

The Quick Reference Guide to Servo Motor Maintenance and Repair



Each minute that a servo motor is off-line, is experiencing intermittent interruption, or is operating at less than full capacity, it takes a toll on production, quality, and ultimately the bottom line. Whether you troubleshoot the problem yourself or outsource the repairs, the best approach is to quickly and accurately pinpoint the root cause(s) of servo motor failure and downtime.

This guide offers insight, best practices, and practical tips to quickly assess the condition of the servo motor and help you to determine the best course for repair. We've also included the information to help you to diagnose servo motor issues, understand common error codes, identify tools you'll need for repair, how to locate the right repair shop, and more.

While servo motor repair shares some similarities with the repair of other types of electrical motors, there are key differences. One important variance lies with encoder feedback testing and alignment. This guide will help you to safely navigate this critical area.

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How to Diagnose Servo Motor Issues

It can be sometimes difficult to determine if equipment failure or underperformance is traceable to a faulty servo motor. Fortunately, there are several reliable indicators that your servo motor may now, or will soon require maintenance.

Common symptoms of a faulty servo motor include:

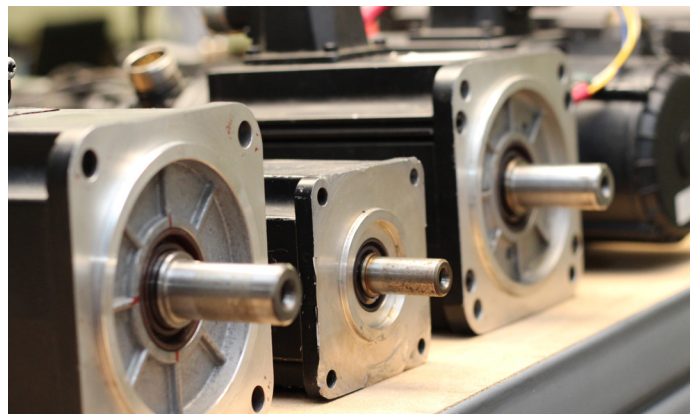
- Error codes on the corresponding drive.
- The servo motor is running hot.
- You're replacing worn bearings at a higher-than-normal rate.
- The servo motor or equipment provides limited speed or torque.
- The servo motor has a sudden or intermittent power loss.
- The equipment or servo motor is frozen or displays a limited range of mobility.
- The servo motor engages intermittently.
- The servo motor or equipment is experiencing a reduction in efficiency.
- The servo motor emits an unusual sound.
- Quality issues and non-conformance with the part being manufactured such as incorrect tolerances.

Note: What if, despite following rigid maintenance schedules, you are encountering servo motor problems? Troubleshooting the problem requires a systematic approach. This [blog post](#) offers 8 practical tips to help you to diagnose and troubleshoot servo motor issues.

Identifying the Common Types of Servo Motor Issues

Damaged Drives

Servo motor drives are designed to work long hours. Many leading servo motor OEMs typically list the lifespan of these components as 20,000 to 30,000 hours. However, voltage spikes can damage the drive, along with electrical issues such as poor grounding. Dust, moisture, and other contaminants can contribute to the failure of the drive.



Recognizing Encoder Drive Error Codes

The list of servo motor encoder drive error codes can be extensive. Here are some of the more common errors that you may encounter:

Initialize Error	Overheat
Absolute Track Error	Battery Backup Warning, Error, or Alarm
Incremental Pulse Error	Incorrect Encoder ID
Overspeed	Indexing Alarm
Reduced Resolution Alarm	Protocol Error
Position Counting Error	Memory or Data Field Error
Multi-Turn Counting Error	Internal Checksum Error
Light Source Error	Data or Parity Error
Signal Amplitude Error	Unrecognized or Incorrect Command or Access Code
Position Value Error	Overspeed Condition
Over/Under Voltage	Position or Multi-Turn Counter Overflow
Overcurrent	Power Supply or Miscellaneous Internal Error

Note: It is important to be able to read these error codes by either having the corresponding motor drive or by having a diagnostic tool that can read these codes out of the encoder and display them in a human readable form in a software user interface. See below for tools that can do this.

Mechanical vs. Electrical Faults

Because servo motor components are largely mechanical, most faults are hardware-related. However, issues can also occur with its electrical components such as the power supply or controller for example.

Mechanical Issues

Because of repetitive motion and sometimes heavy loads, a servo motor's mechanical components will eventually fail. Symptoms may include a decline in speed or performance, or even abrupt failure. Causes generally range from overheating and misalignment to insufficient lubrication or simple wear.

