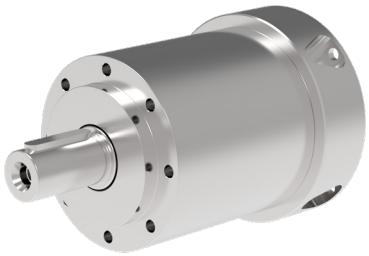
Gearbox Design for Harsh Environments

Introduction



When applying a gearbox in a harsh environment, no two applications are alike. You must consider the environment in conjunction with the application – together they affect the operation of the gearbox. This combination of environment and application means off-the-shelf components typically cannot be used.

Engineering collaboration between the manufacturer and the customer is a best practice for ensuring an optimized, cost-effective design. Gearbox customization for harsh environments could include:

- Alternate materials
- Special lubrication
- Special seals
- Protective shielding

Any additional costs incurred customizing a gearbox will be recouped in the long run through the prevention of poor performance or failure and not overpaying for unnecessary features.

Whatever your environment, it is important to test the customized gearbox in the environment in which it will be used

In this guide, we will provide considerations for integrating gearboxes into harsh environments, as well as real world examples

Food Processing & Packaging

Food processing and packaging applications often come with specific requirements for materials to be used throughout equipment such as:

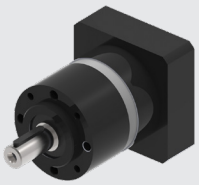
- Stainless steel materials
- Specific paints or coatings
- Food grade lubrication

While food applications often require stainless steel, it is worth investigating other materials or coatings, especially if the component is not in direct contact with the food or packaging itself. These alternatives may offer acceptable protection at a lower cost.

Example

A customer was looking for a cost-effective gearbox for a food packaging application. A gearbox with a stainless steel housing was outside their budget.

Working with GAM, it was determined that alternate materials would be sufficient for the application. GAM supplied a gearbox with a hard anodized housing, stainless steel shafts, and Viton™ seals.



Conclusion

There is value in investigating alternate materials or coatings. A more cost-effective solution may be available without sacrificing performance.

Vacuum

When operating in a vacuum, such as for laser welding, the most important considerations are the lubrication and proper venting. Oil or grease that is appropriate for a normal environment will boil off in a vacuum, eventually causing the gearbox to fail. In these situations, special grease formulated for vacuum should be used. This grease will coat the components rather than fill the cavity.

Example

A customer needed a gearbox that would operate in a vacuum for a laser welding application. GAM provided a gearbox with a special high-vacuum grease and special bearings. In addition, the gearbox was supplied with a vent to help regulate the internal pressure.

Conclusion

Gearboxes can, and do, operate in a vacuum. The main considerations are using the proper lubrication and properly venting the gearbox

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Washdown

Many food or consumer goods applications require equipment be washed down periodically. The washdown may be water or a cleaner. These washdowns fluids can get inside the gearbox and cause premature failure through rust or oxidation of the components. Considerations include:

- Is there shielding or other drainage to ensure fluid does not pool around or enter the gearbox?
- Will it be subjected to direct or indirect washdown and at what pressure?
- Will the washdown cause the gearbox to corrode?

Accommodations for washdown can include:

- Stainless steel shafts or housing
- Epoxy paint or hard anodizing
- Extra seals or O-rings
- Drainage of fluids away from the gearbox
- Stainless steel or zink plated hardware
- No extra holes or crevices which are difficulet to clean

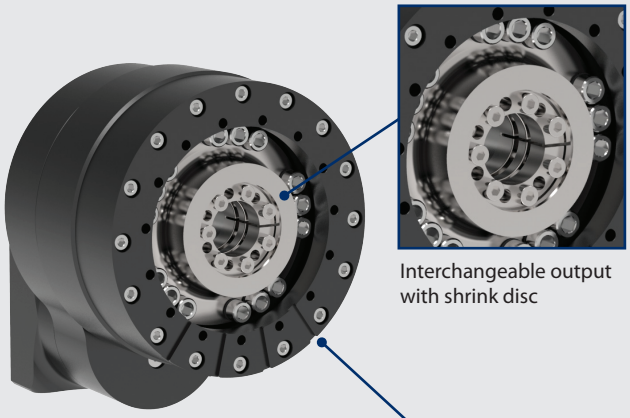
Example

A customer needed a gearbox for a food processing application. The gearbox would not be in direct contact with food but would be subjected to washdown. The prior solution, a direct drive motor, was prone to failure due to fluid entering the motor.

GAM provided a sealed gearbox fully enclosed in a custom housing, with a custom shrink disk connection to connect to the customer's mechanism. The housing was anodized and all hardware was either stainless steel or zinc plated (zinc-plated hardware provide corrosion resistance with higher strength than stainless steel) .

