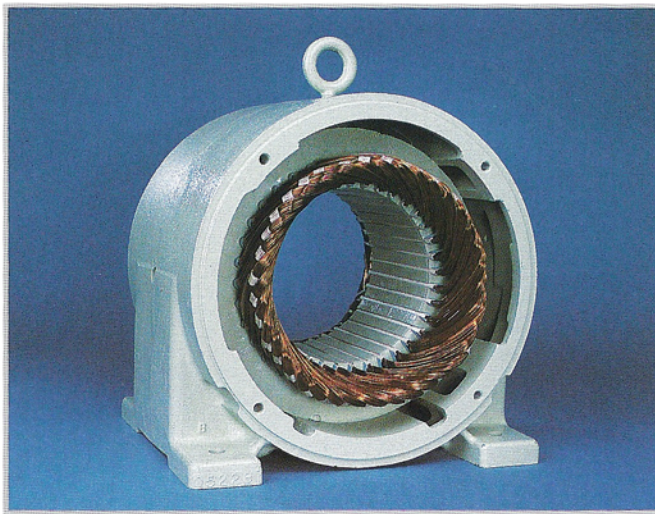
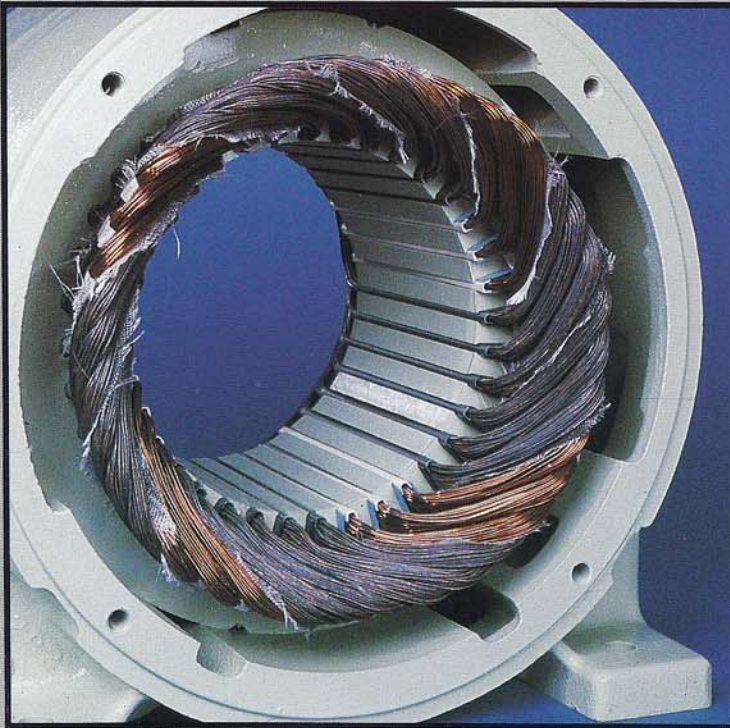


# F

## **FAILURES IN THREE-PHASE STATOR WINDINGS**



# FAILURES IN THREE-PHASE STATOR



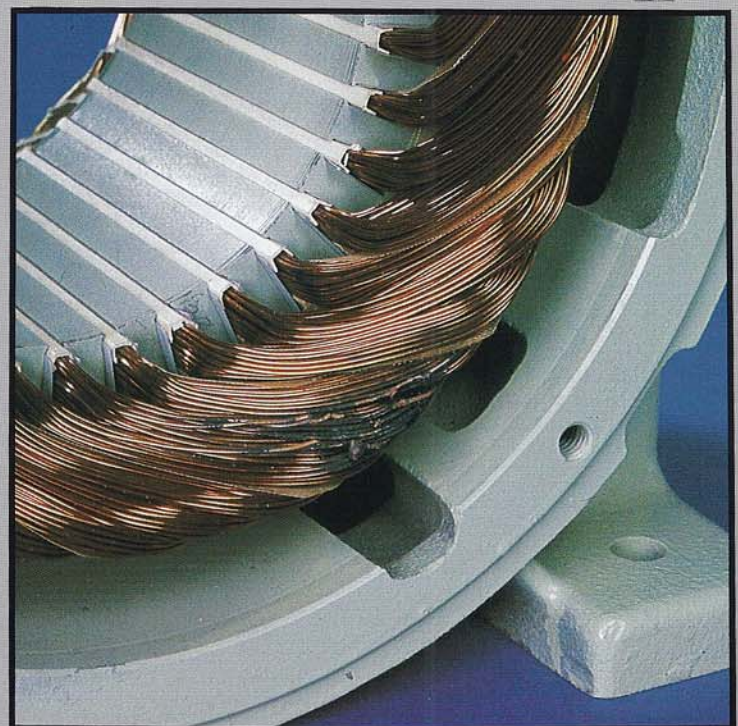
**1** Winding Single-Phased  
(Y - Connected)