It's important to ensure that motors are installed correctly and regularly inspected and maintained. Similarly, for any repair it's recommended to use quality parts recommended by the motor's manufacturer.



Electronic Problems

Temperature cycling, excessive vibration, voltage fluctuations, dirt, dust, grease, and other contaminants will all contribute to electronic component failure. It's therefore important that the servo motor is operating within specified temperature and voltage parameters. Proper maintenance, such as regular cleaning and inspection of the motor and its components, can also help extend the life of the motor.

Encoder Misalignment

Even if the servo motor and encoder are functioning perfectly, failure could occur simply due to an incorrect alignment angle. Encoders must be aligned with sufficient accuracy so that the motor can be correctly commutated by the drive, and deliver the torque and velocity required for the application. Even slight alignment variations can cause the motor to run poorly or not at all.

Go [here](#) for more information about servo motor encoder misalignment causes, effects, and how to ensure proper alignment.

Servo Motor Repair Tools

The general expertise of Mitchell Electronics, Inc. is centered around servo motor encoder diagnosis and repair. Additional information on servo motor basics can be found in the [Servo Motor Repair Guide](#).

Tools You Should Have

- Wrenches and screwdrivers with a variety of bits or adapters.
- [Mitchell Electronics TI-5000JX](#) along with cables and software: Recommended for testing the encoder/resolver feedback and aligning to the servo motor. Also used for testing and reprogramming encoder memory.
- [Mitchell Electronics TI-5260-PSP](#): Ensures that the motor is properly locked during testing. This ensures accurate test results and eliminates the risk of damage to the motor.
- [Mitchell Electronics TI-3000JX](#): Employed for run-testing the motor.
- Back-drive station: Used for turning motors at a constant speed and viewing generated electromagnetic fields (EMF).
- Oscilloscope: Recommended for checking back-drive EMF or for extended analysis of electrical signals. (Note: While nearly any oscilloscope would work, having isolated inputs is helpful if observing more than one EMF winding at a time.)
- Digital Multimeter: For checking volts AC/DC/ohms, etc.
- Spare DC power supply: For releasing motor brakes (24V and 90V are common)

Additional Tools to Consider

- Torque Wrench: For testing static torque while motor is locked.
- Vibration Analyzer: To measure, store and diagnose the vibration produced by the motor.
- Additional Variable DC Power Supply: For encoders with non-standard power requirements.
- Surge Tester/Winding Tester: Used to test the dielectric strength of the insulation in windings.
- Megger Insulation Test: Used to measure insulation resistance.
- Work Station: For repainting motors.

Repairs: In-House or Outsource?

With proper training and tools, servo motor repairs are generally simple and straightforward. However, there are times when the expertise of a shop specializing in servo motor repairs is warranted. For this reason, manufacturers should support internal maintenance teams with the services of a reputable servo motor repair shop.

Before initiating repairs (in-house or outsourced), take the time to inspect the motor for any obvious issues. These motors often operate in harsh environments. Check to see that there is no excess build-up of grease, dirt, water, or other contamination. Similarly, if the motor is running hot, make sure that there is sufficient airflow and that the unit is not mounted on a gearbox or a similar heat-emitting system.

Note: Whether you perform servo motor repairs in-house or outsource them to the experts, there are steps that you can take to make the process as quick and cost-effective as possible. Follow this [link](#) to learn the steps to reducing repair time and costs.

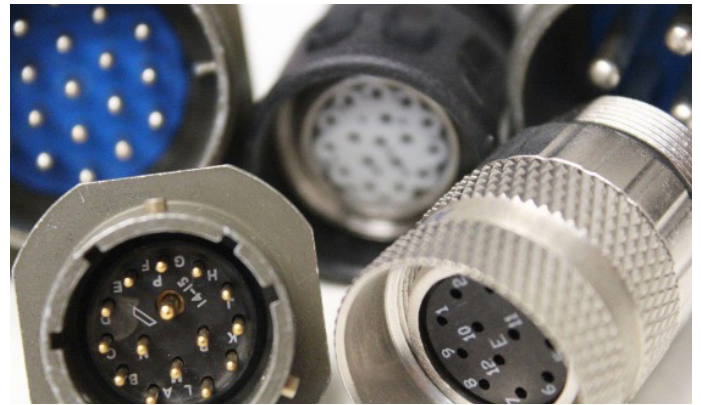


In-House Repair: What Can You Fix Yourself?

