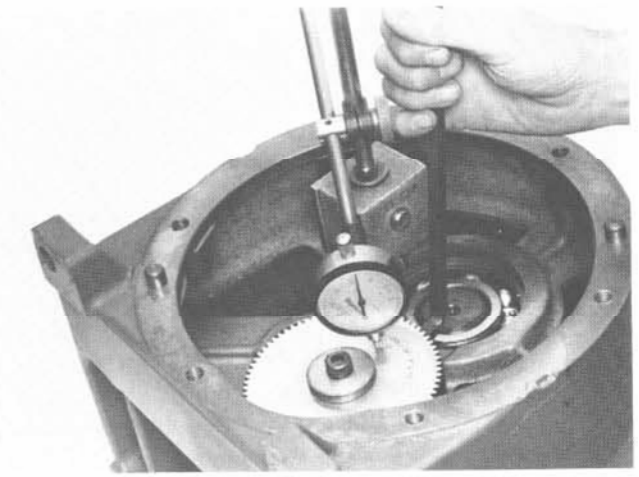


* 12. Place the gearcase back on its feet or with the input face up. Larger sizes are more easily worked on with the input face up. Install the "Y" gear spacer, key and gear. Note that the extended hub on the "Y" gear is installed toward the bearing.

13. Install the gear retainer washer (33) and the socket head cap screw (32). Wedge the gear to prevent rotation and tighten the screw to the torque specified in the Hardware Torque Tables.



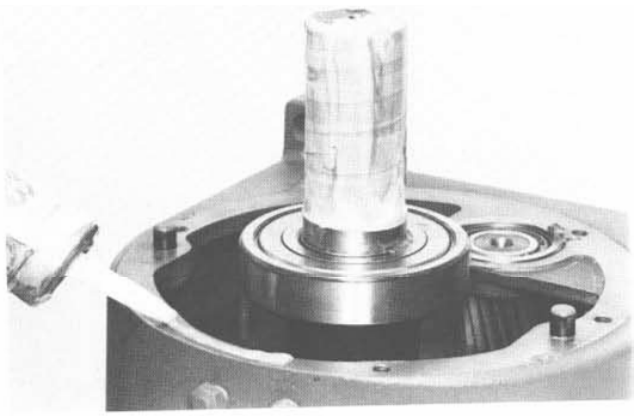
14. Use a dial indicator to check the end play of both the "YZ" pinion shaft (24) and the output shaft (12). Both shafts must indicate end play within the limits specified. If the shafts show end play outside the tolerance, record the actual end play for reference, remove the output bearing housing and add or remove shims as needed. Right angle pry bars, as shown, can be used to move the intermediate shaft if care is taken not to pry on the gear teeth. The output shaft is best moved by pushing and pulling on the output extension.



15. With the end play of the shafts correct, turn the shafts slowly through several revolutions to check for binding or roughness.

* See note on interference fit gearing at the end of this section.

16. Remove the output bearing housing. Apply RTV sealant or Loctite Gasket Eliminator 515 to the gearcase face. Run a $^1/_8$" bead around inside the bolt holes and dowel pins. Carefully set the output bearing housing (7 or 8) into place, checking to be sure the bearing shims remain in place. Tap the bearing housing over the aligning pins. Tighten the bearing housing bolts (7) to the torque specified in the Hardware Torque Tables.



*** NOTE: – Some reducers with special features may include an interference fit of the "Y" gear (31) on the "YZ" pinion shaft (24).** In those cases, it will be necessary to use a bearing puller to remove the gear. Exercise care not to damage gear teeth in this process.
Reinstallation of the gear will require the use of a press.

17. The output shaft extension should be taped, clean and lubricated with the oil to be used in the gearcase. Lubricate the lip of the oil seal (15) with more of the same type of oil and slide it over the shaft. Gently work the seal lip over the seal journal, taking care to not unseat the seal garter spring. Drive or press the seal flush to $^1/_{16}$" below flush with the output bearing housing (8 or 9), using a smooth, cylindrical driver against the outside edge of the seal. The seal must be installed square with the output shaft. The gearcase assembly is complete. See the appropriate sections of this manual for assembly of the input device and triple adapter, and for lubrication instructions.

Care should be taken to support the "YZ" pinion shaft to prevent the pressing load being transmitted to YZ shaft bearing (23).

If you are unsure if your reducer has an interference fit, contact the factory with the identification number of your reducer.

