Computerized Prediction of
Press Bearing Failure
by Anders Sundberg*

Herzian Region

According to Herzian theory, load on a bearing causes elastic deformation of the elements in the contact area, which gives a smooth elliptical stress distribution. Real bearing surfaces are not perfectly smooth, and the actual stress distribution in the contact area will be affected by the random appearance of surface asperities. (See Figure 1)

Stress Waves

The random interaction of surface asperities at the interfaces in an operating roller bearing generate transient stress waves (shock pulses) in the bearing material. (See Figure 2)

Effect of Lubricant on Stress Distribution

The lubricant film on a bearing surface has a dampening or smoothing effect on the stress distribution in the Herzian contact region. The thicker the lubricant film, the greater the dampening effect on the stress distribution and the lower the strength of the shock pulses emitted. (See Figure 3)

Transducer Theory and SPM Method

Transducers detect high frequency transients at the resonant frequency of the transducer and convert these random transients into standard harmonic frequencies. The highest sensitivity is achieved when the transducer resonant frequency is confined to a narrow band.

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Shock pulses generated at the contact area can be detected with a transducer with a pre-determined resonant frequency, this is the SPM Shock Pulse Method. The development at SPM of a transducer with a very narrow resonant frequency band provides our instrument with superior signal to noise ratio. (See Figure 4)

Bearing Operating Condition

Bearing operating condition is determined by the surface finish of the bearing and the thickness of the lubricant film. The surface finish determines the height and number of asperities. The lubricant film thickness will determine whether or not those asperities will be fully separated. These two parameters can and will vary during the lifetime of the bearing. Asperities can be smoothed or rounded during the running-in period, film thickness will vary with lubricant supply rate and other external parameters. The service life of a bearing is determined only by these internal operating conditions; the lubricant film thickness and bearing surface finish which are variable, and the quality of the bearing steel which does not change. (See Figure 5)

Oil Film Thickness Influences Bearing Life

By analyzing size and occurance rate of shock, the oil film thickness of a bearing can be measured. The oil film thickness is directly related to fatique life of the bearing. (See Figure 6)

Shock Pulse Method Enables Early Bearing Detection

Consequently by measruing the oil film thickness, bearing life can be extended by early corrections.

Bearing damage can be followed from an early stage until the time of replacement. This enables long pre-warning time of failure. (See Figure 7)

Computerized Monitoring System

Refine measurements of bearing condition can be taken by hand held instrumentation or by continuous monitoring systems. (See Figures 8A & 8B)

