

Worm Gear Reducers

Installation, Operation and Maintenance Manual

P-6002-DWG



Product Safety Information:

General- The information provided within this document is intended to give guidance to personnel responsible for selecting, installing, maintaining, and operating Delroyd Worm Gear products. This information must be made available and reviewed by the aforementioned parties to ensure proper installation, safe operation, and proper maintenance of Delroyd Worm Gear products is achievable. Provided below is a list of potential hazards that are not listed in any order relative to level of hazard.

Lifting- Follow the lifting instructions as outlined in this manual. Failure to follow these instructions may result in personal injury or death and/or damage to the product and/or surrounding equipment. Always keep clear of elevated loads.

Installation- Installation of all Delroyd Worm Gear products must be performed by suitably qualified personnel in accordance with this manual, local code, and any other supplemental information that may be provided by Delroyd Worm Gear for units with non-standard or special features.

Maintenance- Follow the instructions provided in this manual for recommendations on maintenance frequency and renewal parts. Prior to commencing maintenance on any Delroyd Worm Gear products or associated machinery, personnel must observe hazard warnings and ensure that all loads have been removed from the system and appropriate lockout / tag out procedures are being used. When replacing parts, use only authentic OEM parts supplied by Delroyd Worm Gear. Use of non-OEM parts can lead to improper fits and premature and/or catastrophic failure. In some cases, these failures can lead to injury or death.

Guards- All rotating components (shafts, couplings, fans, etc...) must be safeguarded via rigidly constructed guards that are firmly secured. Guards must be designed and constructed as such to ensure physical contact with rotating or moving parts or entanglement is not possible.

Lubrication- Skin contact with certain lubricants or preservatives maybe harmful; when handling lubricants or preservatives, follow the lubricant manufacturer's recommendations. External machined surfaces of Delroyd Worm Gear products may be protected with a rust inhibitor prior to leaving the manufacturing facility and will require removal at installation; always protect skin from coming in contact with rust inhibitor while removing. Contact Delroyd Worm Gear for more information regarding rust inhibitor. All Delroyd Worm Gear products are shipped without lubrication. Refer to this manual and/or contact Delroyd Worm Gear for lubrication recommendations. Failure to follow lubrication recommendations may result in damage to product and in extreme cases may result in injury to personnel.

Burn Hazard- Operating machinery generates heat and may have external surfaces, and contain lubricants that are hot enough to cause burns. Care must be taken to avoid contact with hot surfaces and lubricants. When possible, allow machinery to sufficiently cool prior to contact.

Fire/Explosion- Lubrication vapors and mist will occur within the gearbox and may seep through openings creating a flammable environment. Do not use open flames or other ignition sources in or near areas that may be subject to lubrication vapors or mists. Contact the lubricant manufacturer for information regarding flammability of the lubricant. When exposed to excessive heat, some materials used in the construction of Delroyd Worm Gear products (such as rubbers and plastics) may decompose and produce hazardous fumes. Care should be taken to avoid exposure to fumes and remains of overheated materials should be handled with the appropriate personal protective equipment. Regular cleaning is required to remove any dirt or dust deposits deeper than 5mm in order to facilitate proper cooling and avoid overheating and fire hazards.

Electric Hazard- Risk of electrical shock may cause serious or fatal injury. Connection of electric motor to the main supply should be made by qualified personnel. Refer to the motor manufacturer for detailed information regarding proper motor connection and care.

Operation- All Delroyd Worm Gear products are provided with a rating nameplate that details the operating conditions for which the product was designed. Operate the unit only at the ratings shown on the nameplate. Before exceeding any of these operational conditions, contact your Delroyd Worm Gear representative for factory approval. Overloading and/or over speeding may result in damage to the unit and may cause injury to personnel. Where gear units provide a backstop facility, ensure that back-up systems are provided if failure of the backstop device would endanger personnel or result in property damage.

Noise- Gearboxes and other associated machinery may produce noise levels that are damaging to the hearing with prolonged exposure. Personnel should wear ear protection when working in areas where these noise levels may exist.

Back-Driving- Never rely on a worm gear reducer's "self-locking" ability to hold a load. Under certain conditions, all worm gear reducers may back-drive. Proper holding devices must be used to restrain loads when appropriate. Failure to do so may result in damage to equipment, personal injury or death. Additionally, due to high ratios used in some worm gear reducers, back-driving may lead to extremely high speeds at the input shaft which can result in catastrophic failure, causing severe equipment damage, personal injury or death. Measures must be taken to ensure that units cannot be back driven at speeds higher than their nameplate rating. Refer to the "Start-Up & Operation" section for more information.

Note- The aforementioned information is based on the current state of knowledge and our best assessment of the potential hazards in the operation of the gear units. For additional information and clarification, please contact the factory.

Safety Warning Symbols-



Caution – Dangers exist that could result in injury, death or damage to machinery.



Danger (Touch Hazard) – Entanglement in rotating components could result in serious injury or death.



Electrical Hazard – Risk of electrical shock could result in serious injury or death.



Damaging Situation- Could result in damage to unit or associated equipment.

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Introduction:

The following instructions apply to all Delroyd Worm Gear reducers and motor/reducer packages. If a unit is furnished with special features, refer to the supplemental instructions shipped with the unit or contact your Delroyd Worm Gear sales representative. In some cases, special outline or assembly drawings may have been provided. In these cases, this manual is meant to be used in conjunction with the drawing(s) for that particular gearbox. Where a conflict exists between this manual and any supplied drawing(s) for a particular gearbox, the drawing(s) take precedence.

The information provided within this Installation, Operation, and Maintenance (IOM) manual must be made available, reviewed and understood by all effected parties to ensure proper installation, safe operation, and proper maintenance of the product.

To protect the warranty of your Delroyd Worm Gear product, installation and maintenance services must only be performed by trained personnel after reading and understanding all instructions that apply to the product (this IOM and supplemental literature provided by Delroyd Worm Gear). Particular attention must be paid to all nameplates and warning tags.



CAUTION: Operate this unit only at the ratings shown on the nameplate. Before exceeding any of these operational conditions, contact your Delroyd Worm Gear representative for factory approval.

The gear drive is designed according to the latest standards of the American Gear Manufacturers Association (AGMA), and was designed to meet the load conditions for the service ratings on the nameplate. Proper performance and service life of the unit depends on adherence to these operational ratings.

When communicating with your Delroyd Worm Gear sales representative, make reference to the nameplate information and any other information that may be useful in identifying the gear drive.

Warranty:



Warning: Service and repair under warranty must be performed only by a Delroyd Worm Gear authorized service shop; otherwise the warranty will become void.

Delroyd Worm Gear warrants that the product furnished will be free of defects in material and workmanship for a period not to exceed one year from installation or eighteen months from shipment to the purchaser, whichever is soonest. Upon prompt notification and written substantiation that the equipment has been stored, installed, operated and maintained in accordance with Delroyd Worm Gear recommendations and standard industry practices, Delroyd Worm Gear will correct the non-conformity by repair or replacement, at its option, F.O.B. factory.

The warranties set forth in this provision are exclusive and in lieu of all other warranties whether statutory, express or implied (including all warranties of merchantability and fitness for particular purpose and all warranties arising from course of dealing or usage of trade), except of title and against patent infringement. The remedies provided above shall constitute complete fulfillment of all the liabilities of Delroyd Worm Gear whether the claims of the purchaser are based in contract, in tort (including negligence), or otherwise with respect to, or arising out of, the product furnished hereunder.

