Independent Technology Service Inc.

9182 Independence Ave., Chatsworth, CA 91311 • Tel: (818) 727-1500 • itscnc.com

SERVICE / WARRANTY BULLETIN

DC Brush Motor Failure

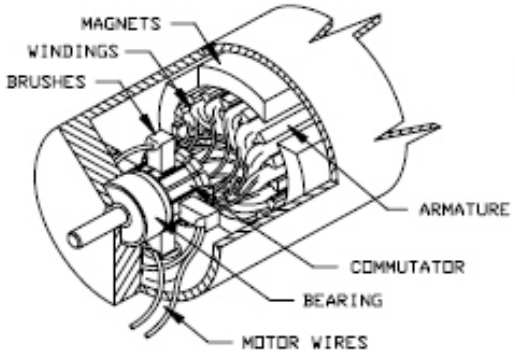
Common DC Brush Motor Failures – Motor Burn Out

IMPORTANT! MOTOR WARRANTY INFORMATION.

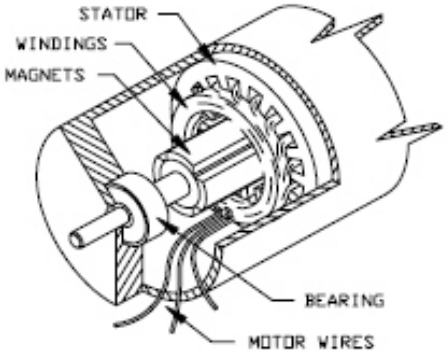
Overview

This Manual discusses a potential loss of warranty due to motor damage. Please read the following in its entirety to ensure you do not lose your warranty!

With all electric motors, the motor torque generated is a product of electric current and the amount of voltage determines the motor RPM. One of the basic differences between the brush and brushless motor is the configuration of the electromagnetic coils. With a Brush motor, the coil windings are part of the rotating armature and are deep inside the motor. With the brushless motors, the coil windings are not deep inside the motor since they not part of the rotating armature. Because of this major design issue, the brush motor has a work load limitation. By having the coil windings deep inside motor, it dramatically reduces the amount of heat escaping from inside the motor. The trapped heat builds up to the point of melting the wire insulation, which in turn can cause an electrical short circuit. This is apparent when you open the back of the motor and it smells burnt. Sometimes you'll see a couple of teaspoons of a brown liquid from the humidly and insulation burning.

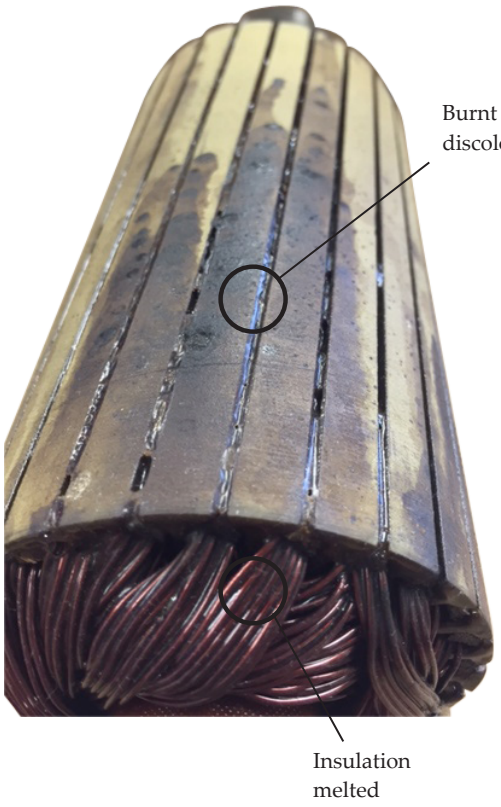


BRUSH-TYPE MOTOR



BRUSHLESS-TYPE MOTOR

Damaged Armature



New Armature

Preventing Heat Problems

With all electric motors, torque is a product of the electric current and the amount of voltage determines the RPM. All motor designs have a limited amount of current the motor coils can utilize. Too much current applied to a motor produces heat (just like your toaster.) Too much heat will melt the coil wires insulation which then shorts the wires.

