cone. Additional ones considered are splined shaft with end lock nut, tapered bore (keyless or interference fit with keyway). The concluding section considers proper interference fits for hydraulically installed hubs and threaded shaft end connections.

Chapter 4 details the necessary preparation for alignment. The author stresses his philosophy. The absolute "must" that he promulgates reduces the time necessary to perform an alignment or an increase in accuracy of alignment between shafts for improved equipment operation. Important features to be remembered are (*a*) measurement of alignment bracket sag, (*b*) measurement of shaft or coupling, (*c*) shaft runout, (*d*) proper rotation of shaft, and (*e*) correct mounting of a dial indicator.

Chapter 5 reports on methods for measuring misalignment in rotating machinery. Dial indicators are a "must" and one should not rely solely upon a pocket rule. The most widely used and oldest is the dial indicator, i.e., fact-peripheral. Its advantages are overshadowed if the rotor has hydrodynamic thrust bearings due to axial float. The reverse indicator method increases its popularity as time goes by. It has an advantage over face peripheral as to thrust bearings. If the distance between two shafts are very long, recourse must be made to the shaft to coupling spoon method. The book furnishes extensive tips in acquiring good alignment readings. The next generation of alignment measuring systems are (*a*) optalign (laser-optic measurement system), and (*b*) linear shaft to shaft alignment instrument.

Chapter 6 details in precise fashion, the procedure in using the instruments stated in the previous chapter. Interpretation of dial indicator instruments are a definite requirement. Trial and error methods are out. A definite need exists in reading the newer types of instruments stated in previous chapters. Mathematical equations are explained in this chapter and should be used for alignment purposes. The procedure for proper graphing is a prime necessity for positions of both the driver and the driven. The author stresses the importance of applying the graphical calculator when employing the shaft to coupling spool method.

The next chapter focuses upon measuring thermal movement of rotating machinery. The former is an important quantity since misjudgment and lack of proper measurement could cause a rough running machine and possible machine downtime. The book states the simple mathematical equations for determining an increase in length due to temperature rise from the cold conditions. An important tool used in determining thermal profile of rotating machinery is the infrared photographic method. Machinery movement can be measured by (*a*) inside micrometer and bevel protractor, and (*b*) optical tooling. The latter is a most versatile piece of equipment. Check the calibration before performing any test (PEG test). Optical or laser alignment should be utilized by personnel doing precise thermal movement determination on rotating equipment. Another important instrument system for measuring changes in distances of shaft is the proximity probes. Two proper mounting techniques are (*a*) water cooled pipe stands, and (*b*) Dodd alignment bars. To compensate for thermal movement, accurate measurements must be collected and analyzed. Now the machine elements can be properly positioned during the dial indicator alignment. The book goes into great detail, replete with mathematical equations and means of compensating for dynamic movement. Detailed sample problems explain the procedure.

Chapter 8 tells us how to carefully move machinery in the field, i.e., axial spacing, lateral (sideways) movement, and vertical movement. Types of movement tools are (*a*) hammer, (*b*) wedges, (*c*) pry and crowbar, (*d*) comealing and chainfuls, (*e*) hydraulic jacks, and (*f*) permanent jackscrew (most preferred method but very costly). Chapter 9 covers proper alignment tolerances plus the requirement of staying within the acceptable misalignment bands. Frequently, well aligned equipment could face problems with lightly loaded shafts in plain hydrodynamic bearings. This causes a whirl phenomena. Misalign the equipment only enough to prevent instability.

The concluding chapter ferrets out the misalignment in rotating machinery. Vibration could cause havoc with the equipment. One should perform a thorough examination (eyes, ears, and touch) of the rotating equipment prior to taking vibration data. If possible, a one/rev signal and phase angle should be taken. If indications show that the amplitude levels are high, a spectrum analyzer should be used in determining the vibration signature of the gear (equipment). The author provides a detailed case history of a combined pump and motor. The book points out other misalignment vibration signatures (one/rev, two/rev, four/rev). In misaligned drive trains, there is a recurring pattern in the vibration spectrum that exhibits multiples of running speeds (harmonics).