The system of connected rotating parts—PRIME MOVER AND ACCESSORIES, GEAR UNIT, AND DRIVEN EQUIPMENT—must be compatible; free from critical speeds, torsional or other types of vibration, within the operating range, regardless of the source of such vibration, and/or its inducement. Delroyd Worm Gear's responsibility is limited to providing a gear unit within normal commercial levels of vibration generation. Delroyd Worm Gear is not responsible for the unsatisfactory operation or failure of the drive system, resulting from either the incompatibility of rotating components or the analysis required. The system responsibility remains with the purchaser, system builder or designer, unless Delroyd Worm Gear has agreed to perform such analysis, and the nature of such vibrations is fully defined.

Those units supplied with motor/gear couplings mounted must be final aligned by the installer. Delroyd Worm Gear verifies that the motor and gear can be aligned; however, Delroyd Worm Gear does not do final alignment, because of changes that occur during shipment handling as well as foundation variances.

The user is responsible for furnishing and installing any guards or other safety equipment needed to protect operating personnel, even though such safety equipment may not have been furnished by the seller with the equipment purchased.

Delroyd Worm Gear, its contractors and suppliers of any tier, shall not be liable in contract, in tort (including negligence), or otherwise for damage or loss of other property or equipment, loss of profits or revenue, loss of use of equipment or power system, cost of capital, cost of purchased or replacement power or temporary equipment (including additional expenses incurred in using existing facilities), claims of customers of the purchaser, or for any special, indirect, incidental, or consequential damages whatsoever.

The remedies of the purchaser set forth herein are exclusive and the liability of Delroyd Worm Gear with respect to any contract, or anything done in connection therewith, such as the performance or breach thereof, or from the manufacture, sale, delivery, resale, or use of any equipment covered by or furnished under the contract, whether in contract, in tort (including negligence) or otherwise, shall not exceed the price of the equipment or part on which such liability is claimed.

In no event shall Delroyd Worm Gear be responsible for providing working access to the defect, including the removal, disassembly, replacement or reinstallation of any equipment, materials or structure to the extent necessary to permit Delroyd Worm Gear to perform its warranty obligations, or transportation costs to and from Delroyd Worm Gear's factory or repair facility. The conditions of any tests shall be mutually agreed upon and Delroyd Worm Gear shall be notified of, and may be present at, all tests that may be made.

Receiving & Handling:



Warning: Immediately upon receipt examine the unit for damage. Notify the carrier and your Delroyd Worm Gear sales representative immediately if there is any evidence of shipping damage. Responsibility for reimbursement for losses or damages incurred during shipment remains solely with the transportation company.



CAUTION: When handling your Delroyd Worm Gear unit:

- o **Never use shaft extensions for pushing or pulling of the unit.**
- o **Never drag the gear unit. Machined mounting surfaces will be marred and overstressing of the housing may occur.**
- o **Motor lifting lugs or eyebolt holes may be used to lift units only when additional load supporting methods are used, such as slings on low speed shafts. Never attempt to lift the entire unit by using the motor lifting lugs.**
- o **When lifting, distribute the load evenly to keep the unit from tilting. Spreader bars may be required to avoid stress on any piping and accessories mounted on the unit.**
- o **Never use piping for lifting or climbing.**
- o **If the unit is to be stored, refer to the storage instructions in this manual.**

Operating instructions for accessories mounted on the gear unit assembly are normally attached to the unit. Save all hardware, accessories, wiring diagrams and instruction information included with the unit.

Weights

For standard catalog designs, refer to the product catalog for the approximate gearbox weight. For non-standard designs, refer to the gearbox's outline and/or assembly drawing(s), or contact your Delroyd Worm Gear sales representative for the approximate gearbox weight. Unless specifically stated, weights provided do not include the motor. Weights do not include lubrication.

Storage:

General

All internal and unpainted external surfaces of gear drives have been treated at the factory, prior to shipment, with a rust preventative. The protective life of this rust preventative will vary with temperature fluctuations, atmospheric moisture content, degree of exposure to the elements during storage, and degree of contact with other objects. Inspect all machined surfaces and spray or add rust inhibitor to exposed metal surfaces that may have had the protective coating removed in shipping and handling. To assure that the gear drive will operate satisfactorily at start-up, certain precautions must be taken by the customer upon receipt. The expected length of storage and the storage atmosphere dictate the maintenance schedule to be followed. Units must always be stored free of loads or weights on output and input shafts. These instructions apply to the reducer only. If a motor is included in our drive package, motor operating maintenance and storage instructions are included with drawing transmittals and are also attached to the unit. These instructions must be carefully read and followed.

Short Term Storage (Indoor)

If the gear drives are to be stored for a period of 30 days or less, the following should be observed: Store in a clean, dry location with factory packaging intact, and with as nearly a constant temperature as possible. Unit should be elevated in a manner that will prohibit water or other liquids to come in contact with the base of the unit. Avoid storing unit in areas that are subject to extremes in temperature, vibrations, and humidity. If the unit will be secured to its storage surface, via the unit's mounting holes, the storage surface must be level to prevent twisting of the housing and subsequent damage to the unit. To prevent oil from spilling over the drywell, where one exists, units should be stored in their operating position.

Long Term Storage (Indoor)

If units are to be stored for a period longer than 30 days, the following should be observed:

1. Store in a clean dry location with the unit elevated in a manner that will prohibit water or other liquids to come in contact with the base of the unit. Avoid areas that are subject to extremes in temperature, vibrations, and humidity. If the unit will be secured to its storage surface, via the unit's mounting holes, the storage surface must be level to prevent twisting of the housing and subsequent damage to the unit. To prevent oil from spilling over the drywell, where one exists, units should be stored in their operating position.
2. Remove breather(s) and replace with pipe plug(s).
3. A vapor-phase rust inhibitor such as Daubert Chemical, Nox-Rust Motorstor VCI-10, or equal, may be added to the recommended oil type in the amount of 2% of the total sump capacity (**Do Not Overfill**). Heat mixture to 110-120°F and immediately close openings to maintain vapors in the housing. "E", "HE", and "DE" style reducers may be completely filled with oil. For all other style reducers fill the unit to the recommended oil level (**Do Not Overfill**).
4. Rotate the high speed shaft slowly by hand long enough so that the low speed shaft makes at least one revolution at least once every four weeks.
5. Inspect the unit periodically and spray or add rust inhibitor suitable for anticipated storage conditions, as required.
6. Upon startup, the unit may run without changing this oil mixture, provided foaming does not occur. If unit has been filled completely with oil, drain oil to proper oil level and replenish grease at all fittings. If foaming occurs, drain oil, flush unit and refill to proper oil level with recommended oil type.