As with any piece of equipment, servo motors have components that must be maintained or replaced as a part of their normal operation. Along with this general maintenance, here are a few other areas that you may be able to handle in-house:

Connectors and Wiring

Verify that there are no unexpected short or open circuits in the motor windings, and check that the resistance of the windings is consistent and within the expected range.



Bearing Replacement

Bearings typically fail due to misalignment, heavy loads, or wear over time. Whether it's an unlubricated bearing or a worn-out one, bearing issues can be easy to diagnose.

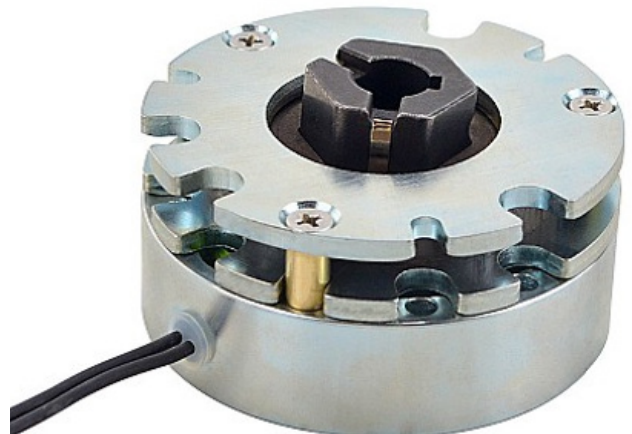
While bearing replacement appears to be a straightforward job, it requires disassembly of the motor and therefore removal of the encoder. Aligning the encoder afterwards can be a difficult task but this can be simplified by having the right tool.



Brake Issues

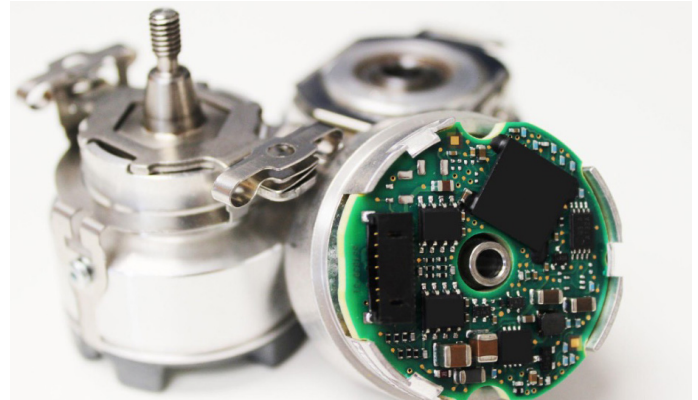
Servo motor brakes protect the equipment from damage in the event of a power loss. Because brakes are designed to disengage when voltage is applied, they often malfunction by failing to release. Reasons for this generally range from wiring problems to bad brake coils, and contamination. Similarly, worn brake pads can become an issue as they no longer maintain the torque required to hold the load.

Brake repair or replacement also requires disassembly of the motor and therefore removal of the encoder. So an encoder alignment tool is also helpful for this.



Feedback Replacement

Encoder alignment is critical when replacing the feedback unit. Even slight alignment variations can cause the motor to run poorly or not at all. This allows the motor to be correctly commutated by the drive, and provides the torque and velocity that is commanded by the controller for the application. Find more information about this [here](#).



Note: Dedicating a space away from the main floor for servo motor repairs will help to reduce noise allowing diagnostics to be performed in a quiet, clean and safe environment. It's recommended that repairs be made on an isolated test bench. Once servo motors are tested and repaired, they can be returned to the main floor or put into storage until needed.

Mistakes to Avoid When Repairing In-House

No matter if you're a beginner or a servo repair expert, mistakes can happen anywhere along the line. For this reason it is beyond critical to document each step of the process through completion.

Not understanding how to safely remove the feedback device is a common mistake. If not removed carefully, sensors are easily damaged or destroyed.

Note: A word of caution. In many cases it is important to not remove the encoder from the shaft by prying as this can damage the encoder or motor. It is highly recommended to use a jack screw for this.

Other common servo motor repair mistakes include:

- Removing the encoder before checking and documenting its alignment.
- Applying lockup voltage to the motor without first testing the windings.
- Run-testing a motor without first testing and verifying the encoder.

When to Outsource Servo Motors Repair

While many servo motor repairs can be generally handled by inhouse maintenance teams there are instances when it's best to rely on the expertise of a certified servo motor repair shop.

Certified repair shops typically provide extensive repairs such as:

- Damaged windings
- Damaged or weakened magnets
- Damaged brake
- Major mechanical damage such as broken shaft
- Motor housing requiring machining
- Anything outside your expertise or range of comfort

Finding the Right Servo Motor Repair Shop

There are capable motor repair shops all over the world offering reliable and prompt service. These shops have been testing electric motors for decades and are well versed in handling various types of repairs.