In summary, this is an informative book. The reviewer feels that a more detailed discussion of vibration analysis, signature and spectrum analyses is in order. No mention is made of turbine or compressor blading. On rare occasions, they can be one of the contributing factors to misalignment. The reviewer recommends this book to those wanting to get an insight into misalignment of rotating machinery.

**Notes on Vibration Frequency Analysis,**
K. G. McConnell,
Published by Society for Exp. Mechanics,
70 pages.

This is not just another book on vibration frequency analysis. It is a book written by a mechanical engineer for mechanical engineers. It is devoid of any advanced type of mathematics. This book is for simple reading and acts as an introduction to the subject. It attempts to teach the neophyte, as well as the more knowledgeable, in a short time, the fundamentals and how they can be applied in the interpretation of random vibration data.

Chapter 1 introduces the subject of frequency analysis and describes in general terms the signal time history and its frequency spectrum. Chapter 2 introduces the basic concepts for a sinusoidal analysis (mean, mean square, root mean square, rms amplitude, and transfer function), periodic time histories with the attendant introduction to Fourier series in periodic time histories. Examples of frequency spectrum and Fourier series are furnished. This continues with transient time histories. Beginning with its definition, it progresses to examples of periodic time histories becoming a time history plus comparison of Fourier series and Fourier transform frequency components. The concluding section of this chapter provides a good introduction to its basic description. This then extends the theory to mean square power spectral density (psd) and autocorrelation. This ends with a description of the transfer function in random process.

Chapter 3 focuses upon an analogue frequency analyzer. The various components embrace tuneable filter, squaring circuit, time averaging, and a recording device. The filter may be constant percentage bandwidth or constant bandwidth. The time averaging can be accomplished by means of an RC type of electrical filter with hints as to its proper use. The output recording device may be a linear or logarithmic type. The latter is more preferred in actual service due to its ability to cover a large dynamic bandwidth. Forging ahead, we encounter periodic frequency spectrum and a simple but meaningful description of frequency resolution. The chapter concludes with an interesting discussion of the meaning of spectra, errors and methods of determining analysis time plus the manner in locating a sinusoidal in a random signal. An interesting chapter that should be read carefully.

Chapter 4 covers the preliminary aspects of digital frequency analyzers. Starting with the time sampling process, this marches forth into double Fourier transforms and convolutions, aliasing of data and use of window functions (rectangular and Hanning) as a filter. The Fourier series is the foundation. Employing this, we next encounter spectrum averaging, periodic time histories, transient time histories (rectangular window must be used). The latter section describes a number of suggestions as to RPM rotating machine, proper display of calibration setting and means of deleting background noise. The concluding chapter mentions very briefly the modal analysis employing a uniform beam and free-free beam (showing mode shapes). The author reports on examples showing how one could solve field problems of equipment by proper interpretation of the frequency spectrum. This includes vibration measured on a boiler feedpump, motor in a coal pulverizer, excessive vibration in a 120 ft. chimney, balancing of rotating equipment and oil whip in journal bearing. The little tome concludes with a short discussion of the Mathieu equation and its application to slight nonlinear problems in mechanical systems.

In summary, this is an excellent little volume. It is fascinating and yet simple to comprehend. However, the reviewer believes that the following topics should have been included (*a*) Fast Fourier Transform and its application to data processing, (*b*) an introduction to filter theory, (*c*) coherence and partial coherence, and (*d*) cross spectrum and cross correlation. The reviewer does recommend this book to the neophyte as well as one versed in some aspects of data processing.

**Fundamentals of Noise Control Engineering,**
A. Thumann and R. K. Miller,
Fairmount Press, P. O. Box 14227, Atlanta, GA 30324,
1986, 287 pages, $36.00.