Outdoor Storage

Note: OUTDOOR STORAGE IS NOT RECOMMENDED. When storage in a warehouse or enclosed building is not possible, the following should be observed:

1. Bring unit to an area in which the ambient temperature is greater than 50°F and allow to stand for a minimum of 24 hours.
2. Remove breather(s) and replace with pipe plug(s). Seal the unit completely by sealing all air vents with pressure sensitive tape. Pack grease around the shafts near the contact seals and tape.
3. A vapor-phase rust inhibitor such as Daubert Chemical, Nox-Rust Motorstor VCI-10, or equal, may be added to the recommended oil type in the amount of 2% of the total sump capacity (Do Not Overfill). Heat mixture to 110-120°F and immediately close openings to maintain vapors in the housing. "E", "HE", and "DE" style reducers may be completely filled with oil. For all other style reducers fill the unit to the recommended oil level (Do Not Overfill).
4. Seal the unit in a moisture proof container with an adequate supply of desiccant inside to avoid moisture build-up. Unit must be elevated in a manner that will prohibit water or other liquids to come in contact with the base of the unit. If the unit will be secured to its storage surface, via the unit's mounting holes, the surface must be level to prevent twisting of the housing and subsequent damage to the unit. To prevent oil from spilling over the drywell, where one exists, units should be stored in their operating position.
5. The high speed shaft should be rotated slowly by hand long enough so that the low speed shaft makes at least one revolution at least once every four weeks.

6. Repeat operations 1 thru 4 every six months. For units that have not been completely filled, the oil/vapor-phase rust inhibitor mixture may be drained and reused. For units that have been completely filled ("E", "HE", and "DE" style reducers), it will not be necessary to drain and refill as long as units have remained completely filled.
7. Do not store the unit in direct sunlight.

Installation:

The continuous efficient operation of a gear unit depends chiefly on four factors:

1. Proper type of foundation and correct mounting.
2. Correct alignment with the driven equipment.
3. Correct lubrication.
4. Full consideration of both preventative and operating maintenance.



CAUTION: Operate the gear unit only within the ratings shown on the nameplate. Review the application to confirm the unit will not be operated in conditions exceeding the nameplate rating.



DANGER: Selection and installation of guards, warning signs, or any provisions required to meet national and local safety codes are the responsibility of the user. Ensure all guarding, safety devices, and warning signs are in place prior to starting equipment. Failure to do this may result in serious injury or death.



CAUTION: All warning labels and instructions for installing and operating electrical equipment must be carefully read and followed. All electrical connections must be installed only by qualified personnel in strict accordance with the National Electric Code and local requirements. Compliance with all codes, laws and safety ordinances is the sole responsibility of the user.

Environmental Considerations

Units should not be installed in locations of unusually high or low temperatures. Adequate air flow is required for proper heat dissipation from the unit. Ambient temperatures must not exceed 100°F, unless supplemental means of cooling are supplied. Environmental conditions, including exposure to direct sunlight, high humidity, dust or chemicals suspended in the air are worthy of special consideration. Gear drives exposed to these and other adverse conditions should be referred to Delroyd Worm Gear for special evaluation and recommendation.

Foundation

A foundation or mounting, which provides rigidity and prevents weaving or flexing with resultant misalignment of the shafts, is essential to the successful operation of a gear unit. A concrete foundation should be used whenever possible and should be carefully prepared to conform with data regarding bolt spacing and physical measurements contained in the Dimension Leaflet supplied prior to delivery of the equipment.

Grout steel mounting pads into the concrete base or foundation; mount the unit on these steel pads. Do not grout the unit directly into the concrete base or foundation. When the unit will be installed on structural foundation pads a supporting base plate of steel should be provided to obtain proper rigidity. These plates or pads should be of a thickness equal to or greater than the diameter of the hold down bolts.

Foundation Bolt Torque Recommendations

Gear units must be securely bolted to their foundations with the specified bolt size. Bolts are to be SAE Grade 5 or equivalent fasteners. Do not lubricate fasteners, as this will promote loosening during operation. Tighten bolts per the torques listed below.

Torque (Ft. Lbs.)			Torque (Ft. Lbs.)		
Bolt Size (UNC)	Metal To Metal	Metal To Concrete	Bolt Size (UNC)	Metal To Metal	Metal To Concrete
1/4	8	6	1-1/4	1,050	834
5/16	16	12	1-3/8	1,375	1,084
3/8	28	22	1-1/2	1,842	1,458
1/2	69	54	1-3/4	1,975	1,558
5/8	137	108	2	3,083	2,147
3/4	245	191	2-1/4	4,333	3,417
7/8	380	313	2-1/2	6,000	4,667
1	567	467	2-3/4	8,167	6,417
1-1/8	742	584	3	10,417	8,250

Bedplates

Bedplates are provided as common mounting surfaces that support several components when mounted on a proper foundation. Bedplates are also designed to facilitate alignment of those components. Because of the disparity of component sizes, bedplates are not designed to be self-supporting structures under all conditions. **They are not designed to provide a platform for lifting and transporting with all of the components mounted**, unless the assemblies are properly supported and balanced with appropriate material handling fixtures. There will be occasions when it will be necessary to remove some of the components for transport, and subsequently, reassemble the drive train in its final location. Delroyd Worm Gear supplies the components on the bedplate assemblies rough aligned. However, due to possible shifting in transit or handling and the possible variances in foundation surfaces, **final alignment and foundation bolt tightening is the responsibility of the installer**. To align a bedplate supplied unit, the output shaft of the reducer should be aligned with the driven shaft by moving and shimming the bedplate assembly. **This should not be accomplished by moving the reducer on the bedplate**. Insure that all bedplate mounting points are properly shimmed for proper support to provide a solid level surface. Failure to do so may create a twist in the bedplate and could make final alignment of the drive components difficult. After aligning the reducer output shaft and shimming between the bedplate and the foundation, the mounting bolts or lugs should be tightened and the bedplate firmly locked and grouted in place. **Final alignment of the other bedplated components must now be completed.**

Alignment

Gear units are designed with a tolerance of $\pm 1/32$ in. between the mount surface and the intersecting shaft center, therefore, shimming may be required. Flat shims of various thicknesses, slotted to slide around the foundation bolts, should be used. All feet must be solidly supported before the mounting bolts are tightened. After alignment has been secured through shimming, the equipment should be bolted down and alignment rechecked. Heat up couplings, sprockets or pinions and shrink them onto shaft extensions when required, avoiding contact with the shaft seal. Do not heat parts above manufacturers recommended limits, or 300°F, whichever is lower.



Caution: To avoid severe damage to bearing and gears, couplings must never be hammered on to shaft extensions.

When the prime-mover is connected to the gear unit or the gear unit is connected to the driven equipment by means of a coupling, correct alignment cannot be overemphasized. This becomes of greater importance as speeds are increased or the drive is subjected to variations in load conditions. Misalignment, either parallel or angular, is one of the most frequent causes of bearing or shaft failures, noisy operation, or excessive operating temperatures due to the extra load imposed. A straight edge laid across the coupling member at the machined diameter, provided for alignment purposes, shows correct parallel alignment when the straight edge rests on both coupling members for their full length. Check this at four positions-90 degrees apart. The use of feeler gauges between coupling member faces is a common method of checking for correct angular alignment. Check at four positions-90 degrees apart. A more accurate alignment check is obtained by the use of dial indicators. This is done by clamping the indicator on one coupling member with the indicator stem resting on the other coupling member, then rotating the member holding the clamped indicator. To minimize overhung loads, pulleys and sprockets should be mounted as close to the gear case as possible. Tighten hardware for pulleys and sprockets in accordance with the manufacturer's recommendations.



