This is a sample of the PowerPoint on Industrial Reliability and Maintenance Management, available at http://www.bin95.com/PPT-Powerpoints/reliability/Reliability-and-Maintenance-Management.htm

Hello, and welcome to the first of our PowerPoint presentations to help you to understand and start to master plant and equipment reliability and maintenance management.

Most people think maintenance is involved with looking after machinery and infrastructure. But the truth is maintenance is about building more reliable and productive businesses. Maintenance is best managed from the perspective of how to use maintenance to maximise the profits of a business. Seen from this light, maintenance becomes a profit centre, that makes money by the amount of savings and additional revenue it brings to the business.

Maintenance makes money by improving the way plant and equipment operate. Particularly by reducing production plant stoppages and slowdowns through removing the causes of equipment failures and improving machinery so it runs more reliable, at full capacity, for longer.

Reliability is manageable by changing the practices used in design, assembly, operation and maintenance. All of these factors are in the control of a business and there is no reason every business cannot make more money from the way they manage their production assets.

Disclaimer

This presentation is intended to help Users improve their knowledge of the topic. It aids, but does not replace the education, training, skills and experience needed to be competent in the topic.

Many concepts have been intentionally oversimplified to explain the fundamentals, or to make a particular point. No responsibility can be accepted for adverse consequences of using the information contained or implied within the presentation.

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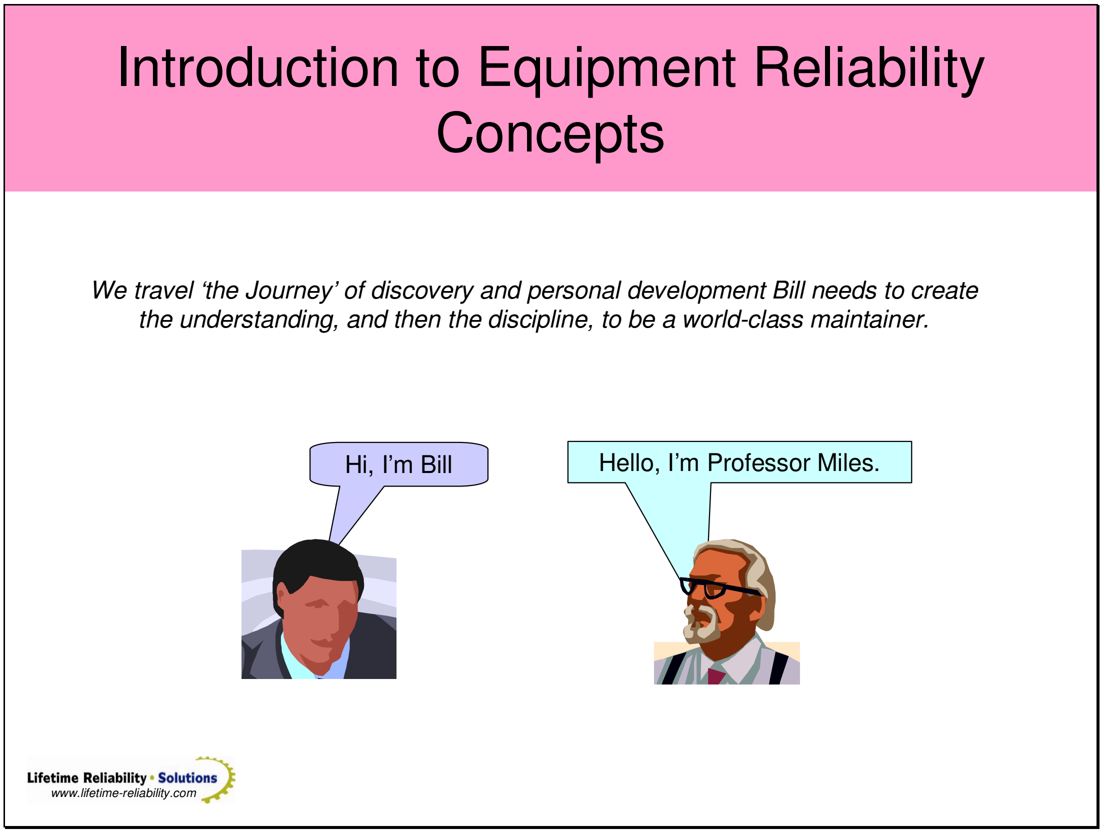

To make it interesting for you to go through this presentation, and fun for me to create it, we will get Bill to tell us about the 'journey' of maintenance and reliability discovery , development and understanding which he learns from Professor Miles. It eventually becomes the 'best practice' he adopts and uses in his own operation.

Bill wants to know more about equipment reliability…

Good morning, is this Professor Miles, the reliability researcher? Hello I'm Bill Rogers. I was given your name as the person to talk to about equipment reliability.