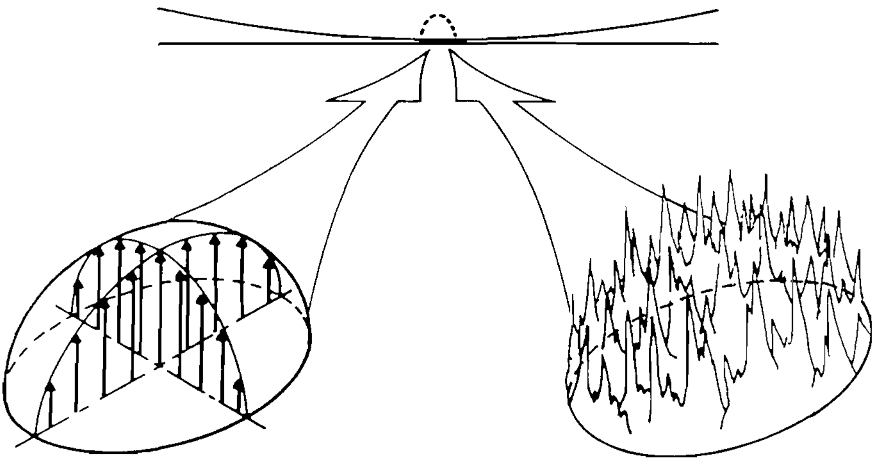


FIGURE 1

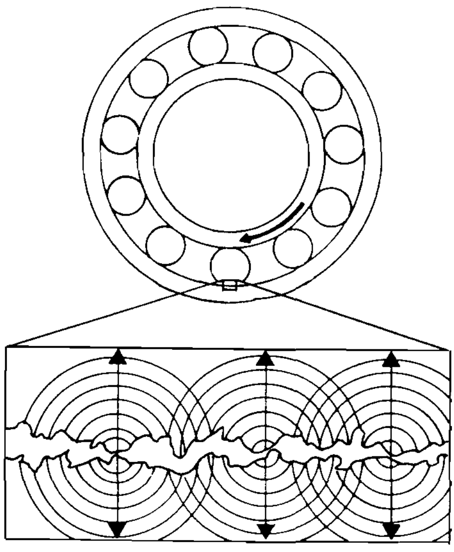


FIGURE 2

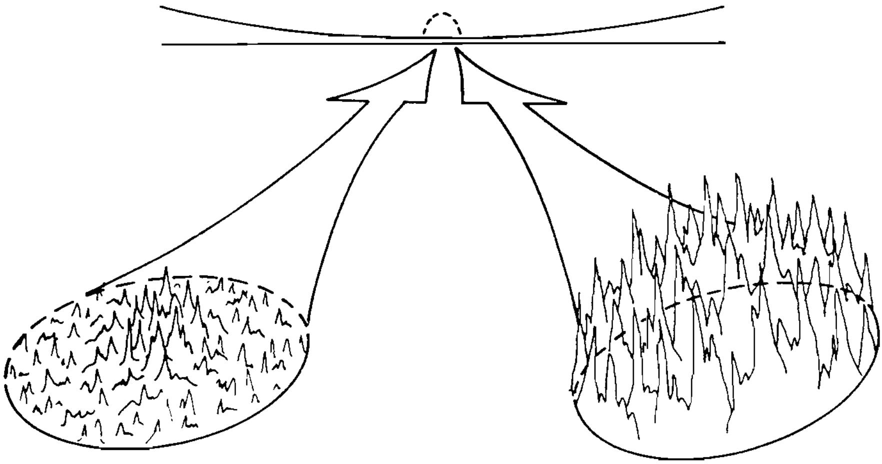


