



## Stepper Motor Reliability

Reliability, within the reasonable life expectation, is a measure of the occurrence of random failures. Many electronic components have virtually no mechanism of failure except such random events for a very long service time. They are therefore often characterized by mean-time-between-failures, the accumulated service for the population between successive failures of two members.

MTTF is a basic measure of reliability for non-repairable systems. It is the mean time expected until the first failure of a piece of equipment. MTTF is a statistical value and is meant to be the mean over a long period of time and large number of units. For constant failure rate systems, MTTF is the inverse of the failure rate. If failure rate is in failures/million hours,  $MTTF = 1,000,000 / \text{Failure Rate}$  for components with exponential distributions.

Since the theoretical failure rates of stepper motors range from 25,000 hours to 13,00,000 hours depending on the temperature, we require a minimum number of samples to test for mttf. The minimum samples for most statistical purposes is set at 24. Since the samples are all homogeneous (they have the same characteristics) the number of samples have to be reduced. Hence 16 samples were put to test.

There were two sets of samples. One set contained the model A-48-42-U23 and the other set contained model B-48-42-U12. They were loaded to 70% of their rated torque. Due to economic considerations, chopper drives were not used and the motors were run on voltage drives drawing more current than rated. The motors were run continuously and all precautions to provide continuous power were taken in the form of full UPS and generator on standby.

We are proud to say that all the motors ran for the full length of the test and did not show any sign of wear. Noise level of operation was the same and the motors maintained a constant temperature level. We are sure that the motors will run longer than the mttf figures that we have established.

The reason for this achievement is our careful selection of all parts and most importantly the winding wires and the bearing. The wires are sourced from the best companies in the world and have been put to a lot of tests before they have been accepted. The bearings are also sourced from reputed companies and their hardness, composition and strength are all tested before being accepted. This process of testing is an integral part of our raw material acceptance procedure. Hence you can be sure of getting a quality product from Precision Motors Private Limited at any time.



## Test Results

### Set I:

No. of Samples = 16 of model A-48-42-U23

Start date = 27.06.00 at 8.30 am.

End Date = 20.08.00 at 9.00 am.

Sample	Temperature (Mean) in °C
1	65.30
2	65.59
3	75.14
4	72.81
5	76.31
6	78.06
7	86.15
8	85.30
9	83.68
10	84.06
11	77.72
12	79.22
13	85.40
14	83.59
15	72.63
16	74.26

Temperatures were recorded every two hours (except on Sundays).

**Remarks:** Samples 9 and 10 stopped running on 02.07.00 around 11.30 am. due failure of the drive chip. The chip was replaced and the motors started running at 2.15pm. Samples 1 & 2 were placed near ventilated area and hence the lower temperatures. The room temperature was 28 °C.

$$MTTF = \frac{\text{No. of samples} \times \text{No. of hours run}}{\text{No. of failures}} = \frac{16 \times 1296}{0} > 20,736 \text{ hours}$$

**Hence the MTTF of model A-48-42-U23 is more than 20,736 hours.**



## Test Results

### Set II:

No. of Samples = 16 of model B-48-42-U12

Start date = 10.01.01 at 10.00 am.

End Date = 05.03.01 at 10.00 am.

Sample	Temperature (Mean) in °C
1	68.5
2	70.2
3	70.3
4	69.5
5	72.4
6	70.1
7	67.3
8	69.5
9	68.2
10	71.4
11	70.3
12	72.3
13	69.4
14	70.8
15	73.5
16	68.4

Temperatures were recorded every two hours (except on Sundays).

**Remarks:** Samples 15 and 16 stopped running on 17.02.01 around 4.00 pm. due failure of the PC that drives it. The PC was fixed and rebooted and the motors started running at 4.25pm. Room temperature was 25°C.

$$\text{MTTF} = \frac{\text{No. of samples} \times \text{No. of hours run}}{\text{No. of failures}} = \frac{16 \times 1344}{0} > 21,504 \text{ hours}$$

**Hence the MTTF of model B-48-42-U12 is more than 21,504 hours.**