Management of three phase plugs and sockets

1.0 Incident / Issue

Failure of three phase plugs and sockets used on high powered equipment.

Every year we have a number of failures of these sockets which are used right across our business. Internal cabling in the plug or socket (Connector) becomes discoloured, the insulation is occasionally melted and there are signs of arcing and burning.

![Figure 1 - Heat fused plug and socket](image)

Most failures appear to be when the plugs and sockets are outdoors, connected and disconnected regularly (daily) and supplying high loads like tanker heating, where the operating current is close to the rating of the connector.

2.0 Contributing Factors

The rated current of the typical connector is well below the maximum current, so connector design and construction is not considered to be a factor.

Damage to the connector is usually localised to the terminal block and pins/sleeves, sometimes extending down the cable away from the terminals. There are often signs of arcing in the terminal block.

Internal cable cores sometimes show discolouration suggesting the cables are running at elevated temperatures. This suggests cable sizes may be too small.

Some connectors had moisture ingress and cases were distorted, this suggests the cases are being over-tightened, possibly with power (screw) drivers then heating and cooling may be drawing moisture in.

We believe the primary cause of failure is elevated heat cycling resulting in an incremental loss of contact pressure in the terminal block over time, initially causing arcing then burning and failure.
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3.0 Recommendations

All electrical equipment and installations must be periodically inspected to ensure they are electrically compliant and safe. All tools and equipment undergo a similar assessment when tested and tagged.

3 phase connectors (plugs and sockets) should be opened and inspected as part of scheduled routine preventative/planned maintenance. Use a registered electrician to test at the following frequencies (based on risk assessment process in the test and tag standard):

Three monthly:
- High load circuits / items (operating at greater than 70% of rated current)
- Circuits / items that are located / used outdoors
- Portable equipment and tools that are frequently moved

Six monthly:
- Bench top or heavy equipment in fixed locations in a dry indoor environment e.g. workshops that may be moved

Annually:
- Permanently installed equipment with flexible leads and a connector in a dry indoor environment e.g. workshops

If you aren’t sure check in the Fulton Hogan Electrical Standard or contact our electrical advisor.

Operational
- Ensure the power supply is isolated when connecting and disconnecting leads and equipment,
- Ensure all leads not in use are stored in a cool, dry space,

Maintenance
- Check for any discolouration or signs of heat / burning in terminal block and on the cable,
- Check glands and connector seals and general condition of connector body,
- Check the size of cable is appropriate for the length of cable, minimum size is 6mm²,
- Replace the connector if damaged and torque screws to manufacturers’ specs (replace seal if damaged),
- Replace cable if core size is inadequate – refer to table in 13.2 of Fulton Hogan Electrical Standard for guidance on sizing cables. Do NOT work to cable supplier’s maximum current rating.

4.0 Revision History

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<thead>
<tr>
<th>Date</th>
<th>Author</th>
<th>Brief Description of change</th>
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<tbody>
<tr>
<td>12/12/2017</td>
<td>Ron Gorter</td>
<td>Original document</td>
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