Warning: Do not over tighten belts or chains; reducer bearing life may be significantly reduced if belts and chains are too tight.
Install pulleys and sprockets on driver/driven equipment so that they run true. Guards should be mounted over couplings, pulleys, and sprockets after final alignment is completed.

Start-Up & Operation:

Pre-start For Units in Storage

1. Replace breather if removed during storage period.
2. Remove all tape applied in storage preparation.
3. Drain all oils applied during storage and charge with appropriate oil as outlined in the lubrication section of this manual.
Flushing of the unit is recommended prior to charging the unit with new oil. Replenish grease at all grease fittings as needed.
4. Thoroughly inspect unit and all accessories for damage.
5. Follow additional start-up steps as outlined below.



WARNING: Delroyd Worm Gear units are shipped without oil. Prior to start-up, the unit must be filled with the proper amount of oil, selected in accordance with the operating conditions.



DANGER: Ensure all guarding, safety devices, and warning signs are in place prior to starting equipment. Failure to do this may result in serious injury or death.



CAUTION: All warning labels and instructions for installing and operating electrical equipment must be carefully read and followed. All electrical connections must be installed only by qualified personnel in strict accordance with the National Electric Code and local requirements. Compliance with all codes, laws and safety ordinances is the sole responsibility of the user.

Additional Start-Up

1. Add the correct amount of oil to the gear unit.
2. For units with additional piping systems (auxiliary cooling and/or forced lubrication systems), momentarily operate the unloaded unit until all lines have been charged with oil. Stop the unit and recheck the oil level and add oil as required. Repeat until required static oil level has been achieved.
3. Confirm proper backstop rotation via hand rotating uncoupled motor (for motor installed backstops) or hand rotating uncoupled unit input shaft (for unit installed backstops).
4. Turn the shafts by hand to confirm there are no obstructions to rotation.
5. Confirm all electrical connections have been properly made and are in accordance with the equipment manufacturers' recommendations and are in strict compliance with the National Electric Code and local requirements. Confirm all accessories have been properly mounted.
6. Check all external mounting bolts, screws, etc. to make sure they have not loosened in transit or handling.
7. Check that all couplings, sprockets, pulleys, etc. are properly aligned, lubricated, mounted and keyed on shaft extensions.
8. Confirm all pipe plugs are securely tightened.
9. For units equipped with oil heaters, turn the heater on and allow the oil temperature to rise at least to 40°F before start-up.
10. Momentarily operate the motor to check for proper shaft rotation; reverse leads if necessary. Reconnect coupling.
11. Start unit under as light a load as possible. If rotation of the unit is limited to one direction only, a tag on the housing should be provided to inform effected persons of the proper direction of rotation.
12. The machinery should be checked frequently for unusual sounds, oil leaks, excessive vibration and excessive heat. If an operating problem develops, shut down immediately and correct the problem before restarting.

Operation

Although the unit has been tested under no load at the factory, it takes additional hours of running to run-in the gear. During the run-in period of the gear, oil temperatures will stabilize at a higher level, efficiency will be lower, and gear noise will be greater. If necessary, full load can be applied immediately, but it is better for the ultimate life of the gear to operate the unit initially at one half load for 20-30 hours and three quarters load for 20-30 hours, whenever possible. Successful operation of worm gearing depends on the ability of the bronze gear to conform to the hardened steel worm. Some initial wear and/or pitting is therefore necessary on the gear tooth to allow the contact to spread across the face of the gear. Once through the run in period the oil temperature rise, noise level, wear and pitting will stabilize and your Delroyd Reducer will be operating at peak efficiency. However, during the first few minutes of cold operation, the reducer's efficiency will be low due to churning of heavy cold oil; the efficiency will improve as the oil warms.

The oil temperature in the gear box, when operated continuously, should stabilize at a maximum of 100°F (not to exceed 200°F) above the surrounding air temperature when transmitting catalog thermal rating. To protect your Delroyd Worm Gear reducer from operating at excessive temperatures (above 200°F) it is important during operation to:

1. Keep surrounding air temperature as low as possible.
2. Shield reducer from external sources of heat such as furnaces or other machinery.
3. Prevent direct exposure to sunlight unless unit is painted with reflective paints.
4. Allow movement of artificial or natural air drafts.
5. Keep fan operating and fan inlet unobstructed.
6. Keep outside surfaces of gear box housing free of dust and dirt if possible.



Caution: Operating machinery generates heat and may have external surfaces, and contain lubricants that are hot enough to cause burns. Care must be taken to avoid contact with hot surfaces and lubricants. When possible, allow machinery to sufficiently cool prior to contact.

Direction of Rotation

Most Delroyd Worm Gear units are designed for operation in both directions of rotation; however, your unit may be assembled for optimum performance for one direction of rotation only. If the operating conditions specified to Delroyd Worm Gear were for a specific direction of rotation, then the contact pattern of the worm and gear, and/or assembly of clutch/brake where one may exist, may have been adjusted for that direction of rotation. If the unit will be operated opposite of the direction of rotation as specified at the time of order, then it may be necessary to adjust the worm and gear contact and/or adjust clutch/brake assembly; please refer to the Worm & Gear Contact section of this manual for adjustments of the contact and contact the factory for assistance with brake assembly.

Back-Driving

Most Delroyd units are designed to operate with the worm driving the gear. There are some applications where the gear drives the worm for all or part of the duty cycle. This type of operation is called back-driving. Back-driving can occur not only when the unit is functioning as a speed increaser, but also as a speed reducer. For example, a gear that is driving heavy components is stopped by switching off the motor, which drives the worm. During the stop, the inertia of the heavy components, driven by the gear, may continue to rotate causing the gear to back-drive the worm. If the back-driving efficiency of the worm and gear is too low, the gear teeth may be subjected to excessive loading resulting in damage to the gear set and/or other components in the unit. In many cases, the stopping load is increased substantially by use of a motor brake. Where back-driving exists, efficient back-driving ratios (typically 15:1 or less) should be used and/or the inertia of the rotating components driven by the gear, reduced. Brake

torque should also be limited to 50%-75% of full load motor torque depending on the worm and gear ratio. Low back-driving efficiencies should not be depended upon to supply sufficient braking action to stop a machine; a properly sized brake should be used. **Even when stopped, there can be no assurance that any reducer will be self-locking under all conditions of load and vibration, therefore a brake or other locking mechanisms must be used to keep the system locked.**


Maintenance:

 **WARNING: Prior to commencing maintenance on any Delroyd Worm Gear products or associated machinery, personnel must observe hazard warnings and ensure that all loads have been removed from the system and appropriate lockout / tagout procedures are being used. Never rely on Delroyd Worm Gear reducers to be "Self-Locking or Irreversible" to protect personnel and/or property from potential energy found in loaded systems.**

Lubrication

 **Warning: Gear units are shipped from the factory without oil. Fill unit to the proper level before operating. Failure to do so will result in damage to the unit.**

 **Caution: Do not use oils containing sulfur as an EP additive due to sulfur's ability to chemically attack bronze, \ promoting premature gear failure.**

 **Caution: The use of an inappropriate lubricant may cause leaks and/or damage to internal components and may void your warranty.**

Maximum performance and long life of the gear unit are dependent upon the use of the proper lubricant, maintaining the correct oil level, and performing regular oil changes. Included in this manual are lists of recommended brands of mineral based and synthetic based lubricants, which have been approved for use in Delroyd Worm Gear reducers. Delroyd Worm Gear should be consulted prior to using any lubricant that is not listed in this manual. We will be happy to review any requested alternate lubricants and provide our recommendations. Suppliers of industrial lubricants, not service stations, should be contacted to supply suitable lubricants to meet the proper AGMA specifications. Units should be filled to the oil level as shown on the outline drawing or as indicated on the unit with the AGMA lubricant listed below.

