Insulation resistance troubleshooting and preventive maintenance guidelines

What’s a good reading?

An insulation resistance measurement, in itself, is not necessarily indicative of anything in particular. As a general rule, the One-Megohm Rule (1MΩ per 1000 volts) is the widely-accepted absolute minimum insulation resistance value for normal electrical equipment.

However, actual minimum acceptable insulation resistance values are based on the type of insulating material being used, and on the physical and electrical characteristics of the equipment being evaluated.

When compared against a previously recorded baseline measurement, or a manufacturer’s factory specification, an insulation resistance measurement may be able to assist you in both troubleshooting and preventative maintenance.

It is strongly recommended that periodic insulation resistance testing is performed, and the measurements are recorded, because persistent downward trends usually indicate that there is something occurring in the system which can prevent optimum performance. It is often a fair warning of impending trouble.
Insulation resistance troubleshooting and preventive maintenance guidelines

<table>
<thead>
<tr>
<th>Baseline*</th>
<th>20 MΩ</th>
<th>40 MΩ</th>
<th>60 MΩ</th>
<th>80 MΩ</th>
<th>100 MΩ</th>
<th>250 MΩ</th>
<th>500 MΩ</th>
<th>750 MΩ</th>
<th>1 GΩ</th>
<th>1.5 GΩ</th>
<th>2 GΩ</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 %</td>
<td>18 MΩ</td>
<td>36 MΩ</td>
<td>54 MΩ</td>
<td>72 MΩ</td>
<td>90 MΩ</td>
<td>225 MΩ</td>
<td>450 MΩ</td>
<td>675 MΩ</td>
<td>900 MΩ</td>
<td>1.35 GΩ</td>
<td>1.8 GΩ</td>
</tr>
<tr>
<td>20 %</td>
<td>16 MΩ</td>
<td>32 MΩ</td>
<td>48 MΩ</td>
<td>64 MΩ</td>
<td>80 MΩ</td>
<td>200 MΩ</td>
<td>400 MΩ</td>
<td>600 MΩ</td>
<td>800 MΩ</td>
<td>1.2 GΩ</td>
<td>1.6 GΩ</td>
</tr>
<tr>
<td>30 %</td>
<td>14 MΩ</td>
<td>28 MΩ</td>
<td>42 MΩ</td>
<td>56 MΩ</td>
<td>70 MΩ</td>
<td>175 MΩ</td>
<td>350 MΩ</td>
<td>525 MΩ</td>
<td>700 MΩ</td>
<td>1.05 GΩ</td>
<td>1.4 GΩ</td>
</tr>
<tr>
<td>40 %</td>
<td>12 MΩ</td>
<td>24 MΩ</td>
<td>36 MΩ</td>
<td>48 MΩ</td>
<td>60 MΩ</td>
<td>150 MΩ</td>
<td>300 MΩ</td>
<td>450 MΩ</td>
<td>600 MΩ</td>
<td>900 MΩ</td>
<td>1.2 GΩ</td>
</tr>
<tr>
<td>50 %</td>
<td>10 MΩ</td>
<td>20 MΩ</td>
<td>30 MΩ</td>
<td>40 MΩ</td>
<td>50 MΩ</td>
<td>125 MΩ</td>
<td>250 MΩ</td>
<td>375 MΩ</td>
<td>500 MΩ</td>
<td>750 MΩ</td>
<td>1.0 GΩ</td>
</tr>
<tr>
<td>60 %</td>
<td>8 MΩ</td>
<td>16 MΩ</td>
<td>24 MΩ</td>
<td>32 MΩ</td>
<td>40 MΩ</td>
<td>100 MΩ</td>
<td>200 MΩ</td>
<td>300 MΩ</td>
<td>400 MΩ</td>
<td>600 MΩ</td>
<td>800 MΩ</td>
</tr>
<tr>
<td>70 %</td>
<td>6 MΩ</td>
<td>12 MΩ</td>
<td>18 MΩ</td>
<td>24 MΩ</td>
<td>30 MΩ</td>
<td>75 MΩ</td>
<td>150 MΩ</td>
<td>225 MΩ</td>
<td>300 MΩ</td>
<td>450 MΩ</td>
<td>600 MΩ</td>
</tr>
<tr>
<td>80 %</td>
<td>4 MΩ</td>
<td>8 MΩ</td>
<td>12 MΩ</td>
<td>16 MΩ</td>
<td>20 MΩ</td>
<td>50 MΩ</td>
<td>100 MΩ</td>
<td>150 MΩ</td>
<td>200 MΩ</td>
<td>300 MΩ</td>
<td>400 MΩ</td>
</tr>
<tr>
<td>90 %</td>
<td>2 MΩ</td>
<td>4 MΩ</td>
<td>6 MΩ</td>
<td>8 MΩ</td>
<td>10 MΩ</td>
<td>25 MΩ</td>
<td>50 MΩ</td>
<td>75 MΩ</td>
<td>100 MΩ</td>
<td>150 MΩ</td>
<td>200 MΩ</td>
</tr>
<tr>
<td>100 %</td>
<td>0 MΩ</td>
<td>0 MΩ</td>
<td>0 MΩ</td>
<td>0 MΩ</td>
<td>0 MΩ</td>
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<td>0 MΩ</td>
<td>0 MΩ</td>
</tr>
</tbody>
</table>

With less than 28 % difference, the equipment is probably still operating acceptably.

If there is a 25 % to 50 % difference, most professionals will recommend additional testing** and inspection to verify proper operation. (Check for potential environmental contamination.)

While equipment may operate at this level for extended periods of time, most professionals would view a change of more than 50 % in insulation resistance as indicative of potential problems somewhere in the system. Additional testing** and diagnostics are highly recommended to ensure continued, uninterrupted operation.

Directions: Determine the applicable baseline measurement for a piece of equipment, take an insulation resistance measurement and trace down the column from the baseline for the closest match to the new reading. Trace left for the % difference and right for guidelines.

* Baseline measurement could be: Manufacturer’s factory specifications for insulation resistance, or the last recorded reading from regularly scheduled preventive maintenance. Resistance values can be affected by environmental conditions (humidity, temperature, particulate matter, etc.). For accurate comparisons, readings should be taken under roughly the same conditions (an inactive motor exposed to moisture may show a lower insulation resistance reading than a dry motor that has been running at normal operating temperature.).

** Additional testing could include: additional insulation resistance testing, inspecting for the presence of moisture, oil, dirt, or other environmental contaminants, temperature measurement, loop impedance testing, advanced motor circuit testing, or other manufacturer’s recommended diagnostics.

Fluke Insulation Resistance Testers
- 1587 Insulation Multimeter P/N 2157271
- 1577 Insulation Multimeter P/N 2157280
- 1550B 5 kV MegOhmMeter P/N 2095847
- 1520 MegOhmMeter P/N 1556892

For additional guidelines on insulation testing in the field, reference these standards:
- IEEE 43-2000 Recommended Practice for Testing Insulation Resistance of Rotating Machinery
- IEC 60034-18 Rotating electrical machines - Part 18: Functional evaluation of insulation systems
- IEC 61557-2 Electrical Safety in Low Voltage Distribution Systems up to 1000 V ac and 1500 V dc

For more information on insulation resistance testing, visit www.fluke.com/2-in-1 or call 1-800-44-Fluke.

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