Mitchell Electronics, Inc. maintains relationships with reputable servo motor repair shops in more than 30 countries around the world. We are happy to discuss your needs and help you achieve the quality that you need in your maintenance and repair process

What to Look For In a Repair Shop

- They are customer-oriented with a support / technical team who will provide you with the attention you deserve.
- A quality repair shop will take the time to thoroughly explain the issue(s) and repair process.
- Most repairs generally take a couple of weeks to complete. However, a responsive shop can often turn repairs around in about a day or so if repairs are urgent.
- They work with you in a consultative fashion, asking detailed questions about your failure and aiming to understand your factory setup.
- They stand behind their work and offer a guarantee.
- They tell you if they could not find a problem with your motor.

The bottom line is, a good shop just doesn't want to fix the motor, they want to help you keep your machines running smoothly. This includes prompt and quality repairs, consulting services, and special attention to the motor as well as your company.

What to Expect: Cost

Costs will vary depending on region, type of motor, and severity of the problem. Expect to pay an extra fee if a quick turn-around is needed. Also, repair costs are generally higher for older/obsolete motors.

As a general rule of thumb, repair costs are often calculated at about half of the replacement cost of the motor.

Expediting the Repair Process

There are steps that you can take to help speed the repair process and mitigate costs. It's important to provide as much information and documentation about the faults and issues. Here are some things to make note of:

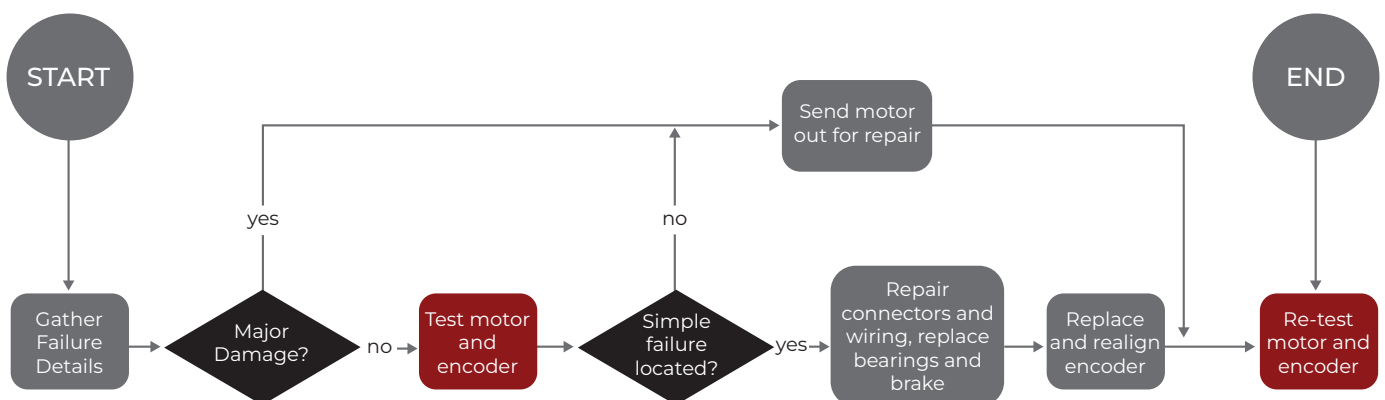
- Document how long you have been experiencing issues.
- Document what error codes are present.
- Note any inconsistencies in the run such as overheating, extra noise, roughness, inaccuracy in the product etc.
- Document if you or anyone else has already attempted to service the motor.

If this is a motor that the repair shop has never before serviced, it is possible they will need a working motor as a benchmark to ensure parameters such as alignment, memory data, and connector wire pinouts can be correctly reestablished on the faulty motor after the repair.

Deciding on In-house Repair or Outsourcing

Not sure whether to send your servo motor out for repair or try to fix it in house? Here's a quick reference chart you can use to determine your best path forward.

If you're still unsure, please don't hesitate to [contact us](#) or visit our [blog](#) to learn more.



Servo Motor Resources from Mitchell Electronics, Inc.

Servo motor technology is constantly changing and it's critical to keep pace. At Mitchell Electronics, Inc. our goal is to help you to optimize your equipment investments. We demonstrate this by offering the industry's leading servo motor testing tools, unmatched service, and practical information regardless of your brand or type of servo motor.