"Unwanted" noise abounds within our midst. It is ever prevalent; this book attempts to develop the skill of the reader. Here, one begins and puts in place a meaningful program to control noise. If the noise engineer is a novice, the book's intention is to elevate his basic knowledge to a high enough degree. This grants one an understanding of noise control in the workplace. It allows one to begin more advanced study in books on noise control. This permits him to understand the available periodicals dealing with noise control. As stated by the authors, "Much of the noise control referenced in the text was legislated in the 1970's. Today, OSHA no longer enforces engineering controls to meet the law . . . . We are aware of the detrimental impact of excessive noise on their health. Communities are also demanding an acceptable acoustic environment." With the authors intent in mind, the book fulfills most of the major goals but slips in other ways.

The book contains 10 chapters.

Chapter 1 stresses the importance of noise control. Undesired noise can cause hearing loss, workmen's compensation and "environmental noise." The Williams-Steiger Occupational Safety and Health Act of 1970 refers to protection of workers from potentially hazardous occupational noise. The stipulated maximum noise level is 900 dbA for a continuous 8 hour exposure during a working day. Noise control in new plant design is extremely important and care must be taken. They are (*a*) cost consideration, (*b*) technical proficiency, and (*c*) adherence to schedule.

Chapter 2 explains propagation of sound, its intensity and power expressed in decibels. The book explains the various noise formulas in either English or metrical systems. Noise levels may be stated in either octave or 1/3 octave bands. Present day practice considers 3 weighing networks, i.e., $A$, $B$, $C$. Community noise may be stated by a formula for equivalent sound level ($L_{eq}$) or day-night sound levels ($L_{dn}$). An interesting example determines the sound pressure level of a specific property containing various pieces of noise producing equipment.

Chapter 3 focuses upon noise control criteria in occupational areas with resultant employee exposure, interior spaces (offices, conference rooms) and communities near the plant. OSHA noise standard permits higher noise levels at different times. The noise dose is based on ($S$ noise level/specified time) and must not be greater than one. As stated in the previous chapter, loss of hearing can result in cost considerations plus money awarded to the individual with this deficiency. A hearing conservation program is in order and the acceptable noise control ($NC$) curves can act as a good guide. A number of government agencies promulgated various noise standards applied to their particular forté. In addition, all states but Alaska have enacted noise control regulations. The community reaction to noise plays an important role and has been plotted in graphs. The most prominent symbol is dbA.

Chapter 4 reports on noise source criteria. The various noise sources are (*a*) various types of fans, (*b*) cooling tower, (*c*) pumps and hydraulic systems, (*d*) motor and/or gears, (*e*) compressors, (*f*) chiller, (*g*) transformers, (*h*) gas control valve, (*i*) vent, (*j*) air (fluctuating pressures), and (*k*) machine vibrations. Each has its particular quirks and mathematical expressions. The next chapter explains outdoor sound propagation. The equivalence of total surface area receiving the noise plus directivity factors are derived. This is employed in determining the $h_p$ (increase/decrease). In continuing, we determine the sound pressure level due to the effect of near and far atmospheric conditions, directivity due to exhaust stack, fans, transformers, and vents. This is combined in a resulting sound pressure level by summing up all sources. Chapter 6 continues with propagation of sound indoors. The sound absorption coefficient, $a$, is determined and use is made of absorption coefficient test standards. The room constant, $R$, is stated in terms of $a$ and the respective area. It is then related to sound pressure levels indoors. The next topics consider sound transmitted through ducts, effect of turning vanes on duct noise, and sound radiated through fan casing and duct. The chapter concludes with the determination of noise levels of indoor transformers utilizing NEMA transformer rating.

Chapter 7, the lengthiest, covers acoustical barriers and enclosures. The sound transmission loss of partitions, respective transmission coefficient, and statement of ASTM sound transmission class opens the chapter. Noise reduction coefficient (NRC) is the single number rating description of absorption materials. The well known mass low of acoustics is stated with relation to stiffness controlled and resonance section plus the octave coincidence controlled section. The book jogs along in estimating the transmission loss for single and double panels and the respective air space sound absorption of double panel construction. The next topic determines the average transmission loss coefficient ($t$) for composite walls. The book applies this to the design of an employee enclosure and methods of calculation. This includes machine enclosures, partial enclosures, complete enclosures with application to a