TRIPLE ADAPTER PARTS IDENTIFICATION DRAWING

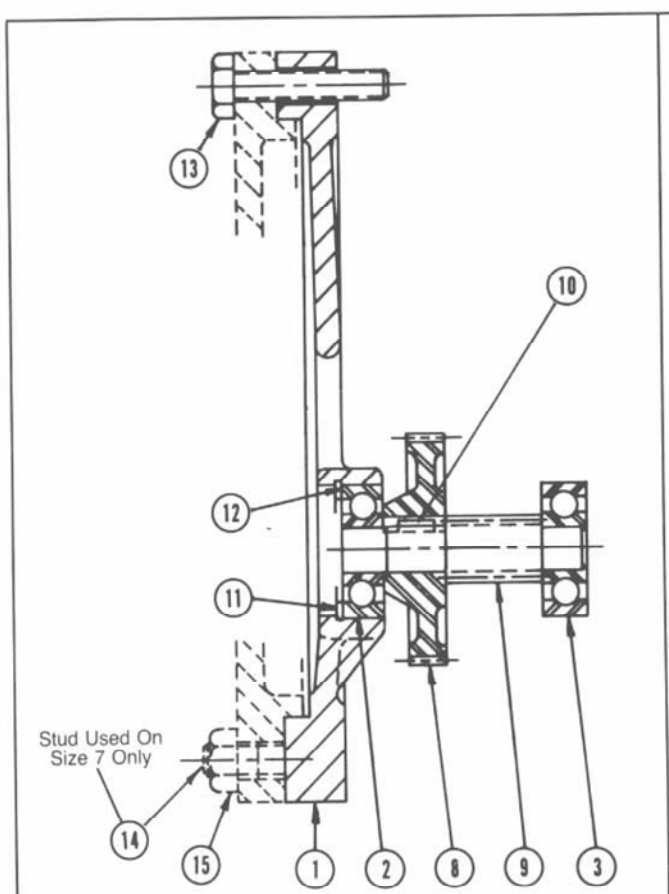


FIGURE 1 - MASTER APG SIZES 2-7

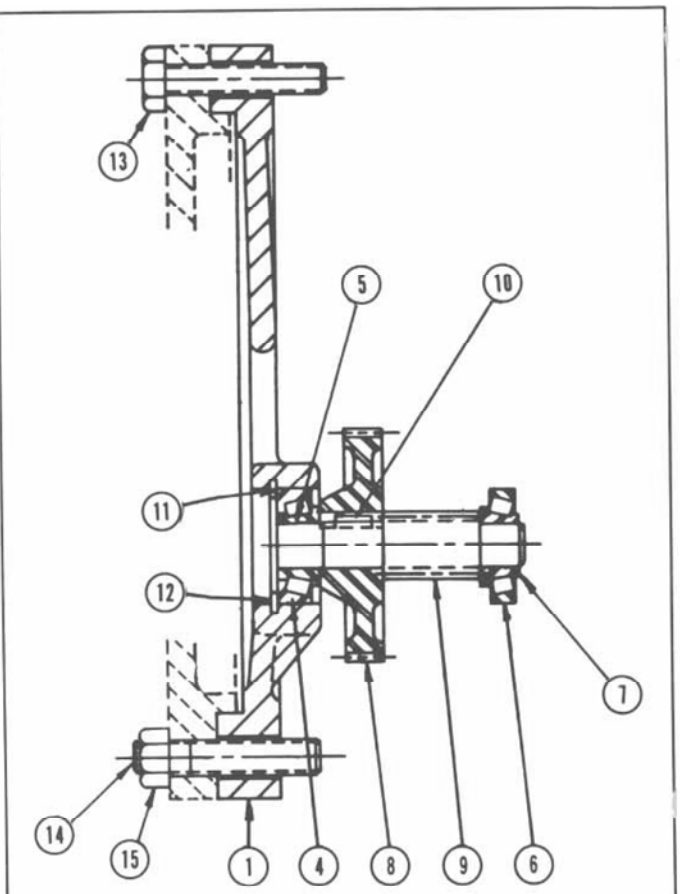


FIGURE 2 - MASTER APG SIZE 8

REF. NO.	PART DESCRIPTION	FIGURE 1 SIZE 2–6 QTY.	FIGURE 1 SIZE 7 QTY.	FIG. 2 SIZE 8 QTY.
1	TRIPLE ADAPTER	1	1	1
2	BALL BEARING	1	1	–
3	BALL BEARING	1	1	
4	BEARING CUP	--	--	1
5	BEARING CONE	–	–	1
6	BEARING CUP	–	–	1
7	BEARING CONE	–	–	1
8	”X” GEAR	1	1	1
9	”XY” PINION SHAFT	1	1	1
10	”X” GEAR KEY	1	1	1
11	BEARING SHIMS	AS REQUIRED		
12	RETAINING RING	1	1	1
13	HEX HEAD SCREW	6	5	5
14	INPUT STUD	–	1	1
15	HEX NUT	–	1	1

REPAIRING THE TRIPLE ADAPTER

NOTE: The triple adapter is used only with overall ratios of 31.4:1 and higher.
The triple adapter will usually come off with the input device, since they are sealed together with RTV silicone rubber sealant. The "XY" pinion shaft (9) assembly will usually stay in the gearcase, though it may pull free during removal of the input device. See "Removing the Input Device."

Triple adapters for MASTER APG Sizes 2 through 7 are equipped with ball bearings on the "XY" pinion shaft as shown in Figure 1 of the Triple Adapter Parts Identification Drawing. The Size 8 triple adapter has tapered roller bearings as shown in Figure 2.

TRIPLE ADAPTER TEARDOWN

Sizes 2 thru 7 (Ball Bearings):
Remove the "XY" pinion shaft assembly.