Ambient Temperature: The ambient temperature range that the reducer is expected to operate in must be considered when selecting the proper lubricant. If ambient temperatures are expected to be between 30°F and 100°F, then either a mineral or synthetic oil may be used. If ambient temperatures are expected to be lower than 30°F or higher than 100°F, then a synthetic oil must be used. Oils that are too thick can lead to channeling allowing mating components to contact without lubrication. Oils that are too thin will not provide an adequate film thickness for proper lubrication. Both of these scenarios can cause damage to the gears or bearings.

NOTE: Regardless of the condition of the oil, it may be necessary to change oil type due to ambient temperature changes.

Mineral vs. Synthetic: Lab tests have shown that using a synthetic based lubricant can lower operating temperatures and increase the efficiency and life of worm gear speed reducers. In addition, synthetic lubricants have a wider range of acceptable operating temperatures, and in some cases last longer than mineral based lubricants. The trade-off is synthetic lubricants are more expensive and selection is limited compared to mineral based lubricants. When choosing to use a synthetic lubricant, use only PAO (PolyAlphaOlefin) based synthetic oil in standard Delroyd Worm Gear products. Do not use PAG based synthetics (PolyAlkylene Glycol). PAG type synthetic oils will degrade some seals and will dissolve certain types of paint. If use of a PAG type oil is desired, please contact the factory.

Lubricants Not Recommended: Ordinary motor oils, automotive rear-end oils, or greases of any kind should not be used in place of Delroyd Worm Gear recommended industrial oils. Caution should be exercised when selecting a lubricant to be used in your Delroyd Worm Gear reducer. There are many lubricants available, some of which claim to be safe for use with the bronze gearing utilized in your Delroyd Worm Gear reducer. However, some manufactures use sulfur as an EP (Extreme Pressure) additive, which will chemically attack the bronze gear. EP lubricants are not recommended for use in Delroyd Worm Gear reducers.

Selection

Lubricants must be compatible with the type of paint and seal materials used in the construction of the unit. They must be non-corrosive to gears and bearings, neutral in reaction, free from grit or abrasives, and have good antifoaming and oxidation resisting properties. Refer to AGMA 9005 for more detailed information on lubricant property requirements. For applications where loads, speeds, or temperatures are abnormal, Delroyd Worm Gear should be contacted for specific recommendations.

Shown below are several tables to help you select the appropriate oil for your conditions. Table 1 will help you select the appropriate viscosity grade and decide whether to use a mineral or synthetic lubricant. Contact the factory if you have conditions that fall outside the ranges shown. Tables 2 and 3 will help you locate an appropriate product to meet these needs.

Table 1: Lubrication Type Selection

Ambient Temperature Range	ISO Viscosity Grade			Recommended Lubricant Type
	Units Size 60 and Smaller	Units Size 70 and Larger		
	All Speeds	Worm Speeds Up To 400 RPM	Worm Speeds Above 400 RPM	
-30° to 30°F	ISO VG 100 (AGMA 3S)			PAO Based Synthetic Oil
-20° to 40°F	ISO VG 150 (AGMA 4S)			
-10° to 50°F	ISO VG 220 (AGMA 5S)			
10° to 125°F	ISO VG 460 (AGMA 7S)			
30° to 70°F	ISO VG 460 (AGMA 7C)	ISO VG 460 (AGMA 7C)	ISO VG 460 (AGMA 7C)	Mineral Based Compounded Steam Cylinder Oil
50° to 100°F		ISO VG 680 (AGMA 8C)		

Table 2: Delroyd Approved* Mineral Based Compounded Steam Cylinder Oils

Manufacturer	ISO VG 460 (AGMA 7C)	ISO VG 680 (AGMA 8C)
Ashland Oil Inc.	Light Cylinder	No Product
British Petroleum	ENERGOL DCC 460	ENERGOL DCC 680
Chevron Oil Co.	Chevron Cyl. Oil W ISO 460	Chevron Cyl. Oil W ISO 680
Citgo Petroleum Corp.	CITGO Cyl. Oil 400-5	CITGO Cyl. Oil 680-7
Continental Oil Co.	INCA Oil 460	INCA Oil 680
Mobil / Exxon Company, U.S.A.	Cylesstic TK 460	Cylesstic TK 680
Imperial Oil Ltd. (Canada)	Cyclesso TK 460	Cyclesso TK 680
Mobil Oil Corp.	600W Super Cylinder Oil	600W Extra Hecla Super Cyl. Oil
Phillips Petroleum Co.	Hector 460S	Hector 630S
Shell Oil Company	Valvata Oil J 460	Valvata Oil J 680

*Use only Delroyd approved lubricants. Contact the factory prior to using any lubricant not appearing above.

Table 3: Delroyd Approved* Synthetic PAO Based Oils

Manufacturer	Product Series
Mobil Oil Corp.	SHC 600 Series

*Use only Delroyd approved lubricants. Contact the factory prior to using any lubricant not appearing above.

Oil Sump Temperature

Gear drives operating in the ambient temperature range described in table 1 generally produce oil sump temperatures of not more than 100°F over ambient. This sump temperature is considered a maximum, as degradation of the lubricant increases rapidly at temperatures above 200°F. These lubrication recommendations exclude applications such as those gear drives installed in the food and drug industry where a possibility exists for incidental contact between the lubricant and the product being processed.

Oil Changes

Proper lubrication is crucial to obtaining the highest possible performance, utmost efficiency and maximum life of your speed reducer. **All units are shipped from the factory without oil.** Due to the nature of worm gear sliding and rolling action, the lubricants listed in this manual must be used. Units should be filled to the oil level as shown on the outline drawing or as indicated on the unit with the AGMA lubricant listed in this manual.

Frequency of Oil Changes

The frequency of oil changes depends on type of service and type of environment the unit is exposed to. After the initial 50-100 hours of operation, an oil change should be performed to remove any bronze particles that have accumulated in the case as a result of gear break-in. After the initial break-in period, the oil should be changed every 3-6 months depending on type of service. The unit should be thoroughly flushed with a flushing oil that is compatible with the service oil. If the unit will be used in severe conditions (rapid or frequent temperature changes, extreme temperatures, dusty, moisture rich, corrosive environment, high loads, or frequent overloads), it may be necessary to perform oil changes more frequently than 3 months to prevent excessive oil contamination.

Many oil suppliers offer periodic oil testing to monitor and determine the health of the oil. This service can provide an excellent means of predictive maintenance by monitoring the level of bronze, iron, dirt, water and other contaminant content suspended within the oil. The level of particle content that is permissible differs from gearbox to gearbox and from application to application. Typically, it is recommended that a trending procedure be performed to determine the gearbox's steady state level of bronze and/or iron content. When this steady state level has been determined, an excessive particle content test result may indicate the unit is in need of maintenance. In some cases, the oil change intervals may be extended based on favorable results of an oil analysis.