Basically, there are two types of shorts inside the motor:

1. A short in the coil wires. The change in the Ohmic resistance affects the motor torque which creates motor overloads and a possible burnout coil.
2. A short in the coil wires to ground. This results in a fast burned-out motor coil and possibly a blown-out amplifier.

Once a coil is shorted, it no longer creates the magnetic flux that causes the torque to rotate the motor. If the melted insulation caused the short to have a low enough Ohmic value (short), this can typically cause the AMC or Glentek amplifiers to damage or blow up the amplifiers internal power devices and PCB traces.

NOTE: For this reason we strongly recommend testing the motor for ground shorts before installing a Glentek amplifier. The ITS amplifiers have internal short protection and will not be damaged by a faulty motor.

Common Causes of a Motor Burn Out

1. Burn Out Due to Coolant Contamination

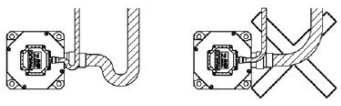
The X-axis motor and the A-axis motor are notorious for moisture damage. **Once a liquid gets into the motor, the motor will be ruined. Glentek will NOT warranty a contaminated motor. They will NEITHER rebuild NOR repair it.**

The X-axis motor has two important features to help prevent contamination:

- A motor cover was added on the X-axis to shield it from coolant run off.
- A Brush Cap motor cover band is available to cover the brush caps and help prevent moisture penetration.

The Rotary axis motors are shielded in a protective box. The motor box must have a drain hole in the bottom of the box and remain clear and free to drain any moisture build up.

It is critical that the Seal Tight conduit connector that attaches to the X-axis motor or the rotary box is property assembled and working correctly to seal the entry from coolants. Check for proper use of plumbers tape at the motor thread. Worn or damaged conduit must be replaced.



The box/motor entry must also have a correct drip-line entry, as noted left.

Note that having a 100% sealed motor is impossible because internal temperature cycles create a pressure cycle inside the motor as it becomes hot, warm and cold. It is difficult to seal because of the motor bearing, brush caps and wiring ingress motor connections. Cutting fluid also has significant impact on the life of the seals. Shielding the motor from coolant is always the best design practice.

Also, note that a contamination problem is not a Fadal specific issue.

Below is a portion from the Fanuc Maintenance manual (FANUC AC servo motor Ai series.pdf):

Usage Considering Environmental Resistance

Overview

The motor is an electric part, and if the lubricant or cutting fluid falls on the motor, it will enter the inside of the motor, possibly adversely affecting the motor. In particular, if the cutting fluid adheres to the motor, it will deteriorate the resin or rubber sealing members, causing a large amount of cutting fluid to enter the inside of the motor and possibly damaging the motor.

If sufficient water-proof performance is required, as in the case in which a motor is used in a cutting fluid mist atmosphere, specify an IP67 type motor.

Note that both the standard and IP67 types satisfy the provisions for short-time water immersion, and do not guarantee their water-proof performance in an atmosphere in which the cutting fluid is applied directly to the motor"

Connectors

Note the following points on use:

Make sure that no cutting fluid is introduced to the motor via cables. If the motor connector is used horizontally, this can be accomplished by forming a slack in the cable.

If the motor connector is directed upward, the cutting fluid collects into the cable connector. Whenever possible, direct the motor connector sideways or downward.

2. Burn Out Due to Excessive Motor Current.

All electric motors will burn out if the designed current limits are exceeded. This is called the motor's rated "Duty Cycle".

In the USA it is usually specified as either a "continuous" or "intermittent" current rating. The continuous rating is the maximum amount of current the motor can use without stopping (a 100% duty cycle).

The intermittent rating is typically 150% of continuous current and commonly referred to as the 30 minute duty cycle. After thirty minutes at 150%, the motor is allow to cool.