The output shrink disk connection was enclosed in a housing. Since this output housing could not be sealed where it was connected to the rest of the mechanism, there was a possibility of washdown fluid entering this area.

GAM added slots to the output housing to facilitate draining of the washdown fluid, preventing any fluid from getting pulled into the gearbox. In addition to solving the fluid issue, GAM designed the gearbox and housing to be modular so one size gearbox could be used for multiple applications simply by swapping out the shrink-disk output and housing.



Interchangeable output with shrink disc

Slots facilitate drainage

Conclusion

When in a washdown situation:

- Select rust-resistant materials including the hardware.
- Ensure gearboxes are properly sealed to prevent fluids from entering the gearbox and rusting internal components. If possible, provide shielding around the gearbox to direct fluids away from the gearbox.
- Simplify your design to eliminate unnecessary holes or crevices

Dirty environments

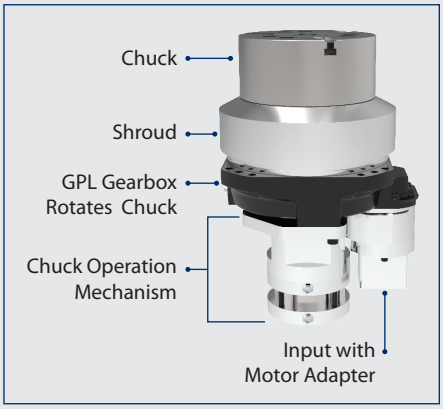
Gearboxes used in machining operations may be subjected to metal dust or shavings. A gearbox in construction may be subjected to dirt or debris. Grit entering the gearbox can cause failure, so measures need to be taken to prevent this. In most cases, gearboxes are designed to keep lubrication in. In a dirty environment, the gearbox needs to be designed to keep grit and dirt out of the gearbox.

Example 1

The customer needed a gearbox that could rotate a chucked part during the during a deburring process. The gearbox would be located under the part being deburred so it would be exposed to the grinding dust.

GAM was able to redesign the machine, replacing a poor-performing gearbox and belt drive mechanism with a single gearbox to direct drive the chucking fixture. This gearbox included a flanged output with a shroud to protect the gearbox from debris.

In addition, GAM suggested and designed a new mechanism for opening and closing the chuck. This collaboration resulted in a much simpler design with higher performance for the customer.

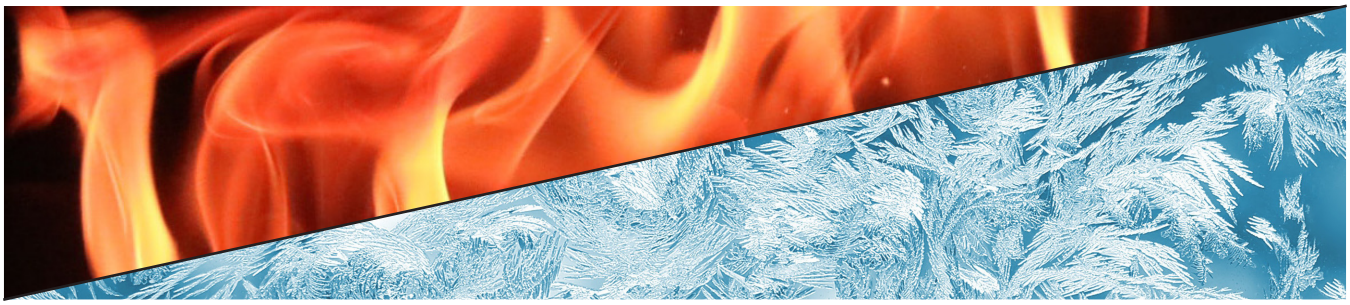


Example 2

The customer required a gearbox for use in an oil drilling operation. The gearbox would be subjected to high temperatures and pushed through sand. Shrouding the gearbox was not possible, so a system was used to force lubrication into the gearbox thereby keeping out the sand.

Conclusion

Gearboxes, like most precision components, need to be protected from dirt or debris entering the gearbox. This can be done with the simple addition of shrouding, or something more extreme as the application warrants.



Outdoors or Variable Conditions

When your environment is outside or where conditions can vary, there can be additional factors to consider including:

- Extreme temperatures (hot or cold)
- Weather conditions including precipitation or humidity
- Contact with fresh or salt water

In this situation consider alternate materials

- Coatings or material resistant to rust or oxidation
- Seals designed for wide temperature ranges

Example 1

A customer required a gearbox for a marine application. The gearbox would be outside, exposed to the elements, and needed to fit within specific space constraints.