Cleaning and Flushing



CAUTION: Operating machinery generates heat and may have external surfaces, and contain lubricants that are hot enough to cause burns. Care must be taken to avoid contact with hot surfaces and lubricants.

Due to internal housing geometry, most reducers have multiple drain points. Refer to the reducer's general assembly, outline drawing, or contact the factory for assistance with identifying all drain locations. Be sure to drain oil from all drain points. Ideally, the lubricant should be drained while the gear drive is at operating temperature. After draining, the gear drive should be thoroughly flushed with flushing oil that is compatible with the service lubricant. Contact your lubricant supplier for flushing oil recommendation. Completely remove used lubricant and flushing oil from the system to avoid contaminating the new oil. Solvents should only be used if the gear drive contains deposits of oxidized or contaminated lubricant that could not be removed with the flushing oil.



CAUTION: Never attempt to add or replace oil while the unit is running.



WARNING: Do not overfill beyond the indicated oil level; excess lubrication may result in overheating, leaks, and subsequent damage to unit.



WARNING: Do not use lubricants of the EP type or those containing slippery additive such as Molybdenum disulphide and graphite in a backstop.

Cold Temperature Conditions

Lubrication, either by splash or pump, must be given special attention if the gear drive is to be started or operated at temperatures below which the oil can be effectively splashed or pumped. Preheating the oil may be necessary under these low ambient temperature conditions. Delroyd Worm Gear should be informed when gear drives are to operate outside the individual temperature ranges listed in this manual. Gear drives operating in cold areas must be provided with oil that circulates freely and does not cause high starting torques. An acceptable low temperature gear oil, in addition to meeting AGMA specifications, must have a pour point at least 5°C (10°F) below the minimum expected ambient temperature, with a viscosity low enough to permit the oil to flow freely at the start up temperature, but high enough to carry the load at the operating temperature. When the lubricant selected does not provide proper lubrication for the expected ambient temperature range, the gear drive should be equipped with a sump heater to bring the oil up to a temperature at which it will circulate freely for starting. The heater watt-density should be selected to avoid excessive localized heating which could result in rapid degradation of the lubricant.

Abnormal Operating Conditions

Ambient temperature fluctuations may result in condensation build-up in the unit. Dust, dirt, chemical particles, or chemical fumes may also react with the lubricant resulting in the formation of sludge. Sustained sump temperatures in excess of 200°F may result in accelerated degradation of the lubricant and excessive component wear. When operating under these conditions the lubricant should be analyzed more frequently and changed when required.

Filling

Units should be installed prior to filling with oil. Lifting a unit that is filled with oil will not only add extra weight to the unit, but also will permit oil to flood drywells, where they exist, and migrate into grease packed areas creating leaks. When filling your Delroyd Worm Gear unit, never allow the oil to exceed the prescribed oil level, as this may permit oil to flood drywells, where they exist, and to migrate into grease packed areas creating leaks. When multiple filling ports have been provided, to facilitate the filling of multiple reduction units, they should be used.

Oil Capacities

Listed below are approximate oil capacity values in U.S. gallons for standard units that do not incorporate auxiliary cooling and/or forced lubrication systems. This information is provided for assisting with estimating approximate oil volume requirements; always fill units to the prescribed oil level as outlined in the Lubrication section of this manual.

Single Worm Reduction Approximate Oil Capacities

Type SM, SMB, SMF Units	Oil Capacity (Gallons)		
	Bottom Drive	Top Drive	Vertical
20	-	-	-
25	-	-	-
30	0.25	0.36	0.3
35	0.33	0.62	0.53
40	0.55	0.83	0.82
50	0.87	1.5	1.4
60	1.3	2.3	2.3
70	1.5	3.7	2.6
80	2	4.7	3.2
90	3.2	7	5
100	3.5	10	6.9
120	5.5	14	12
140	11.7	23	19
170	17.9	35.5	32
200	26.1	55	37

Type E or V Units	Oil Capacity (Gallons)		
	Bottom Drive	Top Drive	Vertical
20	0.15	0.29	0.34
25	0.16	0.3	0.44
30	0.29	0.47	0.88
35	0.38	0.57	1.5
40	0.56	1.1	2
50	0.57	0.88	1.4
60	0.69	1.4	2.3
70	0.75	1.9	2.6
80	1.3	2.3	3.2
90	1.8	3	5
100	2.5	3.9	6.9
120	3.2	5.5	12
140	5	6.5	19
170	-	-	32
200	-	-	37

Double Worm Reduction Approximate Oil Capacities

Type DSM, DSMB, DSMF Units	Oil Capacity (Gallons)	
	Bottom Drive	Vertical
35	0.45	0.65
40	0.67	0.94
50	1	1.6
60	1.7	2.7
70	2	3.1
80	2.6	3.8
90	4.3	6.1
100	4.6	7.9
120	7.3	13.8
140	13.5	20.8
170	22.3	36.4
200	32.6	43.5

Type DE or DV Units	Oil Capacity (Gallons)	
	Bottom Drive	Vertical
35	0.5	1.6
40	0.68	2.1
50	0.76	1.6
60	1.1	2.7
70	1.3	3.1
80	1.9	3.8
90	2.9	6.1
100	3.6	7.9
120	5	13.8
140	6.8	20.8
170	-	36.4
200	-	43.5

Helical / Worm Reduction Approximate Oil Capacities

Type HSM, HSMB, HSMF Units	Oil Capacity (Gallons)	
	Bottom Drive	Vertical
35	0.44	0.64
40	0.73	1
50	1.1	1.6
60	1.6	2.6
70	1.9	3
80	2.7	3.9
90	4.1	5.9
100	4.8	8.2
120	7.6	14.1
140	13.8	21.1
170	25.4	39.5
200	33.6	44.5

Type HE or HV Units	Oil Capacity (Gallons)	
	Bottom Drive	Vertical
35	0.49	1.6
40	0.74	2.2
50	0.8	1.6
60	1	2.6
70	1.2	3
80	2	3.9
90	2.7	5.9
100	3.8	8.2
120	5.3	14.1
140	7.1	21.1
170	-	39.5
200	-	44.5

Grease Lubrication of Seals and Bearings

Depending on the design and assembly figure, your Delroyd Worm Gear reducer may contain bearings and/or seals that require grease to ensure proper function. To identify which components require grease, refer to the unit outline or contact the factory. Components requiring grease will be equipped with a grease fitting. For bearings and seals that require grease, these components are packed with a NLGI (National Lubricating Grease Institute) approved grade 2 grease prior to leaving the manufacturing facility. Delroyd Worm Gear recommends replenishing greased components with Mobilgrease XHP222 or equivalent; this grease is a mineral based lubricant with a lithium based thickener. Unless all factory grease is removed from the unit, grease compatible to the factory-supplied grease must be used for maintaining grease levels. It is imperative that proper grease selection and maintenance practices be followed to obtain maximum bearing and/or seal life of your Delroyd Worm Gear Reducer. Delroyd recommends using only NLGI approved greases suitable for intended unit operating conditions.

Frequency



Caution: To prevent over grease and possible damage to seals, always use a hand operated grease gun; never use a pneumatic grease gun.