Hardware Products

Mitchell Electronics, Inc. offers a wide variety of on-line training sessions tailored to your applications, skill-level, and requirements. Training topics include:

- **TI-5000JX** –The TI-5000JX is a servo motor test product that can be used to diagnose, test, align, read, and program hundreds of different feedback types, such as incremental encoders, absolute encoders, serial encoders, and resolvers.
- **TI-3000JX** - The TI-3000JX is a servo motor run test product which acts as a universal servo motor drive providing a diagnostic test before or after a servo motor repair.
- **TI-5260-PSP** - The TI-5260-PSP Permanent Magnet Servo Motor Rotor Lockup System provides a simple and accurate method of applying the correct current to the correct set of windings to lock up a permanent magnet brushless AC or DC servo motor.
- **Hardware Adapter Modules** – Various hardware adapter modules are available to extend the functionality of the above test products. For example, the TI-5106 hardware adapter module is designed to support all Hiperface DSL encoders used on new servo motor models from Allen Bradley VP, Kollmorgen AKM, Beckhoff AM8, Parker SME, and others.
- **Test Cables** – Our catalog contains more than 300 power and feedback cables. Their functionality is verified by our automated test process. Many can ship next day air for your urgent jobs. If a cable for your motor is not already in our catalog, contact us for a quote.

Software

- **Athena** - The Athena Windows PC software application is licensed with most product purchases and provides a graphical user interface to the TI-5000JX Servo Motor Feedback Test System or the TI-3000JX Servo Motor Run Test System.
- **Bobcat** - Bobcat is an online database offered in certain editions which answers support questions and provides a knowledge base designed to make available a wealth of information right at your fingertips. From instructional videos to manuals, training, and help documents, our media center and blog provide helpful information and answers to many of your questions in a variety of formats.

Training

Mitchell Electronics, Inc. offers a wide variety of on-line training sessions tailored to your applications, skill-level, and requirements. Training topics include:

- Basic servo motor terminology and discussion
- Identifying, testing, and aligning common servo motor feedback types including:
 - Resolvers
 - Hall Effect Sensors
 - Tachometers
 - Incremental Encoders
 - Serial Encoders
- Gaining proficiency with the Mitchell Electronics, Inc. products, note-keeping, servo motor troubleshooting skills, and practicing a standardized approach for testing and running each type of servo motor
- Brief theory of servo motors and electronic commutation

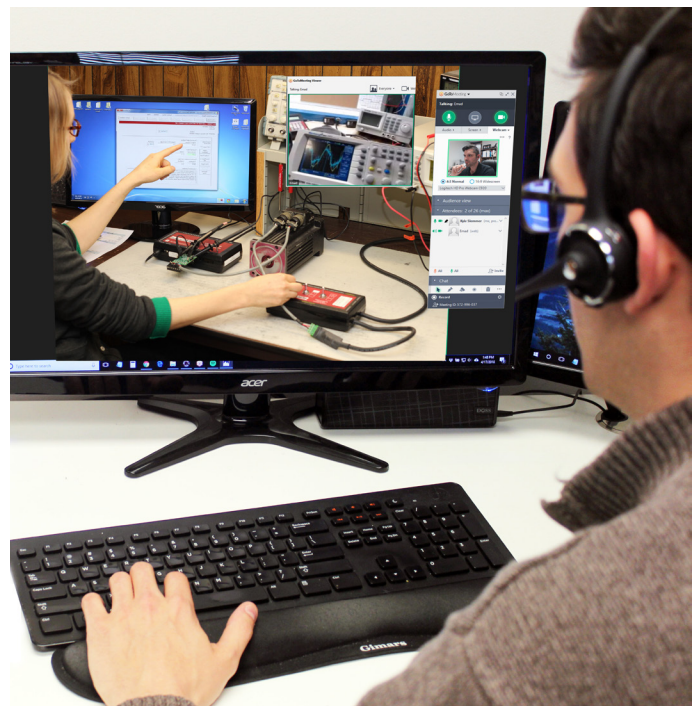
Product Support

Our experienced technical support team represents years of experience and a wealth of servo motor and encoder knowledge. The Mitchell Electronics, Inc. support team enables customers to navigate the many variables associated with testing, diagnosing, and repairing hundreds of different motor and encoder types.

Need advice where to start?

Unplanned equipment downtime has an adverse effect on production and profitability. Today, a growing number of manufacturers are turning to Mitchell Electronics, Inc. to keep their equipment running. Contact us to learn how to keep your equipment running and at peak performance.

We invite you to experience the difference. [Contact us](#) if you have questions or wish to learn more.





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