GAM provided a bevel gearbox with stainless steel shafts and white epoxy paint to protect exposed surfaces. The bevel gearbox is normally supplied with mounting holes on all sides. Only the holes necessary to mount the gearbox were added, eliminating pockets that could rust or where mold could grow.

Example 2

A customer required gearboxes that could be stored for long periods of time before being used. While in storage, the gearbox would be subjected to a temperature range of -40°F to +90°F but needed to be in good condition to run when needed. GAM provided gearboxes with special seals and O-rings with tolerance to the wide temperature range. In addition, the gearboxes were filled with a grease with long shelf stability.

Conclusion

Consider how variable the operating environment will be. Is it constant or will the temperature change? Will the component be exposed to water or humidity? Ensure the lubrication and seals are designed for temperature fluctuations. Consider water- or humidity-esistant materials.

Summary

When applying a gearbox in a harsh environment, no two applications are alike. It is important to understand:

- The environment
- Critical aspects of the application
- Features required

Engineering collaboration between the manufacturer and the customer is a best practice for ensuring an optimized, cost-effective design that meets the needs of the application.

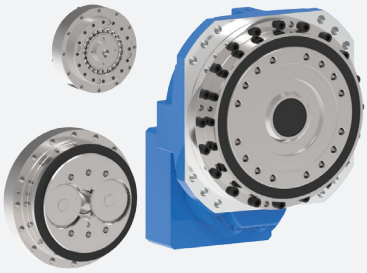
In all cases, it is important to test the customized gearbox in the environment in which it will be used.

Each application is different, the contents of this guide are only suggestions. The customer is responsible for what is appropriate and applicable for their specific application.

GAM has the Broadest automation product range on the market

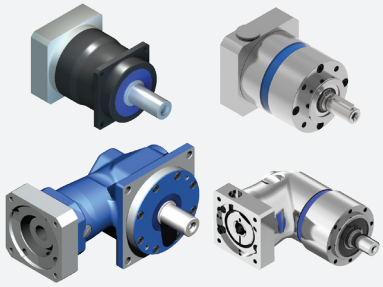
We are your complete source for innovative products used in automation technology.

Robotic Gearboxes



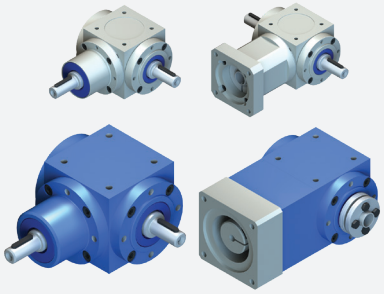
Zero-backlash gearboxes for robotics and high-precision applications with revolutionary zero-backlash planetary, cycloidal, or strain-wave (harmonic) gearing

Servo Gearboxes



In-line and right angle gearboxes for precision servo applications in a wide variety of configurations and frame sizes. Off-the-shelf or custom, GAM has the gearbox for your application

Bevel Gearboxes

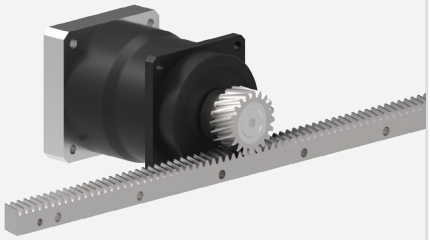


Precision spiral bevel gearboxes, from miniature to extremely large, with multiple shaft configuration options for servo or precision power transmission applications

Servo Couplings

Bellows, elastomer, safety, or distance (line shaft) couplings are all zero-backlash and custom bored

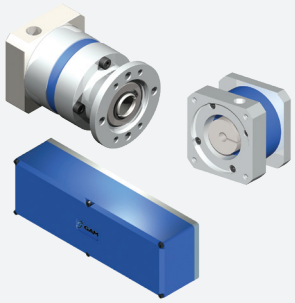
Rack & Pinion Systems



Helical rack and pinion pair with GAM gearboxes for optimal system performance in a complete linear system.

GAM rack available separately

Linear Mounts



Everything Between the Motor and the Actuator: GAM linear mounts make it easy to connect any motor to any actuator.

GAM, a U.S. company, is your complete source for robotic and servo gear reducers, rack and pinion systems, servo couplings, linear mounting kits, and other precision mechanical drive solutions used in automation technology.

With one of the largest product offerings in the motion control industry as well as the engineering expertise and manufacturing capabilities to develop customized solutions, GAM can help with your application.

U.S. manufacturing, being flexible to meet the needs of customer requests, and great service are what set us apart from the rest.

GAM Can.