Size 8 (Roller Bearings):
Remove the "XY" pinion shaft assembly.
Remove the bearing cup (4), bearing shims (11), and the retaining ring (12) from the bearing bore in the triple adaptor. Remove the bearing cup (6) from the bore in the gearcase.

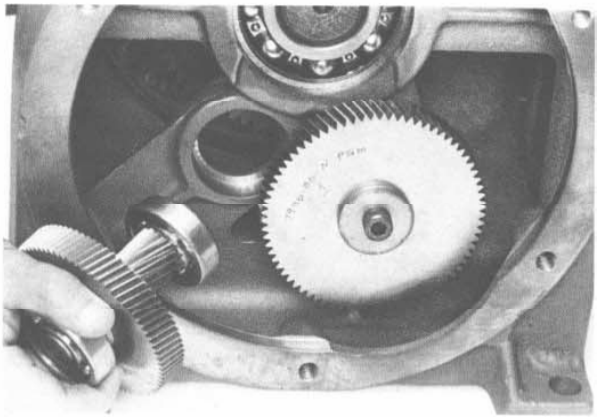
Sizes 2 thru 8:
Remove the triple adaptor from the input device by inserting pry bars and blocks between the triple adaptor spokes and the gearcase side of the input device. Pry carefully to separate. Use proper gear and bearing removal tools to separate the "XY" pinion assembly into its component parts if necessary. Clean and inspect all parts to determine what needs to be replaced.

TRIPLE ADAPTER ASSEMBLY

NOTE: All work on the gearcase and the input device should be completed before assembly of the triple adapter is started.

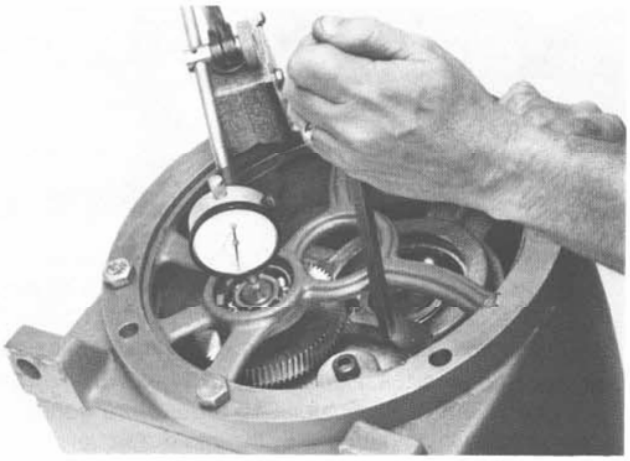
NOTE: A number of flat washers of the correct size to fit the input device attaching bolts will prove handy while setting the "XY" pinion shaft end play. Place several on each bolt used to temporarily hold the triple adapter to the gearcase so the triple adapter can be snugged down without bottoming out the bolts.

1. Begin assembly by pressing all parts in the "XY" pinion shaft assembly into place on the "XY" pinion shaft (9). Be sure the gear (8) and bearing (2 or 5) are solid against each other and the shaft shoulder and that the key (10) is in place. Press the bearing (3 or 7) solid against the other shaft shoulder.
2. Install the bearing cup (6) in the gearcase bore (Size 8 only). Tap with a soft hammer to be sure the bearing cup is seated. Install the "XY" pinion shaft assembly into the gearcase bore. In some cases, the "Y" gear will have to be loosened on the "YZ" pinion and pulled back to provide clearance to install the "XY" pinion assembly. See "REPAIRING THE DOUBLE REDUCTION GEARCASE".

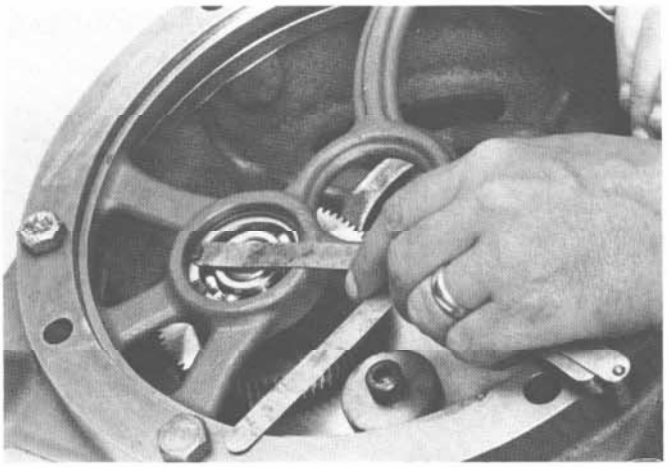


3. Install the retaining ring (12) into the triple adapter (1). Be sure the ring snaps all the way into the groove.
4. Temporarily install the triple adapter on the gearcase. Make sure the two dowel pins which align the triple adapter with the gearcase are in place. Three of the six bolts are sufficient.
5. Measure the shaft end play by either of the two methods shown:

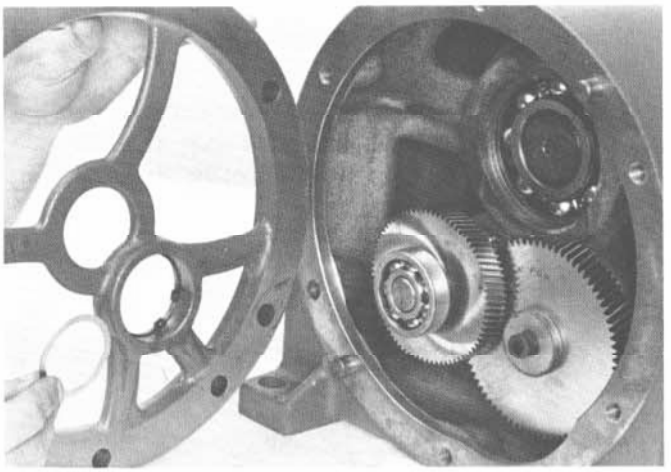
Preferred Method: Mount a dial indicator and move the "XY" shaft end to end. Rotate the shaft to be sure the bearings are seating at both ends of the stroke. Record the total end play indicated.



Optional Method: Use feeler gauges to measure the clearance between the outside race of the bearing and the retaining ring. Be sure the bearings are fully seated toward the gearcase by tapping with a soft mallet while rotating the shaft. Record the clearance measured.



6. Remove the triple adapter. For Sizes 2 through 7, select a shim pack .005 to .010 inches less than the end play measured in Step 5. For the Size 8, select a shim pack .001 to .003 inches less than the measured end play. Insert the shims in the triple adapter bore so they are solid against the retaining ring. Again, temporarily assemble the triple adapter. Spin the shaft to be sure the bearings are seated and turning smoothly. Recheck the end play. Reshim as needed.



7. With the end play of the "XY" pinion shaft assembly properly set, remove the triple adapter for final assembly. Be sure the input stud (14) is in place in Sizes 7 and 8 gearcases. Be sure the aligning dowel pins are in place on all sizes. Apply a $^{1}/_{8}$" bead of RTV sealant or Loctite Gasket Eliminator 515 around the gearcase flange face which mates with the triple adapter. Apply the bead just inside the bolt and dowel pin holes on the gearcase.
8. Assemble the triple adapter to the gearcase. Use a soft mallet to seat the adapter over the dowel pins. Replace the input device (See "Replacing the Input Device") immediately. Tighten the attaching hardware (13 and 15) to the torque shown in the Hardware Torque Tables. The MASTER APG is now complete and ready for relubrication. See the "Lubrication" section of this manual.

TABLE OF BEARING SHIMMING CLEARANCES (IN INCHES) FOR ALL CONFIGURATIONS OF APG UNITS

GEAR CASE SIZE	SEPARATE REDUCER INPUT SHAFT	XY PINION SHAFT	YZ PINION SHAFT	OUTPUT SHAFT
2 to 3	*	.005 TO .010	.001 TO .003	.005 TO .010
4	*	.005 TO .010	.001 TO .003	.005 TO .010
5	*	.005 TO .010	.001 TO .003	.005 TO .010
6	*	.005 TO .010	.001 TO .003	.005 TO .010
7 100/750 RPM 750/1800 RPM 1800/2500 RPM	• .000 TO .002 .002 TO .004 .003 TO .005	.005 TO .010	.001 TO .003	.005 TO .010
8 100/750 RPM 750/1800 RPM 1800/2500 RPM	• .000 TO .002 .002 TO .004 .003 TO .005	.001 TO .003	.001 TO .003	.001 TO .003

* Sizes 2 thru 6 separate reducers have clamped ball bearings on the input shaft. No shimming is necessary.

• Sizes 7 & 8 clearances are for normal ambient duty (20ºF to 110ºF). See page 22 of this manual for low ambient duty (-30ºF to -20ºF).

All Single Parallel units have roller bearings on the output shaft—shim to .001/.003.

TORQUES FOR GEARCASE BOLTS
(Metric Grade 8.8, Hex Head Screws)

INPUT DEVICE TO GEARCASE			OUTPUT BEARING HOUSING TO GEARCASE			
			SINGLE REDUCTION		D / T REDUCTION	
CASE SIZE	BOLT SIZE	TORQUE LB-IN	BOLT SIZE	TORQUE LB-IN	BOLT SIZE	TORQUE LB-IN
2	M8	230	–	–	M8	230
3 & 4	M10	460	M12	800	M10	460
5	M12	800	M16	1900	M10	460
6	M12	800	M16	1900	M12	800
7 & 8	M20	3700	M20	3700	M20	3700

TORQUES FOR "Y" GEAR RETAINING SCREWS
(Metric Grade 12.9, Hex Socket Head Screws)