FIGURE 3

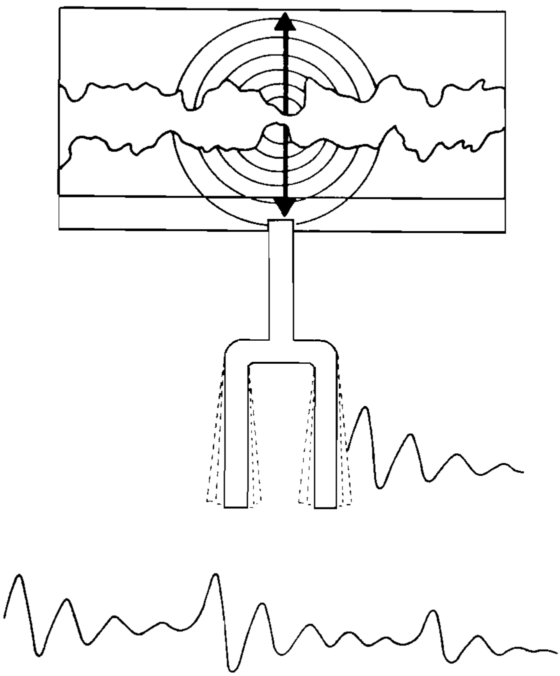
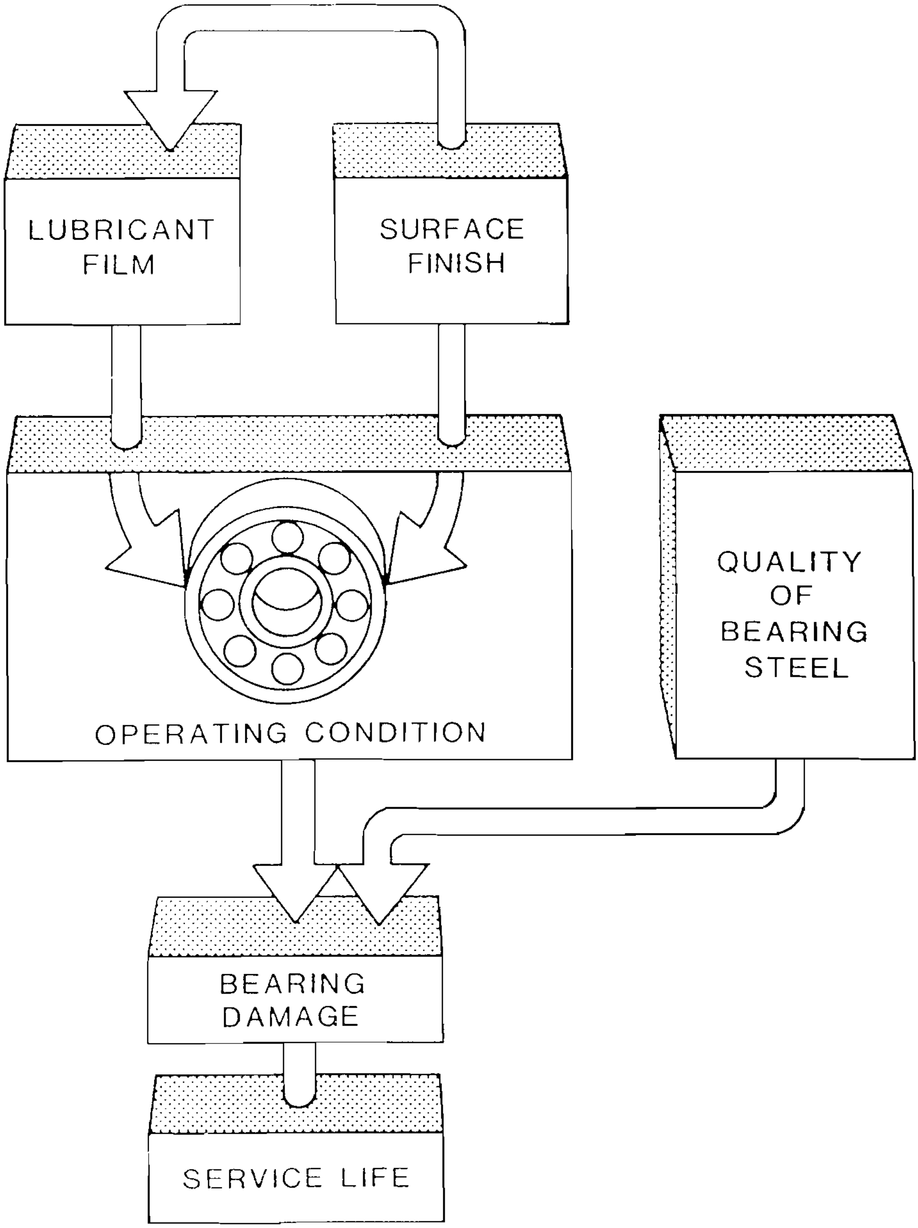
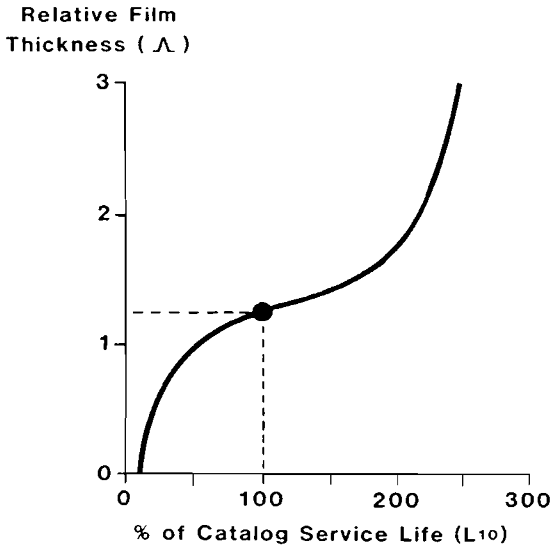