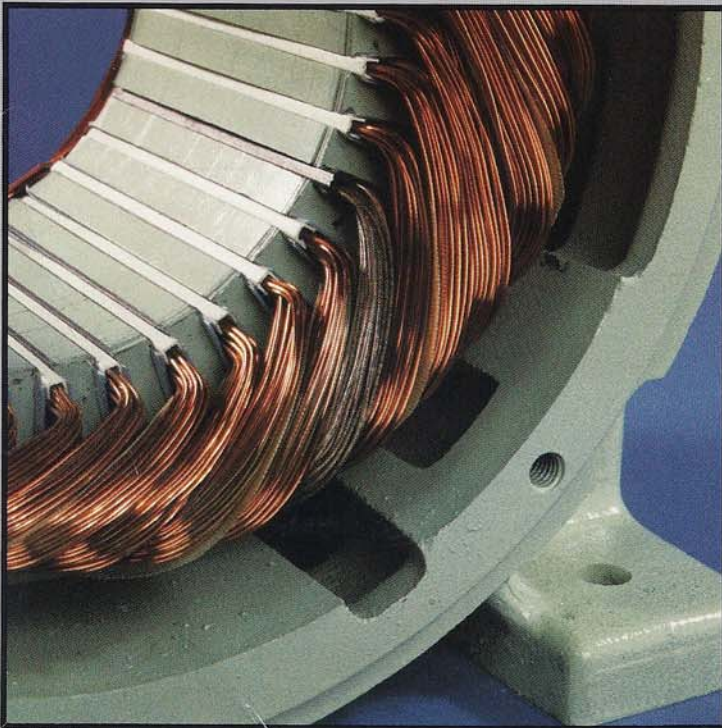
**2** Winding Single-Phased  
( $\Delta$ - Connected)