CASE SIZE	BOLT SIZE	TORQUE LB-IN
3	M8	410
4 & 5	M10	815
6 & 7	M12	1415
8	M16	3425

TORQUES FOR PIPE PLUGS

	TORQUE	
CASE SIZE	PLUG SIZE	LB-IN
ALL CASE SIZES	1/8–27 NPT	100
	3/4–18 NPT	200
	3/8–18 NPT	400
	1/2–14 NPT	700

TORQUES FOR SEPARATE REDUCER ADAPTER BEARING CLAMP SCREWS

CASE SIZE	BOLT SIZE & DESCRIPTION	TORQUE LB-IN
3 & 4	M5 HEX SOCKET HEAD, Grade 12.9	100
5, 6, 7, 8	M6 HEX HEAD, Grade 8.8	96

TORQUES FOR C-FACE ADAPTER BEARING CLAMP SCREWS

CASE SIZE	BOLT SIZE & DESCRIPTION	TORQUE LB-IN
2, 3, 4	M5 HEX SOCKET HEAD, Grade 12.9	100
5, 6, 7, 8	M5 HEX SOCKET HEAD, Grade 12.9 for 56/140C motors	100
5, 6, 7, 8	M6 HEX HEAD, Grade 8.8 for 180C motors and larger	96

MISCELLANEOUS HARDWARE The following tables are for general application where threaded hardware is not included in previous torque tables.

TORQUES FOR ENGLISH SYSTEM
THREADED HARDWARE
HEX HEAD OR HEX SOCKET SCREWS

THREAD SIZE	TORQUE (LB-IN) FOR GRADE 2	GRADE 5	GRADE 8
6–32	8	12	28
6–40	9	13	30
8–32	14	22	49
8–36	15	23	50
10–24	21	32	64
10–32	23	36	76
1/4–20	50	75	150
1/4–28	56	86	170
5/16–18	96	156	305
5/16–24	108	168	325
3/8–16	180	276	545
3/8–24	204	300	570
7/16–14	288	420	840
7/16–20	324	480	900
1/2–13	420	660	1300
1/2–20	480	780	1370
5/8–11	900	1320	2530
5/8–18	1020	1560	2660
3/4–10	1560	2400	4400
3/4–16	1800	2640	4800
7/8–9	1500	3840	7000
7/8–14	1680	4320	7600
1–8	2280	5760	10400
1–12	2520	6360	11000

TORQUES FOR METRIC SYSTEM
THREADED HARDWARE
HEX HEAD OR HEX SOCKET SCREWS
(Coarse Thread Series per ISO 261262)

THREAD SIZE	TORQUE (LB-IN) FOR GRADE 8.8	GRADE 12.9	HEX BOLT SOCKET WRENCH SIZE (mm)
M3	12	22	5.5
M4	28	50	7
M5	56	100	8
M6	96	170	10
M8	230	410	13
M10	460	815	17
M12	800	1415	19
M14	1260	2250	22
M16	1900	3425	24
M20	3700	6640	30
M24	6400	11400	36
M30	12800	22900	46
M36	22500	40000	55

NOTE: THREAD LUBRICATION

The torques shown are for "lubricated" threads. Lubricated threads are defined as any plated thread or any thread coated with any amount of oil or wax. By this definition, most threaded hardware is lubricated. If in doubt, wipe the threads with a lightly oiled rag.

Specifications and torques for hardware for mounting the gearcase and for C-Face motor attachment are detailed in the "Installation" section of this manual.

RENEWAL PARTS

CONTACT MASTER RENEWAL PARTS FOR ASSISTANCE AT (888) 616-1094.
IDENTIFICATION NUMBER FROM UNIT WILL BE REQUIRED FOR PARTS ASSISTANCE.

LUBRICANT

FACTORY APPROVED LUBRICANTS ARE AVAILABLE IN SMALL VOLUME CONTAINERS.
ORDER BY PART NUMBER FROM YOUR LOCAL MASTER DISTRIBUTOR.

VOLUME	PART NUMBER (SHC-634)
12 OZ	41170966AB
1 QT	41170966AE
1 GAL	41170966AF

VOLUME	PART NUMBER (SHC-629)
1QT	41170966AG
1 GAL	41170966AH

MASTER APG REDUCERS RECOMMENDED LUBRICANT SHC-634

Size	Capacity*		Part No.	Quantity
	Quarts	Gallons		
D2	.75	.188	41170966AE	1 Quart
T2	1.00	.250	41170966AE	1 Quart
S3	.88	.219	41170966AE	1 Quart
D3	1.25	.312	41170966AE	2 Quarts
T3	1.25	.312	41170966AE	2 Quarts
S4	.70	.172	41170966AE	1 Quart
D4	1.63	.406	41170966AE	2 Quarts
T4	1.63	.406	41170966AE	2 Quarts
S5	2.00	.500	41170966AE	2 Quarts
D5	3.38	.844	41170966AF	1 Gallon
T5	3.50	.875	41170966AF	1 Gallon
S6	2.75	.688	41170966AE	3 Quarts
D6	5.25	1.313	41170966AF 41170966AE	1 Gallon 2 Quarts
T6	5.25	1.313	41170966AF 41170966AE	1 Gallon 2 Quarts
S7	6.75	1.688	41170966AF	2 Gallons
D7	15.00	3.750	41170966AF	4 Gallons
T7	16.50	4.125	41170966AF 41170966AE	4 Gallons 1 Quart
S8	4.75	1.188	41170966AF 41170966AE	1 Gallon 1 Quart
D8	16.00	4.000	41170966AF	4 Gallons
T8	17.75	4.438	41170966AF 41170966AE	4 Gallons 2 Quarts