Exceeding the motor rated duty cycle will damage the coil windings and eventually ruin the motor.

Measure the motor current to avoid damage! Simply replacing a motor does NOT guarantee that the new motor will not burn out also.

With the Brushless motor system, the option of Load Percentage was added to the SETP command, instead of displaying the Following Error. The Brush motor system does not have this option. But with the use of an digital clamp multimeter, we can measure the current.

The clamp-on probe is a fast and easy way to read the amount of current the servo motor requires to move the slide or rotary head. Simply clamp around the positive motor wire at the output terminal of the amplifier.

The following tests use the meter. We recommend using the **Etekcity© model MSR-C600.** For information on purchasing one, please contact us.

Testing the Motor Current in Motion

The goal of this test is to run the machine and verify the mechanics of the machine are not binding and requiring too much current to move the axis. During a rotary or linear move, the current usage should be fairly constant. Seeing a fluctuation in the amperage indicates a bind or tight spot in the gear, Gib or a bad ball screw.

The following is a table of the standard Glentek motor current ratings for your reference.

Glentek Motor Current Ratings

Glentek Motor	Continuous	Peak
MTR-0002	12 amps	24 amps, 2 seconds
MTR-0010	18 amps	36 amps, 2 seconds
MTR-0003	7 amps	14 amps, 2 seconds

An installed meter reading a constant .704 amps

Install the meter as shown over the motor wires and begin by moving the machine. Enter a program to move the axis back and forth to a full travel. Lower the feed pot and start by moving at a slow speed. Observe and record, then increase the feedrate for more samples.

Repeat the above procedure doing rapid moves. Rapid should not exceed the continuous rating in the table above. Note: observing the amperage can also be performed while machining a recent part to verify that the machining cycle was not the cause of the excessive demand on the original motor.

Testing the Motor Current in Standby Mode

It is critical that when the machine stops moving the motor current drops to a value of 1 or 2 amps. Excessive current in standby mode could cause a burnout.

Again, begin by installing an amp probe. To test, simply make a move and press SLIDE HOLD. Within two seconds, the motor amperage output should drop. If the motor amperage does not drop, it indicates that the motor is requiring torque to hold/get the axis into position.

A mechanical condition that requires too much current to hold the slide into position will eventually cause the motor to overheat and permanently damage the motor. To fix excessive standby current, check the following:

1. Look for a mechanical bind that is causing the slide to resist going to position. Check for a bind or tight spot in the slide system. Components such as ball screws, Gibs, and way lube systems can cause a "wind-up" in the positioning system. For more information, see – Fadal Maintenance Manual, Section 06: Axis Drive Systems http://www.flintmachine.com/pdfs/fadal-manuals/maintenance-manual/Axis_Drive_Systems.pdf

2. Adjust the BACKLASH using the BL command. Verify that the BL command does not have a zero value. You should have a minimum value of 2 counts. Having a zero backlash value would disable the motor wind-up overheat protection.

   The Backlash system was designed to have a split application. If you enter a value of 4 counts, the axis card then applies +2 when moving positive and -2 when moving negative, for a total of 4 counts.

   The backlash is removed when the control stops moving. This can be observed when looking at a motor coupler and jogging the machine. As you slowly pulse an axis, ½ the BL is applied. When you stop pulsing, you will see the couple backup (removing the BL) as the axis goes into standby mode.

   The Fadal backlash removal technique was specifically designed to remove the wind-up and reduce the motor torque required by the positioning system. Removing wind-up causes the motor current to drop to approximately 1 or 2 amps.

   Warning: a condition where the amperage does not drop and the output is greater than half the continuous motor rating when in standby mode has a strong probability of overheating the motor. If allowed to be in this condition for even a couple of hours, it could permanently damage a coil winding.

Additional Tests

Rotary Table Brake Test.

Cycle the brake ON/OFF to verify the brake is not sticking. If the break is sticking, this will cause the motor to burn out.