For units operating under normal operating conditions, grease should be added to each fitting until grease begins to spill from the grease relief fitting every three to six months. In some cases, relief fittings may become clogged over time. If grease does not purge from the relief fitting after a reasonable amount has been added, remove the relief fitting and reapply grease until grease purges from the relief fitting hole. Re-install the relief fitting after grease has been replenished. For units operating in severe operating conditions (rapid or frequent temperature changes, extreme temperatures, dusty, moisture rich, or corrosive environment), it may be necessary to replenish grease more frequently than every 3 months.

Oil Seals

Lip type oil seals are used on both high speed and low speed shafts of your Delroyd Worm Gear reducer. Standard design high speed shaft seals are constructed of Viton and standard design low speed shaft seals are constructed of Nitrile. When selecting the proper type of lubricant for your Delroyd Worm Gear reducer, attention should be paid to the compatibility of the lubricant with the construction materials of the seals. All lubricants provided in the above tables are compatible with both Viton and Nitrile materials. Use only Delroyd approved lubricants. Contact the factory prior to using any lubricant not appearing in the above tables. Oil seals should not be exposed to extreme temperatures. Nitrile seals should not be exposed to temperatures lower than -40°F or higher than 250°F. Viton seals should not be exposed to temperatures lower than -40°F or higher than 400°F. If your application requires seal exposure temperatures outside of these ranges, please contact your Delroyd Worm Gear sales representative for assistance.

Worm & Gear Contact

General

Proper contact between the worm and gear is critical to the life and performance of your Delroyd Worm Gear reducer and was established at the factory prior to shipment. When assembling a reducer that has been taken apart, the initial no load contact should be checked after the worm and gear have been installed into the housing and proper axial end play has been achieved. To check the initial no load contact, apply a coating of Prussian Blue to the worm threads and turn the unloaded worm shaft by hand and observe the contact pattern produced by the worm on the gear teeth. To shift the contact pattern on the gear tooth on gears that are straddled between bearings, interchange gear shaft bearing retainer shims from one end to the other, moving the gear to the right or left of the worm, as required; shims should not be added or deleted after axial end play has been established. To shift the contact pattern on the gear tooth on gears that are not straddled between bearings (cantilevered), add or delete shims between the gear hub and the gear hub locating shoulder on the shaft.

The initial no-load contact pattern should be less than the full face width of the gear tooth and less than the whole depth of the gear tooth. The contact pattern outlined in this manual will provide compensation for tooth deflections, small errors in axial position of the gear, and mounting variations to ensure a lubricant entry region will exist during full load operation. The contact pattern should be checked in minimum of three (3) equally spaced locations on the gear. The minimum span of gear teeth the contact check should be validated on should be equal to the number of the mating worm starts or three (3), whichever is greater. During full load operation, the worm and the gear tooth will deflect resulting in a fuller face contact pattern. Even under full load conditions, the resulting contact pattern should never consume the entire gear tooth flank. If the resulting full-load contact does consume the entire gear tooth face width, sufficient lubrication will not be possible.

For non back-driving applications, the initial no-load contact pattern should be concentrated on the “Leaving Side” of the gear. Figure 1 provides illustration of proper initial no load contact for right handed non back-driving worm and gear sets for both rotations. Figure 2 provides illustration of proper initial no load contact for left handed non back-driving worm and gear sets for both rotations. For back-driving applications, the initial no-load contact pattern should be “Central” on the gear. Central contact is also recommended when the loaded flank does not change with changes in direction of rotation (for example, cranes, elevators or other lifting applications). Figure 3 provides illustration of proper initial no load central contact.



Figure 1: RH Gear

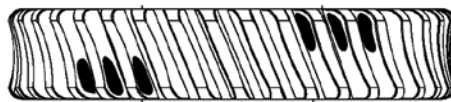


Figure 2: LH Gear



Figure 3: Central Contact for Back Driving Applications

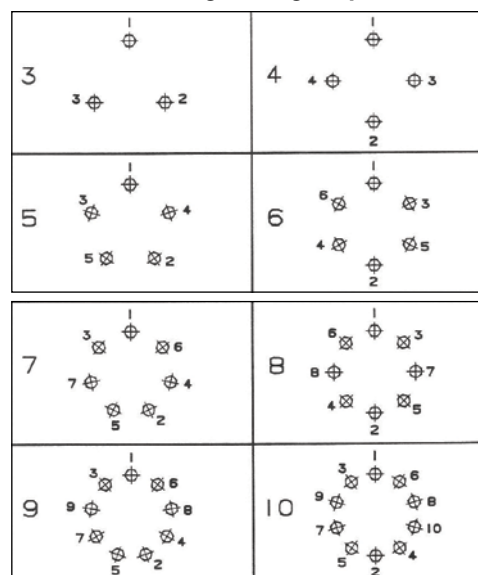
Fasteners

The following fastener torque values and fastener tightening sequences are to be used for end covers, seal retainers, shaft guards, inspection covers, and housing split line bolts, unless otherwise specified on the drawing or assembly instructions. Torque values for lubricated fasteners are to be used when fasteners are coated with thread locking compounds.

Fastener Torque Values

Diameter	Dry Fastener (foot-lbs)		Lubricated Fastener (foot-lbs)	
	Min.	Max.	Min.	Max.
UNC				
1/4	7	8	4	5
5/16	14	17	8	10
3/8	25	31	15	19
7/16	40	49	24	30
1/2	60	75	36	45
9/16	87	109	52	65
5/8	120	150	72	90
3/4	213	266	128	160
7/8	344	430	206	258
1	515	644	309	386
1-1/8	635	794	381	476
1-1/4	896	1,120	538	672
1-3/8	1,175	1,469	705	881
1-1/2	1,560	1,949	936	1,170
1-3/4	1,829	2,286	1,097	1,372
2	2,750	3,438	1,650	2,063
2-1/4	4,022	5,027	2,413	3,016
2-1/2	5,500	6,875	3,300	4,125
2-3/4	7,457	9,321	4,474	5,592

Fastener Tightening Sequence



Trouble Shooting:



WARNING: Prior to commencing maintenance on any Delroyd Worm Gear products or associated machinery, personnel must observe hazard warnings and ensure that all loads have been removed from the system and appropriate lockout / tagout procedures are being used. Never rely on Delroyd Worm Gear reducers to be "Self Locking or Irreversible" to protect personnel and/or property from potential energy found in loaded systems.

Operating Temperature

Delroyd Worm Gear drives are designed for a 100°F rise in temperature over the ambient temperature, but not to exceed 200°F. If the unit is operated in the sun and/or at high ambient temperatures, auxiliary cooling may be required. In these instances, please contact your Delroyd Worm Gear sales representative for assistance.

Noise

By nature, all gear units produce some type of noise during operation. Normal gear noises that are generally observed are either a low pitch rumble or a high whine from the high speed helical mesh. Learn to distinguish between normal gear noise and symptomatic gear noise which could be an indication of a larger problem. Remember, sound is often amplified by the type of mounting or can be induced by coupled equipment. A new gear unit may be initially noisy and then quiet down after a reasonable period of service; normal wear has taken place and teeth have established a well defined run-in-pattern. As part of a good preventative maintenance program, always record changes in noise levels and operating temperatures.

