

TABLE I ILLUSTRATED VIBRATION DIAGNOSTIC CHART

PROBLEM SOURCE	TYPICAL SPECTRUM	PHASE RELATIONSHIP	REMARKS
MASS UNBALANCE A. FORCE UNBALANCE			Force unbalance will be in-phase and steady. Amplitude tends to increase with increase in the square of speed below first critical up to speed increase of 50% higher vibration. 1X RPM phase constant and usually dominates spectrum. Can be corrected by placement of one or two correction weights in one plane at Force center of gravity (FCG). Approx. 0° phase difference should exist between CIG & 1X vibration, as well as between CIG & 2X vibration. Also, approx. 90° phase difference between horizontal & vertical readings usually exists at each bearing of unbalanced rotor (180°).
B. COUPLE UNBALANCE			Couple UNB also exists at 180° out-of-phase motion on same shaft. 1X RPM always present and normally dominates spectrum. Amplitude varies with square of increasing speed below first critical speed. 180° phase difference exists in at least 2 planes. Note that approx. 180° phase difference should exist between CIG & 1X vibration, as well as between CIG & 2X vibration. Also, approx. 180° difference between 180° horizontal & vertical phase readings at each bearing usually exists (180°).
C. DYNAMIC UNBALANCE			Dynamic Unbalance is the dominant type of unbalance found and is a combination of both force and couple unbalance. 1X RPM dominates the spectrum, and may require 2 plane correction. Note: two radial phase difference between 2 different and radial readings can vary anywhere from 0° to 180° (vertical). The horizontal phase difference should usually match the vertical phase difference, resulting in 0° and 180° readings. Doubling measurements (x200%). Separation of unbalance phenomenon. Roughly a 90° phase difference exists for shafts between the horizontal and vertical readings on each bearing (180°).
D. OVERHUNG ROTOR UNBALANCE			Overhung Rotor Unbalance causes high 1X RPM in both axial and radial directions. Axial readings tend to be in-phase with radial phase readings except for unbalance. However, the horizontal phase difference will usually exist. One axial phase difference on the horizontal (near 180°). Overhung rotors have both force and couple unbalance, each of which will likely require correction. Thus, correction weights will most always have to be placed in 2 planes to counteract both force & couple unbalance.
ECCENTRIC ROTOR			Eccentricity occurs when center of rotation is offset from geometric centerline of a shaft, gear, bearing, motor assembly, etc. Largest vibration occurs at 1X RPM or appears in a direction of rotation or that two planes. Corresponding horizontal and vertical phase readings usually differ either by 0° or by 180° (near 0° indicates centrifugal motion, 180° indicates radial motion). Eccentricity often results in reducing vibration in one radial direction, but increasing it in the other radial direction, depending on amount of eccentricity.
BENT SHAFT			Bent shaft problems cause high axial vibration with phase differences varying between 180° on the same machine components. Dynamic vibration normally occurs at 1X of bent over shaft member, but at 2X if bent over 180°. Coupling the shafts to correct for transducer error before for such axial measurements if you reverse probe direction. Use and evaluate for center bent shaft.
MISALIGNMENT A. ANGULAR MISALIGNMENT			Angular Misalignment is characterized by high axial vibration, 180° axial phase across the coupling. Usually will have high axial vibration over 2000 1X and 2X RPM. However, not unusual for other 1X, 2X, or 3X to dominate. These conditions may also indicate coupling problems as well. Some angular misalignment may exist in 1X, 2X, 3X, 4X, 5X, 6X, 7X, 8X, 9X, 10X, 11X, 12X, 13X, 14X, 15X, 16X, 17X, 18X, 19X, 20X, 21X, 22X, 23X, 24X, 25X, 26X, 27X, 28X, 29X, 30X, 31X, 32X, 33X, 34X, 35X, 36X, 37X, 38X, 39X, 40X, 41X, 42X, 43X, 44X, 45X, 46X, 47X, 48X, 49X, 50X, 51X, 52X, 53X, 54X, 55X, 56X, 57X, 58X, 59X, 60X, 61X, 62X, 63X, 64X, 65X, 66X, 67X, 68X, 69X, 70X, 71X, 72X, 73X, 74X, 75X, 76X, 77X, 78X, 79X, 80X, 81X, 82X, 83X, 84X, 85X, 86X, 87X, 88X, 89X, 90X, 91X, 92X, 93X, 94X, 95X, 96X, 97X, 98X, 99X, 100X.
B. PARALLEL MISALIGNMENT			Parallel Misalignment has similar vibration symptoms to angular, but shows high axial vibration which approx 90° 180° out-of-phase with coupling. 2X often larger than 1X, this is helpful feature for 1X is often, instead of by coupling type and construction. Symptom when Angular or Parallel Misalignment exists, 180° phase difference in amplitude peaks at much higher harmonics (2X-10X), depending on tolerance of shaft between or between similar in appearance to mechanical misalignment. Coupling type and material will often greatly influence the axial spectrum when misalignment is severe. Does not typically have radial noise from.
C. MISALIGNED BEARING COCKED ON SHAFT			Overhung bearing will generate unbalanced axial vibration. 180° phase between 180° phase shift top to bottom and across to side as measured in disk direction on same bearing housing. Attempts to align bearing to improve the noise will not always produce. Bearing usually must be removed and correctly refitted.
RESONANCE			Resonance occurs when a forcing frequency coincides with a system natural frequency, and can cause dramatic amplitude amplification, which might result in structural failure. This may be a natural or forced resonance of the rotor, but can also originate from support frame. Resonance peaks occur even after the 1st critical speed is reached, and the 2nd critical speed is reached. The 1st critical speed is reached when the forcing frequency is equal to the natural frequency. The 2nd critical speed is reached when the forcing frequency is equal to the natural frequency. The 3rd critical speed is reached when the forcing frequency is equal to the natural frequency. The 4th critical speed is reached when the forcing frequency is equal to the natural frequency. The 5th critical speed is reached when the forcing frequency is equal to the natural frequency. The 6th critical speed is reached when the forcing frequency is equal to the natural frequency. 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compressors and steam turbines for use in the chemical and process industry is highly interdisciplinary The success of a project is determined by a number of areas of knowledge from mechanical electrical materials and control engineering knowledge to thermodynamics fluid mechanics and strength theory through to project management and quality control In this guide the individual steps are presented along the chronological chain together with the basic decisions and pitfalls that need to be taken into account The work is limited to custom built machines that are specially optimized for a specific process and to gases and vapours as conveying media It is presented from the operator s point of view with a focus on high system availability safety and favorable conditions for maintenance and servicing **The Shock and Vibration Digest** ,1993

