TECHNICIAN TRAINING MANUAL

Bearing Fault Detection & Analysis

MODULE 1: BEARING FUNDAMENTALS

Rolling element bearings consist of four main components: • Inner race (inner ring) • Outer race (outer ring) • Rolling elements (balls or rollers) • Cage (separator/retainer) Each component has characteristic failure frequencies that can be calculated based on bearing geometry and operating speed.

FAULT FREQUENCY CALCULATIONS

Fault Type	Formula	Typical Range
Outer Race	$BPFO = (N/2) \times (1 - d/D \times \cos \phi) \times RPM$	$0.4 \times RPM$
Inner Race	$BPFI = (N/2) \times (1 + d/D \times \cos \phi) \times RPM$	$0.6 \times RPM$
Ball Spin	$BSF = (D/2d) \times (1 - (d/D \times \cos \phi)^2) \times RPM$	$2\text{-}5 \times RPM$
Cage	$FTF = (1/2) \times (1 - d/D \times \cos \phi) \times RPM$	$0.4 \times RPM$

MODULE 2: DIAGNOSTIC TECHNIQUES

VIBRATION ANALYSIS:
• Time domain: RMS, peak, crest factor
• Frequency domain: FFT spectrum analysis
• Time-frequency: Envelope analysis, spectrograms
TEMPERATURE MONITORING:
• Infrared thermography
• Embedded temperature sensors
• Trending analysis
LUBRICANT ANALYSIS:
• Particle counting
• Spectrographic analysis
• Viscosity testing