* CAPACITY IS FOR A-1 &C-1 MOUNTINGS ONLY

APG BEARING PART NUMBERS
For Sizes 2–8

Size	Type	X-Stage		Y-Stage		Z-Stage (Foot MTD)		Z-Stage (Flange)
		Inner	Outer	Inner	Outer	Inner	Outer	Outer
2	SM2	–	–	41162601FR	41162601BC	–	–	–
	DM	–	–	41162601D	41162601D	07914703E	07914703CS	07914702CX
	TM	0714701BJ	07914701BJ	41162601D	41162601D	07914703E	07914703CS	07914702CS
3	SG/SM	–	–	41162601BC	41162601GB	–	–	–
	DG/DM	–	–	41162601FR	41162601FR	07914703K	07914703CT	07914703CT
	TG/TM	07914703BP	07914703BP	41162601FR	41162601FR	07914703K	07914703CT	07914703CT
4	SG/SM	–	–	41162601AC	41162601GB	–	–	–
	DG/DM	–	–	41162601BC	41162601BC	07914703N	07914703CU	07914703CX
	TG/TM	07914703D	07914703D	41162601BC	41162601BC	07914703N	07914703CU	07914703CX
5	SG/SM	–	–	41162601GC	41162601FT	–	–	–
	DG/DM	–	–	41162601FS	41162601FS	07914703AA	07914703CV	07914703CV
	TG/TM	07914703E	07914703E	41162601FS	41162601FS	07914703AA	07914703CV	07914703CV
6	SG/SM	–	–	41162601GD	41162601FV	–	–	–
	DG/DM	–	–	4116201FT	41162601FT	07914703AG	07914703CW	07914703CW
	TG/TM	07914704L	07914704L	41162601FT	41162601FT	07914703AG	07914703CW	07914703CW
7	SG/SM	–	–	41162601FW	41162601FW	–	–	–
	DG/DM	–	–	41162601FV	41162601FV	07914703AP	07914703CM	07914703CM
	TG/TM	07914704M	07914704M	41162601FV	41162601FV	07914703AP	07914703CM	07914703CM
8	SG/SM	–	–	41162601GE	41162601GE	–	–	–
	DG/DM	–	–	41162601FW	41162601FW	41162601FX	41162601FY	41162601FY
	TG/TM	41162601FT	41162601GA	41162601FW	41162601FW	41162601FX	41162601FY	41162601FY

BEARING KITS

INCLUDES ALL REDUCER BEARINGS FOR GEARMOTOR STYLE UNITS. REDUCERS WITH “C” FACE AND SEPARATE INPUT DEVICES HAVE ADDITIONAL BEARING(S) WHICH MUST BE SELECTED FROM FOLLOWING CHARTS.

SIZE	PART NO.	SIZE	PART NO.	SIZE	PART NO.
S2	41164245AW	D2	41164245AE	T2	41164245AM
S3	41164245Y	D2F	41164245AX	T2F	41164245AY
S4	41164245Z	D3	41164245AF	T3	41164245AN
S5	41164245AA	D4	41164245AG	T4	41164245AP
S6	41164245AB	D4F	41164245AZ	T4F	41164245BA
S7	41164245AC	D5	41164245AH	T5	41164245AR
S8	41164245AD	D6	41164245AJ	T6	41164245AS
		D7	41164245AK	T7	41164245AT
		D8	41164245AL	T8	41164245AV

C-FACE ADAPTOR BEARING CHART

Size	Motor Frame	C-Face Adaptor Bearing
2	All	07914702AC
3	56C/140TC	07914702CR
	182TC/184TC	07914702CS
	210TC	07914702CS
4	56C/140TC	07914702CR
	182TC/184TC	07914702CS
	210TC/250TC	07914702CS
5	56TC/140TC	07914702CR
	182TC/184TC	07914702CS
	210TC	07914702CS
	250TC	07914702CT
	280TC	07914702CM

Size	Motor Frame	C-Face Adaptor Bearing
6	140TC	07914702CR
	182TC/184TC	07914702CS
	210TC	07914702CS
	250TC	07914702CT
	280TC	07914702CM
	320TC/360TC	07914702CN
7 & 8	182TC/184TC	07914702CS
	210TC	07914702CS
	250TC	07914702CT
	280TC	07914702CP
	320TC/360TC	07914702CP
	400TC	07914702CN

SEPARATE ADAPTOR BEARING CHART

Size	Input Bearing	
	Inner	Outer
3 & 4	07914703CU	07914703DA
5	07914703DB	07914703CU
6	07914703DC	07914703CV
7 & 8	41162601GG	41162601GH