Hello Bill. Yes, this is Professor Miles. How can I help you?

Professor Miles, the company I work for is struggling to get production from its plant and equipment. Our machinery has the capacity, but it is out-of-service, or run at slow speeds too often, that we cannot meet our orders on-time. Our current maintenance regime is not working and I wanted to get your advice as to what to do.

I can explain the concepts of reliability and show you how they are applied through maintenance strategy. But it is not until you use that knowledge that you will come to properly understand it.

Thank you Professor, I have experience in maintenance management, but I don't know enough about delivering equipment reliability. Can I visit you at your office?

Yes, I have an hour free next Monday morning at 11am before a lecture. On your arrival ask the receptionist where I am located, and find your way to my room. I'll see you then.

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Monday, they meet at the Professor's office…

Hello Professor Miles, I'm Bill Rogers. It is good of you to make time to see me.

Good morning Bill, please sit down and tell me of your company's equipment problems.

As I mentioned during our phone call, we are suffering a lot of equipment downtime and not getting our orders out to customers. We do maintenance on our plant but we still suffer unplanned outages and reduced production rates. The whole situation confounds me and I am looking for answers to get the higher plant availability we need.

And you believe that knowing the foundations of equipment reliability will help you find the answers?

That is what I am hoping for Professor. If I can understand why those machines are failing, I will then be in a position to find the answers to reduce the downtime.

You are looking in the right places for the answers. I can take you through the basic concepts of reliability and help make clear what it can do for you. It will take a few hours to go through the key issues. We can meet at this time each day for the rest of the week if that suits you?

Thank you Professor. I will be here. Can we start right now?

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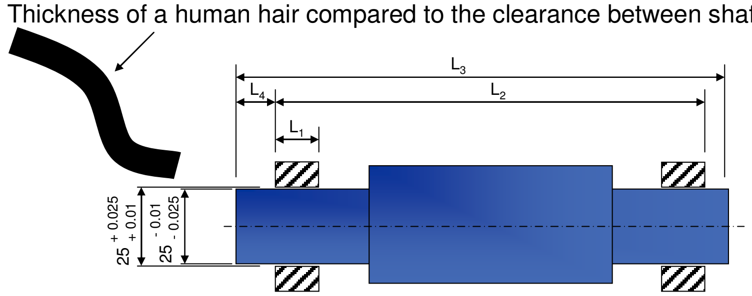
Understand How Machines are Designed and the Limits They Must Live Within

Thickness of a human hair compared to the clearance between shaft and bearing



When they design machines, like this shaft rotating in two journal bearings, they keep the parts in place by making the gaps between them very small. The hair on your head is about 0.1 mm (0.004") thick. On this 25 mm (1") shaft, the gap between the metal surfaces can be as small as 0.01 mm (less then 0.0005"). That is 10 times thinner than the thickness of your hair. That is very little space for things to move in. If the parts get twisted and distorted then that clearance disappears and you have parts hitting each other. Any machine in that situation will quickly fail.