U.S. Coast Guard Systems Times ,2002 Scientific and Technical Aerospace Reports ,1995 Lists citations with abstracts for aerospace related reports obtained from world wide sources and announces documents that have recently been entered into the NASA Scientific and Technical Information Database Nonlinear Structures & Systems, Vol. 1 Matthew R.W. Brake,Ludovic Renson,Robert J. Kuether,Paolo Tiso,2025-08-07 Nonlinear Structures Systems Volume 1 Proceedings of the 42nd IMAC A Conference and Exposition on Structural Dynamics 2024 the first volume of ten from the Conference brings together contributions to this important area of research and engineering The collection presents early findings and case studies on fundamental and applied aspects of Nonlinear Dynamics including papers on Experimental Nonlinear Dynamics Jointed Structures Identification Mechanics Dynamics Nonlinear Damping Nonlinear Modeling and Simulation Nonlinear Reduced Order Modeling Nonlinearity and System Identification **Framework for cumulative risk assessmentexternal review draft** ,2002 **Building Pathologies and Acoustic Performance** João M. P. Q. Delgado,2021-04-23 This book presents recent research works related to salt attack and corrosion in concrete structures durability and service life in concrete non destructive techniques applied to reinforced concrete structures and acoustic performance of buildings It identifies anomalies that affect the acoustic performance and the concrete structures namely anomalies associated to salt

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European Workshop on Structural Health Monitoring Piervincenzo Rizzo,Alberto Milazzo,2022-06-21 This volume gathers the latest advances innovations and applications in the field of structural health monitoring SHM and more broadly in the fields of smart materials and intelligent systems as presented by leading international researchers and engineers at the 10th European Workshop on Structural Health Monitoring EWSHM held in Palermo Italy on July 4 7 2022 The volume covers highly diverse topics including signal processing smart sensors autonomous systems remote sensing and support UAV platforms for SHM Internet of Things Industry 4 0 and SHM for civil structures and infrastructures The contributions which are published after a rigorous international peer review process highlight numerous exciting ideas that will spur novel research directions and foster multidisciplinary collaboration among different specialists

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CIM Bulletin Canadian Institute of Mining and Metallurgy,1974 **Bridge Safety, Maintenance, Management, Life-Cycle, Resilience and Sustainability** Joan Ramon Casas,Dan M. Frangopol,Jose Turmo,2022-06-27 Bridge Safety Maintenance Management Life Cycle Resilience and Sustainability contains lectures and papers presented at the Eleventh International Conference on Bridge Maintenance Safety and Management IABMAS 2022 Barcelona Spain 11 15 July 2022 This e book contains the full papers of 322 contributions presented at IABMAS 2022 including the T Y Lin Lecture 4 Keynote Lectures and 317 technical papers from 36 countries all around the world The contributions deal with the state of the art as well as emerging concepts and innovative applications related to the main aspects of safety maintenance management life cycle resilience sustainability and technological innovations of bridges Major topics include advanced bridge design construction and maintenance approaches safety reliability and risk evaluation life

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