APG OIL SEAL CHART

SIZE & TYPE	MOTOR FRAME	INPUT		OUTPUT SEAL STANDARD	OUTPUT SEAL EASY CLEAN-XT
		OIL SEAL	SLEEVE		
SM2▪	56C/140TC	411627–01CR	–	411627–01DE	411627–02FE
	180TC	411627–01CS	–	411627–01DE	411627–02FE
DM-TM2A	56C/140TC	411627–01CS	–	411627–01CN	411627–02EW
	180TC	411627–01CS	–	411627–01CN	
DM-TM2F	56C/140TC	411627–01CR	–	411627–01DF	411627–02FG
	180TC	411627–01CS	–	411627–01DF	
SG3	56/143/145	411627–01DA	79142–05K	411627–01DF	
	146/147	411627–01DA	79142–05D	411627–01DF	
	180	411627–02DB	79142–05B	411627–01DF	411627–02FG
	210	411627–01DC	79142–05E	411627–01DF	
SM3	56C/140TC	411627–01CE	–	411627–01DF	
	180TC/210TC	411627–01CF	–	411627–01DF	
DG-TG3	56/143/145	411627–01DA	79142–05K	411627–01CP	
	146/147	411627–01DA	79142–05D	411627–01CP	
	180	411627–01DB	79142–05B	411627–01CP	411627–02EX
	210	411627–01DC	79142–05E	411672–01CP	
DM-TM3	56C/140TC	411627–01CE	–	411627–01CP	
	180TC/210TC	411627–01CF	–	411627–01CP	
SG4	56/143/145	411627–01DA	79142–05K	411627–01DF	
	146/147	411627–01DA	79142–05D	411627–01DF	
	180	411627–01DB	79142–05B	411627–01DF	
	210	411627–01DC	79142–05E	411627–01DF	411627–02FG
	256	411627–01DD	79142-05A	411627–01DF	
SM4	56C/140TC	411627–01CE	–	411627–01DF	
	180TC/210TC/250TC	411627–01CF	–	411627–01DF	
DG-TG4A	56/143/145	411627–01DA	79142–05K	411627–01CR	
	146/147	411627–01DA	79142–05D	411627–01CR	
	180	411627–01DB	79142–05B	411627–01CR	
	210	411627–01DC	79142–05E	411627–01CR	411627–02EY
	256	411627–01DD	79142–05A	411627–01CR	
DG-TG4F	56/143/145	411627–01DA	79142–05K	411627–01CX	
	146/147	411627–01DA	79142–05D	411627–01CX	
	180	411627–01DB	79142–05B	411627–01CX	
	210	411627–01DC	79142–05E	411627–01CX	411627–02FD
	256	411627-01DD	79142-05A	411627-01CX	
DM-TM4A	56C/140TC	411627–01CE	–	411627–01CR	
	180TC/210TC/250TC	411627–01CF	–	411627–01CR	411627–02EY
DM-TM4F	56C/140TC	411627–01CE	–	411627–01CX	
	180TC/210TC/250TC	411627–01CF	–	411627–01CX	411627–02FD
SG5	56/143/145	411627–01DA	79142–05K	411627–01DG	
	146/147	411627–01DA	79142–05D	411627–01DG	
	180	411627–01DB	79142–05B	411627–01DG	
	210	411627–01DC	79142–05E	411627–01DG	
	256	411627–01DD	79142–05A	411627–01DG	411627-02FH
SM5	56C/140TC	411627–01CE	–	411627–01DG	
	180TC/210TC/250TC	411627–01CF	–	411627–01DG	
	280TC	411627–01CG	–	411627–01DG	
DG-TG5	56/143/145	411627–01DA	79142–05K	411627–01CS	
	146/147	411627–01DA	79142–05D	411627–01CS	
	180	411627–01DB	79142–05B	411627–01CS	
	210	411627–01DC	79142–05E	411627–01CS	
	256	411627–01DD	79142–05A	411627–01CS	
DM-TM5	56C/140TC	411627–01CE	–	411627–01CS	411627-02EZ
	180TC/210TC/250TC	411627–01CF	–	411627–01CS	
	280TC	411627–01CG	–	411627–01CS	
SG6	56/143/145	411627–01DA	79142–05K	411627–01DH	
	146/147	411627–01DA	79142–05D	411627–01DH	
	180	411627–01DB	79142–05B	411627–01DH	
	210	411627–01DC	79142–05E	411627–01DH	
	256	411627–01DD	79142–05A	411627–01DH	
	286	411627–01DD	79142–05F	411627–01DH	411627–02FJ
	326	411627–01DJ	79142–05G	411627–01DH	
	365	411627–01DL	79142–05H	411627–01DH	
SM6	140TC	411627–01CE	–	411627–01DH	
	180TC/210TC/250TC	411627–01CF	–	411627–01DH	
	280TC	411627–01CG	–	411627–01DH	