Problem	Potential Causes
Excessive operating temperature	1, 2, 3, 4, 5, 6, 7, 9, 12, 18, 21, 22, 23
Oil leakage	1, 2, 3, 4, 5, 7, 9, 12, 13, 18, 19, 20, 22, 23
Gear wear	1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 22, 23
Bearing failure	1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20
Shaft failure	1, 6, 7, 8, 9, 10, 11, 12, 15, 16, 20, 21, 23
Excessive noise	1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 21, 22, 23, 24

Potential Cause	Action
1. Unit overload	Reduce the loading.
2. Incorrect oil level	Verify that the oil level is correct. Too little or too much oil can cause high operating temperatures.
3. Wrong oil grade	Use only the AGMA grade oil as specified for the unit size and ambient temperature. Do not use lubricants with sulfur-phosphorus EP additives.
4. Contaminated oil	If oil is oxidized, dirty, or has high sludge content, change the oil.
5. Clogged breather	Clean breather regularly.
6. Improper bearing adjustment	Too few or too many shims cause incorrect bearing clearance. Contact the factory for correct end play, checking technique, and tolerance. Shafts should turn freely when disconnected from the load.
7. Improper coupling alignment	Disconnect couplings, check spacing between shafts, and check alignment. Realign as required.
8. Incorrect coupling	Rigid couplings can cause shaft failure. Replace with a coupling that provides flexibility and lateral play.
9. Excessive operating speed	Reduce the speed.
10. Torsional or lateral vibrations	Vibration can occur through a particular speed range known as the critical speed. Contact the factory for specific recommendations.
11. Extreme repetitive shocks	Apply couplings capable of absorbing shocks.
12. Improper lubrication of bearings	Verify that all bearings are receiving adequate amounts of lubricating oil, or grease.
13. Improper storage or prolonged shutdown	Destructive rusting of bearings and gears will be caused by storage or prolonged shutdown in humid conditions. If rust is found, unit must be disassembled, inspected and repaired.
14. Excessive backlash	Contact factory.
15. Misalignment of helical gears	Contact factory.
16. Housing twisted or distorted	Verify proper shimming or stiffness of the foundation.
17. Gear tooth wear (worm)	Improper worm/gear contact. Contact factory.
18. Open drains	Tighten drain plugs.
19. Worn oil seals	Check oil seals and replace if worn.
20. Loosely bolted covers	Check all bolted joints and tighten if necessary.
21. Motor related	Verify actual operating conditions are consistent with motor nameplate.
22. Excessive ambient temperature	Shield unit from direct sunlight, and maintain proper air flow around the gear unit.
23. Excessive overhung load	Move the pulley or sprocket closer to the housing. Check for excessive tension in belts or chains.
24. Gear tooth wear (helical)	Contact factory.

Renewal Parts:

To order renewal parts for your Delroyd Worm Gear reducer, contact your Delroyd Worm Gear sales representative to obtain a general assembly and/or a recommended renewal parts list. In order for your Delroyd Worm Gear sales representative to properly identify your Delroyd Worm Gear reducer, please record all of the information off of the reducer nameplate (refer to the nameplate illustrations below).


SHOP ORDER: _____

CATALOG NO.: _____

SERVICE HP: _____ RATIO: _____

SERVICE FACTOR: _____ OUTPUT RPM: _____

FIGURE NO.: _____

 IN ACCORDANCE WITH AGMA STANDARDS

DELROYD WORM GEAR RECOMMENDS MOBIL LUBRICANTS

DELROYD WORM GEAR

NIAGARA FALLS, NY www.delroyd.com

SHOP ORDER: _____

CATALOG NO.: _____

RATIO: _____

FIGURE NO.: _____

DELROYD WORM GEAR

NIAGARA FALLS, NY

DELROYD WORM GEAR RECOMMENDS MOBIL LUBRICANTS

Engineered Solutions

Proven history of analysis & design of unique custom solutions for virtually all industrial applications. Wide ranging application experience - Ultra low speed (175,000:1 ratio) to ultra high speed (45,000 RPM) with output torques to 6,000,000 in-lbs.

Design of spur, helical, double helical, bevel and worm gearing. Lubrication system design - Internal splash / channeling, force fed, pressurized / cooling systems with instrumentation. Sleeve bearing design and rotor dynamic analysis.

Reverse engineering of reducers, helical and worm gearing. Redesign and Rerate of existing designs of Nuttall Gear, Delroyd Worm Gear, and competitors products. Complex solid modeling & drafting.

Field Services

Maintenance - Routine lubrication service and end-play adjustments.

Inspections - Evaluate condition of gearing, shafts, bearings, seals, and lubrication systems.

Trouble Shooting - Root cause analysis for vibration, noise, premature gear wear, and oil leaks.

Repairs - Short-term emergency repairs and long-term permanent repairs can be made on site.

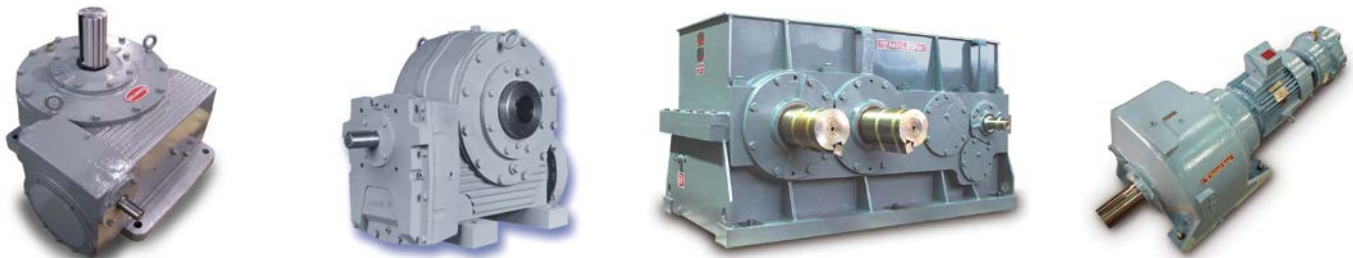
Torque Measurements - Record torque under actual operating conditions using telemetry (transmitter and receiver). Training Seminars that cover all phases of repair in a hands-on environment: Inspection, teardown, reassembly, and testing.

Rebuild & Repair

Comprehensive Inspection and evaluation of gearing, housings, bearings, and lubrication systems. Repair / Rework of Returned Components. Complete rebuild of Nuttall Gear, Delroyd Worm Gear, and Westinghouse units. Ability to also rebuild most competitors' units. All complete rebuilds are returned in new condition and include a new factory backed warranty.

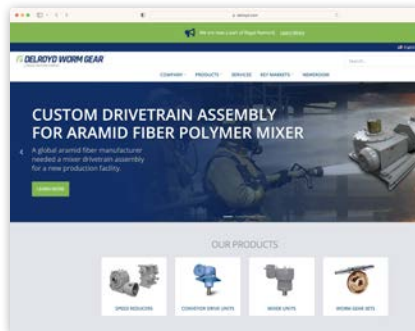
Trouble Shooting- Root cause analysis for vibration, noise, premature gear wear, and oil leaks.

In-House Testing - No load testing capabilities for all units with temperature, sound, and vibration measurements of critical components. Load testing available in some cases.



Delroyd Worm Gear is an ISO9001:2008 Certified Company

Member of AGMA



visit us online at
www.delroyd.com

Find our latest product literature online



P-7000-DWG

P-7002-DWG

P-7003-DWG

DELROYD WORM GEAR™

A REGAL REYNOLD BRAND

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