**3** Winding Shorted  
Phase-To-Phase



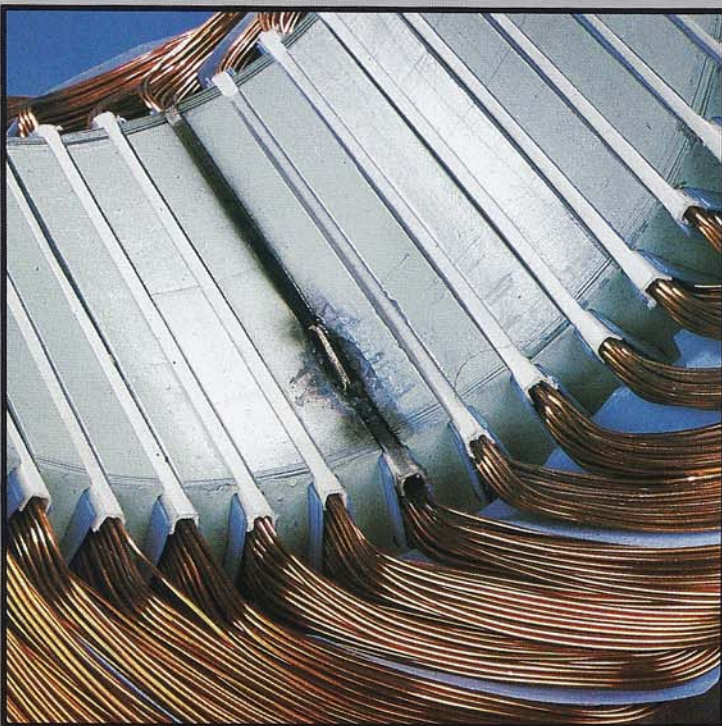
**4** Winding Shorted  
Turn-To-Turn



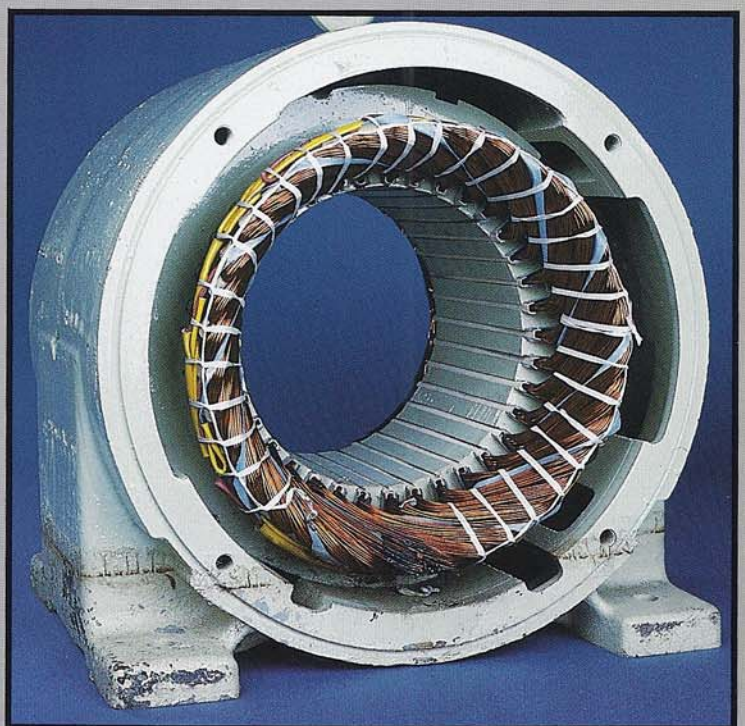
**5** Winding with Shorted Coil



**6** Winding Grounded at Edge of Slot



**7** Winding Grounded in the Slot



**8** Shorted Connection



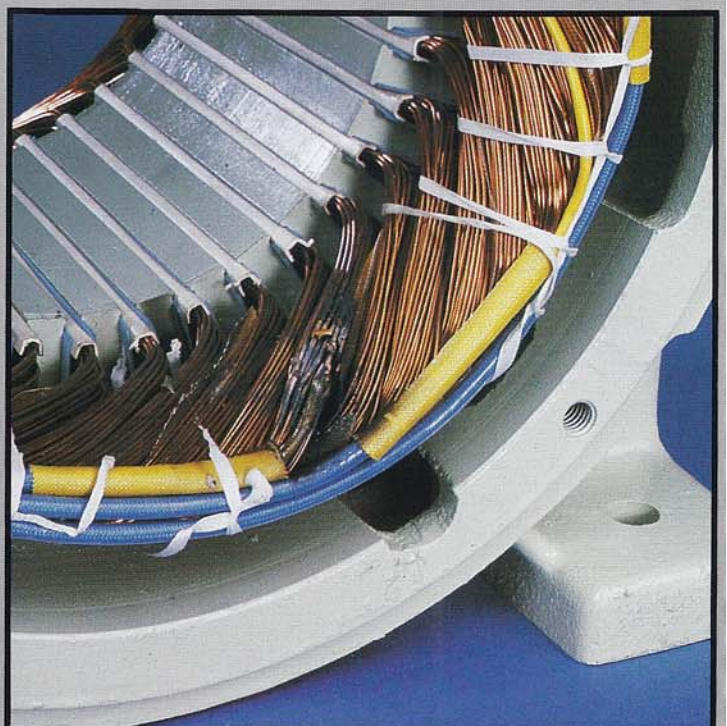
**9** Phase Damage Due to Unbalanced Voltage