APG Oil Seals - Continued

SIZE	MOTOR FRAME	INPUT		OUTPUT SEAL	OUTPUT SEAL
		OIL SEAL	SLEEVE	STANDARD	EASY CLEAN-XT
SM6	320TC/360TC	411627–01–CH	–	411627–01DH	411627–02FJ
DG-TG6	56/143/145	411627–01DA	79142–05K	411627–01CT	
	146/147	411627–01DA	79142–05D	411627–01CT	
	180	411627–01DB	79142–05B	411627–01CT	
	210	411627-01DC	79142-05E	411627-01CT	
	256	411627-01DD	79142-05A	411627-01CT	411627-02AF
	286	411627-01DD	79142-05F	411627-01CT	
	326	411627–01DJ	79142–05G	411627–01CT	
	365	411627–01DL	79142–05H	411627–01CT	
DM-TM6	140TC	411627–01CE	–	411627–01CT	
	180TC210TC/250TC	411627–01CF	–	411627–01CT	
	280TC	411627–01CG	–	411627–01CT	
	320TC/360TC	411627–01CH	–	411627–01CT	
SG7	180	411627–01DB	79142–05B	411627–01CT	
	210	411627–01DC	79142–05E	411627–01CT	
	256	411627–01DD	79142–05A	411627–01CT	
	286	411627–01DD	79142–05F	411627–01CT	
	326	411627–01DJ	79142–05G	411627–01CT	
	365	411627–01DL	79142–05H	411627–01CT	411627–02FA
	405/445	411627–01DL	79142–05J	411627–01CT	
SM7	180TC/210TC/250TC	411627–01CF	–	411627–01CT	
	280TC	411627–01CG	–	411627–01CT	
	320TC/360TC	411627–01CH	–	411627–01CT	
	400TC	411627–01CJ	–	411627–01CT	
DG-TG7	180	411627–01DB	79142–05B	411627–01CV	
	210	411627–01DC	79142–05E	411627–01CV	411627–02FB
	256	411627–01DD	79142–05A	411628–01CV	
	286	411627–01DD	79142–05F	411627–01CV	
	326	411627–01DJ	79142–05G	411627–01CV	
	365	411627–01DL	79142–05H	411627–01CV	
	405/445	411627–01DL	79142–05J	411627–01CV	
DM-TM7	180TC/210TC/250TC	411627–01CF	–	411627–01CV	411627-02FB
	280TC	411627–01CG	–	411627–01CV	
	320TC/360TC	411627–01CH	–	411627–01CV	
	400TC	411627–01CJ	–	411627–01CV	
SG8	180	411627–01DB	79142–05B	411627–01CV	
	210	411627–01DC	79142–05E	411627–01CV	
	256	411627–01DD	79142–05A	411627–01CV	
	286	411627–01DD	79142–05F	411627–01CV	
	326	411627–01DJ	79142–05G	411627–01CV	
	365	411627–01DL	79142–05H	411627–01CV	411627–02FB
	405/445	411627–01DL	79142–05J	411627–01CV	
SM8	180TC/210TC/250TC	41162701CF	–	411627–01CV	
	280TC	411627–01CG	–	411627–01CV	
	320TC/360TC	411267–01CH	–	411627–01CV	
	400TC	411627–01CJ	–	411627–01CV	
DG-TG8	180	411627–01DB	79142–05B	411627–01CW	
	210	411627–01DC	79142–05F	411627–01CW	
	256	411627–01DD	79142–05A	411627–01CW	
	286	411627–01DD	79142–05F	411627–01CW	
	326	411627–01DJ	79142–05G	411627–01CW	411627–02FC
	365	411627–01DL	79142–05H	411627–01CW	
	405/445	411627–01DL	79142–05J	411627–01CW	
DM-TM8	180TC/210TC/250TC	411627–01CF	–	411627–01CW	
	280TC	411627–01CG	–	411627–01CW	
	320TC/360TC	411627–01CH	–	411627–01CW	
	400	411627–01CJ	–	411627–01CW	

SEPARATE REDUCER OIL SEAL CHART

Size	Enclosure	Input	Output
SR3	Standard	41162701DK	41162701DF
	XT-EZ Clean	41162702FK	41162702FG
DR-TR3	Standard	41162701DK	41162701CP
	XT-EZ Clean	41162702FK	41162702EX
SR4	Standard	41162701DK	41162701DF
	XT-EZ Clean	41162702FK	41162702FG
DR-TR4	Standard	41162701DK	41162701CR
	XT-EZ Clean	41162702FK	41162702EY
SR5	Standard	41162701CP	41162701DG
	XT-EZ Clean	41162702EX	41162702FH
DR-TR5	Standard	41162701CP	41162701CS
	XT-EZ Clean	41162702EX	41162702EZ
SR6	Standard	41162701CR	41162701DH
	XT-EZ Clean	41162702EY	41162702FJ
DR-TR6	Standard	41162701CR	41162701CT
	XT-EZ Clean	41162702FY	41162702FA
SR7	Standard	41162701DN	41162701CT
	XT-EZ Clean	41162701DN	41162702FA
DR-TR7	Standard	41162701DN	41162701CV
	XT-EZ Clean	41162701DN	41162702FB
SR8	Standard	41162701DN	41162701CV
	XT-EZ Clean	41162701DN	41162702FB
DR-TR8	Standard	41162701DN	41162701CW
	XT-EZ Clean	41162701DN	41162702FC

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