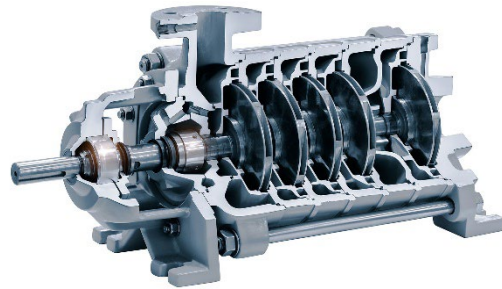


# Centrifugal Compressors

## Common Failure Modes and Preventive Actions



Centrifugal compressors are used in various industrial applications to increase the pressure of gases or air. Like any mechanical equipment, they can fail due to various reasons. Here are some common failure modes of centrifugal compressors and preventive measures to avoid them:



### 1. **Bearing Failure:**

- **Causes:** Overloading, misalignment, inadequate lubrication, contamination of lubricants.
- **Prevention:** Regularly monitor bearing condition, perform alignment checks, ensure proper lubrication, and use quality lubricants.

### 2. **Impeller and Blade Damage:**

- **Causes:** Foreign object damage (FOD), erosion, corrosion, cavitation, and fatigue.
- **Prevention:** Install inlet filters and screens to prevent FOD, use erosion-resistant materials, monitor for cavitation, and perform regular inspections.

### 3. **Surging and Choking:**

- **Causes:** Operating the compressor outside its stable operating range, leading to surging (flow reversal) or choking (inlet restriction).
- **Prevention:** Ensure proper compressor selection, control system, and operating conditions to stay within the stable operating range.

### 4. **Vibration and Misalignment:**

- **Causes:** Imbalance, misalignment, structural issues, worn components.
- **Prevention:** Regularly check for vibration, perform balancing and alignment checks, and address any structural issues.

### 5. **Seal and Gasket Failure:**

- **Causes:** Wear and tear, inadequate sealing, thermal cycling.
- **Prevention:** Replace seals and gaskets as needed, use appropriate materials, and maintain proper clearance.

### 6. **Overheating:**

- **Causes:** Inadequate cooling, excessive discharge temperatures.
- **Prevention:** Ensure proper cooling system design and monitor discharge temperatures.

### 7. Corrosion and Erosion:

- **Causes:** Exposure to corrosive gases, abrasive particles in the gas stream.
- **Prevention:** Use materials resistant to corrosion and erosion, install protective coatings, and monitor for signs of wear.

### 8. Operating Beyond Design Conditions:

- **Causes:** Overloading the compressor, exceeding speed limits.
- **Prevention:** Operate the compressor within its design specifications and avoid overloading.

### 9. Inadequate Maintenance:

- **Causes:** Neglecting regular inspections, maintenance, and servicing.
- **Prevention:** Implement a robust maintenance program, conduct routine inspections, and follow manufacturer's maintenance guidelines.

### 10. Contaminated Inlet Air:

- **Causes:** Inlet air with dirt, moisture, or corrosive substances.
- **Prevention:** Install proper filtration and conditioning systems for the inlet air.

### 11. Operational Errors:

- **Causes:** Improper startup, shutdown procedures, or operator errors.
- **Prevention:** Train operators, establish clear operating procedures, and ensure proper supervision.

### 12. Material Fatigue:

- **Causes:** Repeated stress cycles, vibration, and thermal cycling.
- **Prevention:** Choose materials with high fatigue resistance, monitor for signs of fatigue, and perform scheduled inspections.

Preventive maintenance, regular monitoring, and adherence to operating guidelines are crucial in preventing centrifugal compressor failures. Manufacturers often provide detailed maintenance and operational recommendations in their manuals, which should be followed diligently. Additionally, implementing a predictive maintenance program using vibration analysis, thermography, and other condition monitoring techniques can help detect issues before they lead to catastrophic failures.