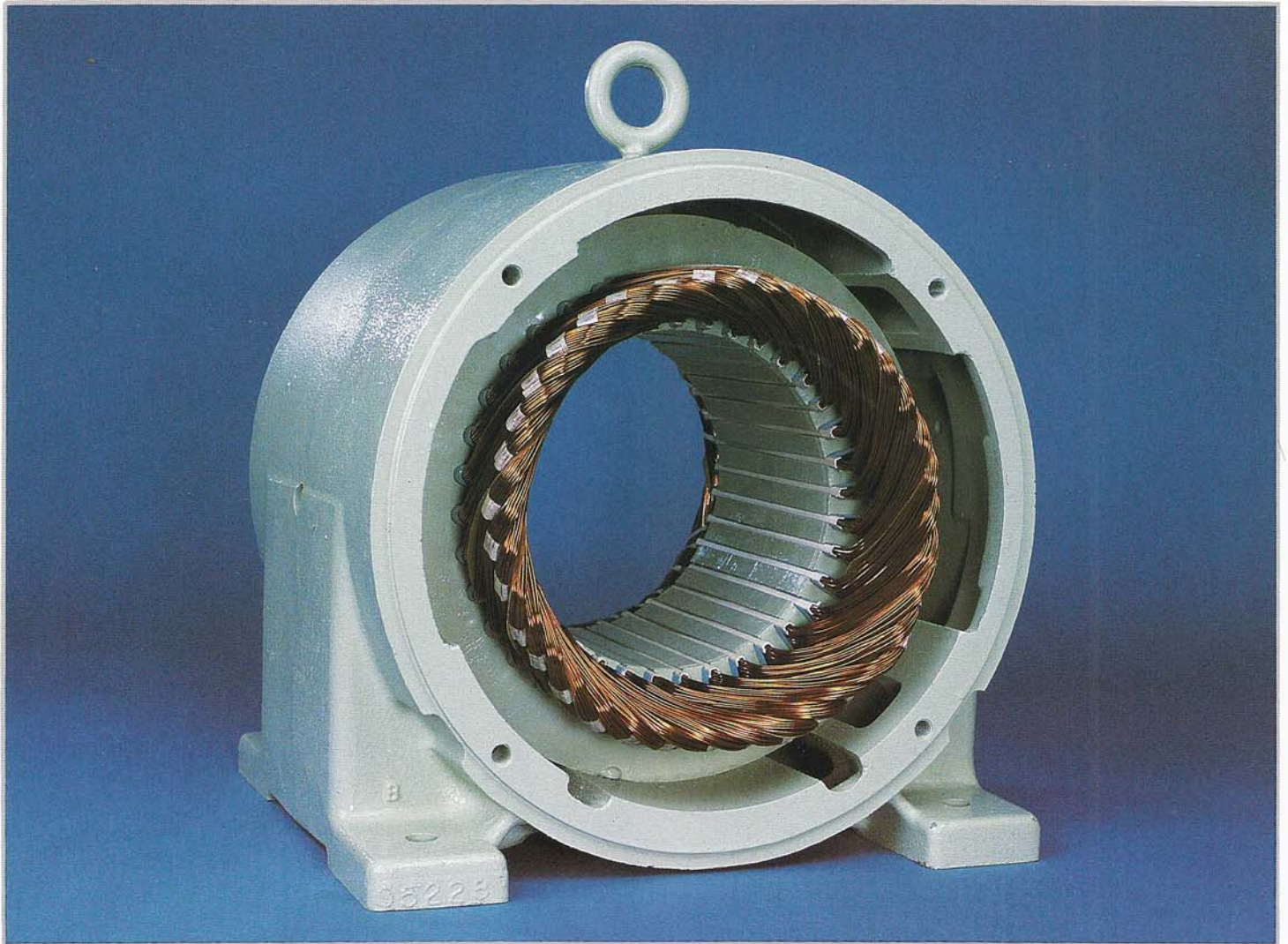
**10** Winding Damaged Due to Overload



**11** Damage Caused by Locked Rotor



**12** Winding Damaged by Voltage Surge



**T**he life of a three-phase stator winding can be shortened dramatically when the motor is exposed to unfavorable operating conditions — electrical, mechanical or environmental. The winding failures illustrated in this brochure are typical of what can happen in such circumstances. They are shown here to help in identifying the causes of failure, so that, where possible, preventive measures may be taken.

**A** new stator winding is pictured above for purposes of comparison with the winding failures shown in Photos 1 - 12. Descriptions of the causes of failure are provided on the back cover.

# TYPICAL CAUSES OF WINDING FAILURES IN THREE-PHASE STATORS

## Photo Number

- 1&2** A single-phased winding failure is the result of an open in one phase of the power supply to the motor. The open is usually caused by a blown fuse, an open contactor, a broken power line or bad connections.
- 3,4,5, 6,7 &8** These photos illustrate insulation failures that typically are caused by contaminants, abrasion, vibration or voltage surge.
- 9** Thermal deterioration of insulation in one phase of the stator winding can result from unequal voltage between phases. Unequal voltages usually are caused by unbalanced loads on the power source, a poor connection at the motor terminal, or a high resistance contact (weak spring).  
NOTE: A one-percent voltage unbalance may result in a six-to ten-percent current unbalance.
- 10** Thermal deterioration of the insulation in all phases of the stator winding typically is caused by load demands exceeding the rating of the motor.  
NOTE: Under-voltage and over-voltage (exceeding NEMA standards) will result in the same type of insulation deterioration.
- 11** Severe thermal deterioration of the insulation in all phases of the motor normally is caused by very high currents in the stator winding due to a locked rotor condition. It may also occur as a result of excessive starts or reversals.
- 12** Insulation failures like this usually are caused by voltage surges. Voltage surges are often the result of switching power circuits, lightning strikes, capacitor discharges and solid-state power devices.



Prepared by: **Engineering Committee**  
**Electrical Apparatus Service Association, Inc.**  
1331 Baur Boulevard  
St. Louis, Missouri 63132  
(314) 993-2220