FIGURE 4

FIGURE 5


LUBRICANT
FILM
SURFACE
FINISH
OPERATING CONDITION
QUALITY
OF
BEARING
STEEL
BEARING
DAMAGE
SERVICE LIFE



$$\frac{\text{Lubricant Film Thickness}}{\text{Composite Surface Roughness}} = \Lambda$$

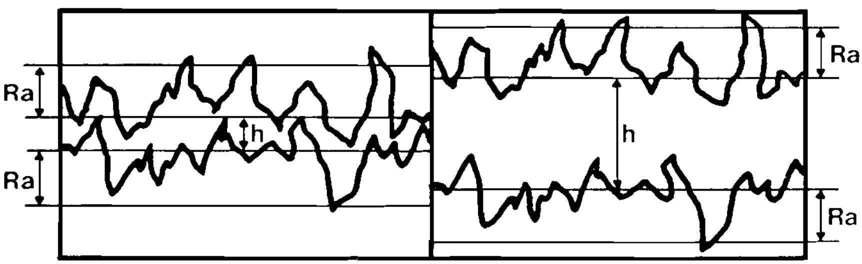


FIGURE 6

COND. No. < 30	Minor damage
COND. No. 30 to 45	Damage in progress
COND. No. > 45	Severe damage

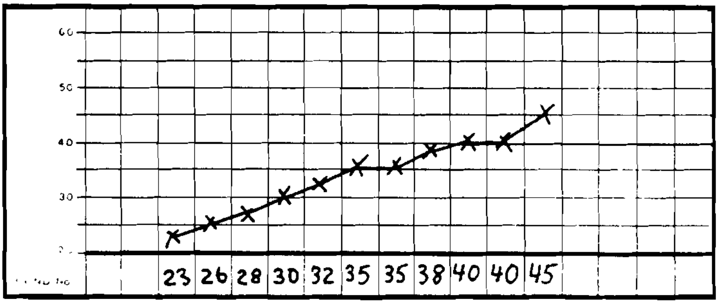


FIGURE 7

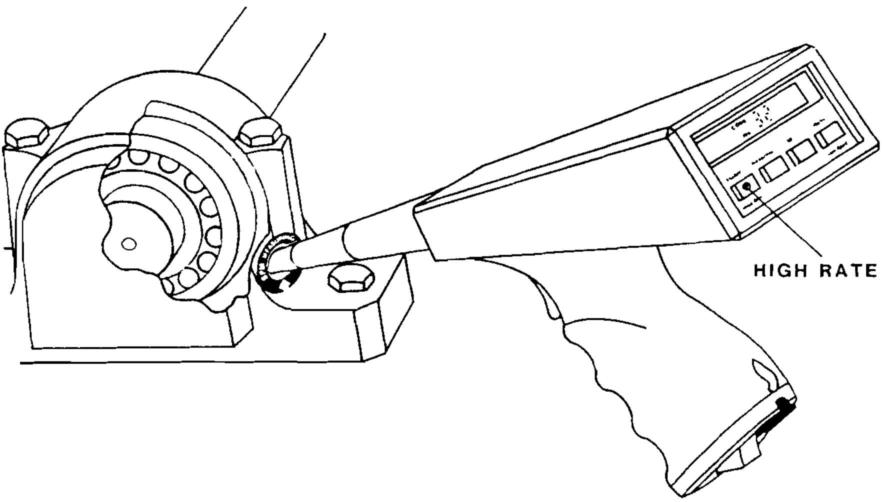
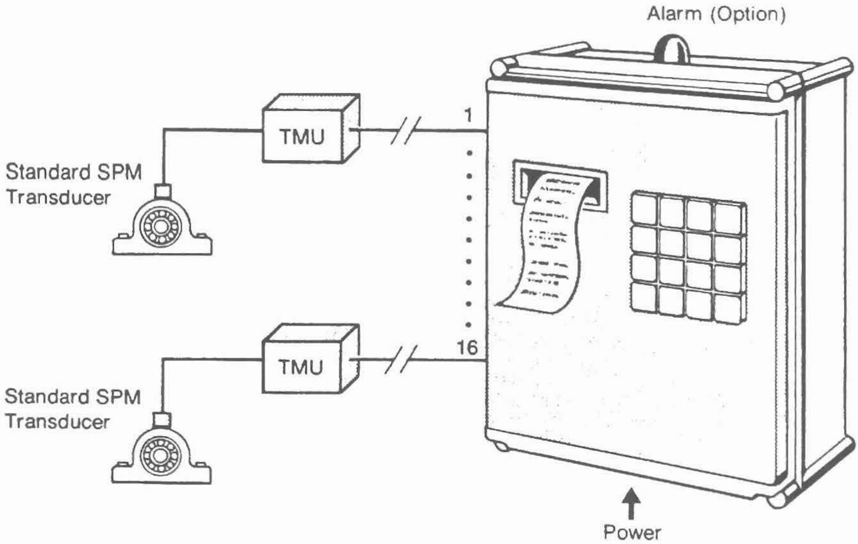


FIGURE 8A

Minimum Bearing Monitoring System



Maximum Bearing Monitoring System

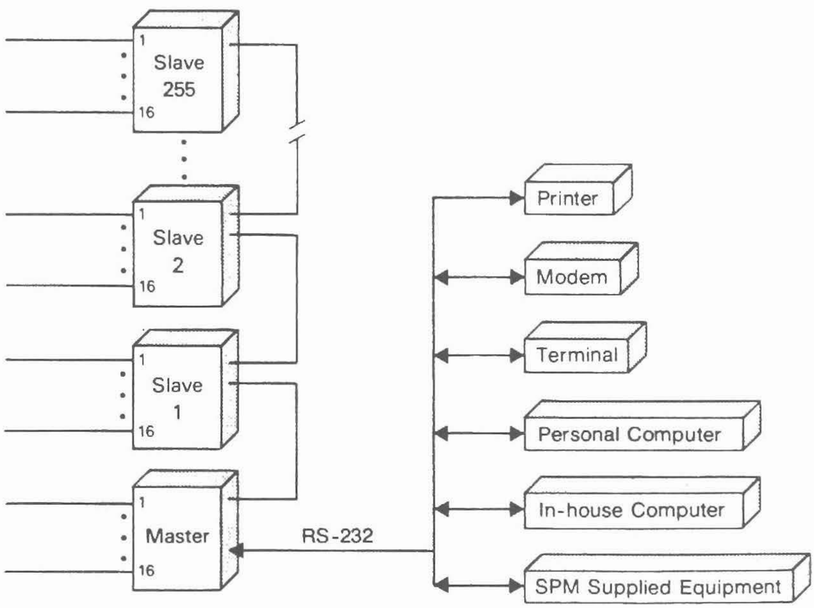


FIGURE 8B