

**HEAVY MOVABLE STRUCTURES, INC.
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**Enclosed Gear Reducers: Long-Term
Storage and Inspections**

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Projects to replace, redesign or overhaul any heavy movable structure or their machinery will often span several years and have long project life cycles.

Unexpected delays, modifications, and revisions are a near certainty on almost all large, public infrastructure projects. During this life cycle, gear reducers may be ordered, manufactured, and received years before they will be needed for construction and installation. As the heart of any heavy movable structure, the gear reducers have special requirements that must be followed if they are to sit idle for long periods of inactivity. Project managers and engineers need to proactively have plans in place for the proper long-term storage of the gear reducers.

Long-term Storage of Enclosed Gear Reducers

Most gear manufacturers define long-term storage to be a period of 30 days or more of inactivity. If a gear reducer is to be stored longer than 30 days, special considerations and procedures must be in place to ensure the reliability of the equipment remains as intended when the gear reducers were manufactured.

Climate and Storage Environment

Gear reducers being stored longer than 30 days require storage in climate-controlled facilities, free of sudden temperature fluctuations. Temperature fluctuations are a major contributor to condensation buildup inside of gear reducers. Once moisture is present inside a gear reducer, one of the primary modes of degradation will occur: corrosion. Corrosion of internal components is one of the most common reasons that improperly stored gear reducers fail.

Vibration

Exposure to vibration is another major factor to consider with stored gear reducers. Bridge construction sites are often filled with activities that pose significant

vibration risks to gear reducers. Even slight vibrations over a period of time can cause gear reducers to form false brinelling on the bearing contact points. False brinelling is damage that occurs when bearing rollers are exposed to vibration and the contact points with the bearing race become fretted. This fretting can also become corroded which contributes to bearing abrasive wear and ultimately, reducer failure. Gear reducers being stored for long periods without being rotated are especially at risk for this type of hidden damage.

Lubrication During Storage

Some gear manufacturers suggestions for long-term storage include filling the reducers completely to the top with oil during the storage period. This limits the area of exposed surfaces within a gear reducer and can be an effective means of containing corrosion. However, due to the special nature of gear reducers designed for the heavy movable structures market, this is not always possible or feasible. Special features that are common in HMS-specific gear reducers can include dry-well construction on shaft down reducers or labyrinth-type non-contact seals at shaft extensions. Drywell construction consists of a well inside the housing, which is above the oil level, to prevent oil from entering the shaft cavity and leaking out of the reducer. Labyrinth seals are a type of non-contact seal that relies on the centrifugal force of rotation to contain lubricant inside a gear reducer. Gear reducers with these features cannot be filled to the top of the housing with lubricant.

Long-term Storage Best Practices

While there is not a "one-size-fits-all" approach to long-term storage of gear reducers, there are several common requirements that most gear manufacturers will

agree upon to ensure gear reducers remain in the original intended condition when ready to be placed into service.

- **Environment:** Gear reducers should be stored indoors, in a climate-controlled environment free of temperature fluctuations. Storing reducers near loading docks or in a shipping warehouse are often the worst possible areas for temperature fluctuations! This is also true when it comes to minimizing exposure to vibrations. Warehouses often see heavy forklift or truck traffic that will increase vibration exposure to statically stored gear reducers.
- **Corrosion-Resistant Additives:** Many manufacturers have well-defined procedures for preparing gear reducers for long-term storage. This typically includes treating the insides of reducers with volatile corrosion inhibitors or VCI preservatives. These additives can be added to existing lubricants or fogged into the interior with high-pressure sprayers. Many manufacturers will not perform this service unless requested by the customer! Never assume gear reducers are prepared for long-term storage unless it is written into the purchase order or contract documents.
- **Rotation:** Most manufacturers will require stored gear reducers to be rotated periodically. I have found recommendations to range from "every 30 days" to a generic "periodically rotated" statement. Rotation recommendations range from a 1/2 turn of output shaft to one full rotation of the output shaft. While there are some differences in the timing and amount of rotation by various manufacturers, it is wholly agreed that stored gear reducers need to be rotated during storage. HMS project engineers and managers must take this requirement into consideration when planning a project. Planning who will perform this requirement and how often it will be done will avert major

issues from occurring with the stored gear reducers. If gear reducers must be installed onto bridge structures early in the construction cycle, months or years before operation will begin, consider how the gear reducers will be stored and rotated.

Best Practices Inspections

In addition to proper long-term storage of new enclosed gear reducers, inspections by qualified and trained gear experts are another requirement to ensure enclosed gear reducers remain reliable and operating properly for decades of service.

Having a good program to address inspections will aid in spotting issues that need minor repairs, before they become costly equipment failures.

While gear reducers in HMS-service will see fewer annual operating hours than a similar reducer in continuous operation at a 24/7 steelmaking operation, inspections still must be performed regularly on them. Many lift bridge gear reducers are custom designed for the bridge they will operate, and replacements are not readily available. A good inspection procedure will greatly minimize the risk of total failure or unexpected downtime. At a minimum, gear reducers in HMS applications should be inspected annually. A few best practices for gear inspections are:

- Have the right equipment on hand. Typical inspection equipment for gear reducers will be a high-quality borescope, camera for photographing gear condition, tools for opening inspection covers, general assembly drawings of the units to be inspected (if available), an indicator for measuring

backlash, clean containers for oil sampling and general inspection forms for documenting condition.

- Document and photograph any observations. A photograph can help even after you have left the inspection site! Visually inspect and photograph all exterior sides of a reducer. Look at the base and structure. Signs of distress can often be found on the exterior. Cracked paint can indicate movement or looseness of mounting hardware. Discoloration can indicate overheating. A plugged or painted over breather can cause leaks.
- Collect an oil sample for later analysis. Do not automatically assume the oil inside the unit is the correct oil!
- When removing inspection covers, clean the area around the cover prior to removing. Do not set anything around or near an inspection cover opening that can fall inside the reducer. Immediately replace inspection cover when the inspection is complete.
- When photographing gear condition, it is very important to get clear photographs of both tooth flanks on each gear or pinion. If good, clear photographs are collected in the same manner annually, trending wear and rate of wear is much easier. It will also enable others to analyze the data long after the inspection has been completed.

Annual gear inspections will ensure that lift bridge and other HMS-related gear reducers remain in good operating condition, operating safely and reliably for decades. The proper storage and handling of gear reducers prior to installation ensures a project will have a successful turnover to the owner.