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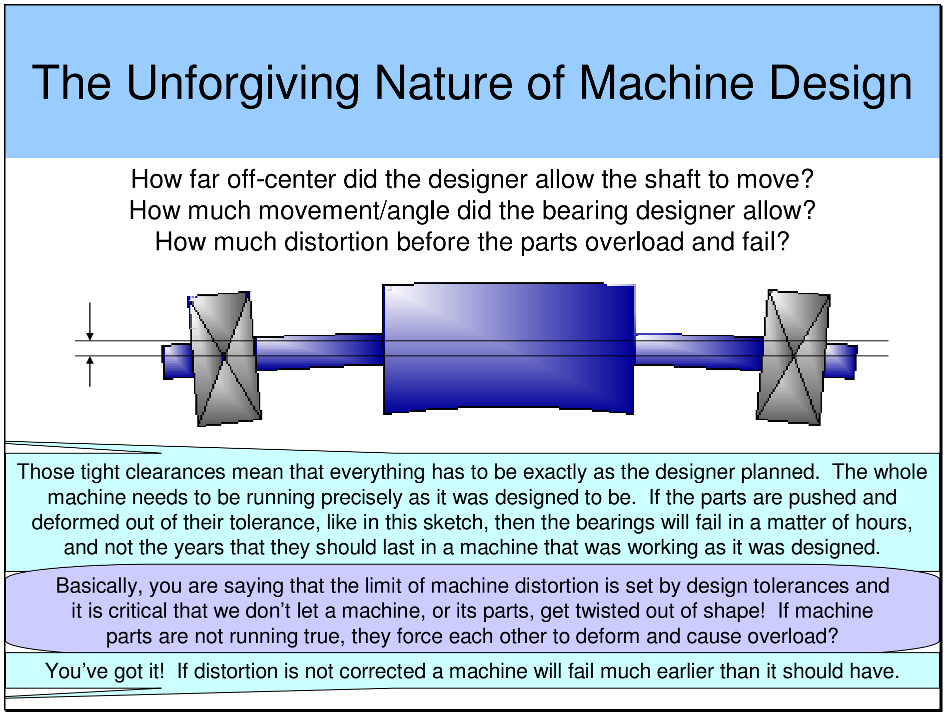
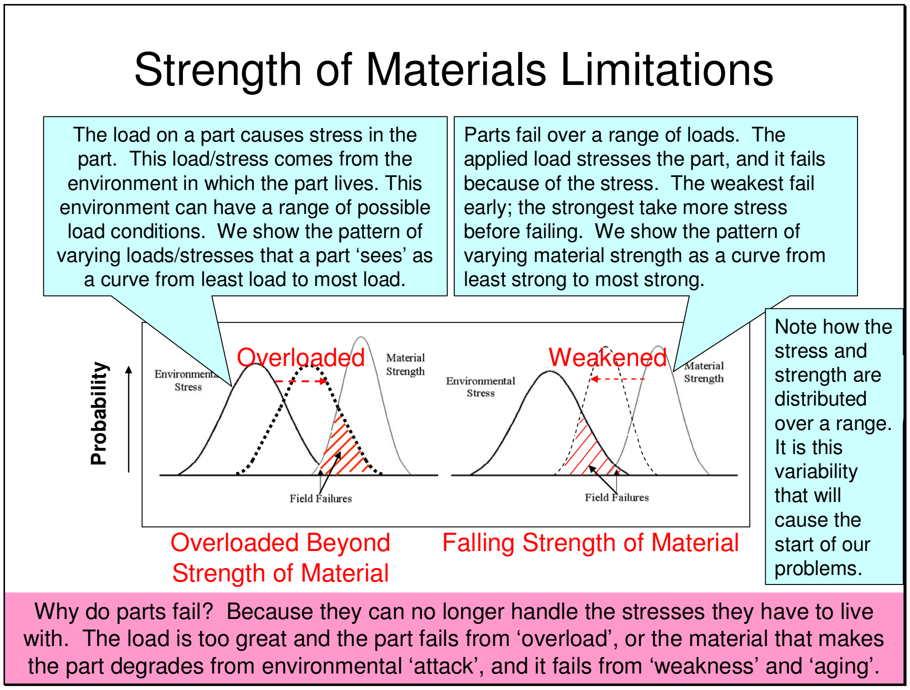
In the sketch the bearing diameter ranges 25.01 to 25.025 mm. Shaft diameter ranges 24.975 to 24.99 mm. Bearing to Shaft <u>diametric</u> clearance ranges from a possible low of 0.02 mm (0.0008") to a maximum of 0.05 mm (0.002") So a **<u>radial</u> movement of 0.01 (0.0004") to 0.025 mm (0.001") will cause a clash of shaft and bearing**

There is no forgiveness in machines when they are pushed and distorted beyond their design capability. Understand that machines need to be cared for in service by using them, and looking after them, within the limits, and in the ways the designer expected.



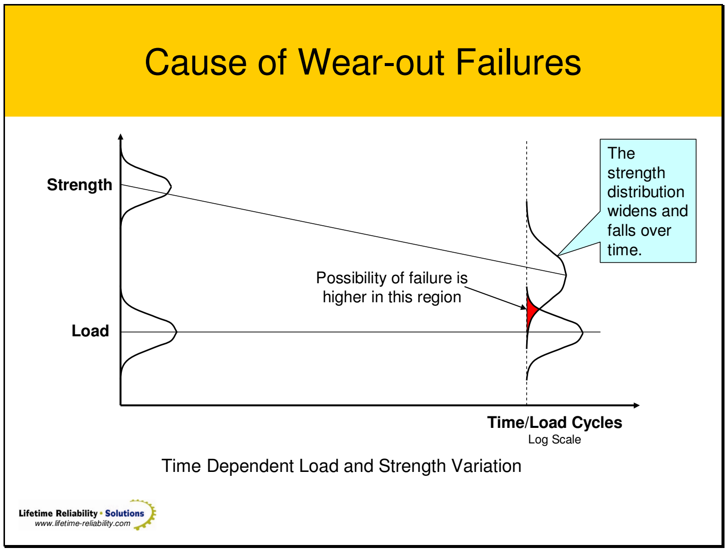
As soon as a machine part deforms outside of its tolerance limits it is on the way to premature failure. Plant, machinery and equipment can only be expected to be reliable if kept within the design stresses and the internal and external environmental conditions it is designed to handle. Once the stresses or environment conditions are beyond its capability, it is on the way to an unwanted breakdown at sometime in future. **Remember: The Limit of Machine Distortion is set by Design Tolerances –** ***don't let a machine, or its parts, get twisted out of shape!***



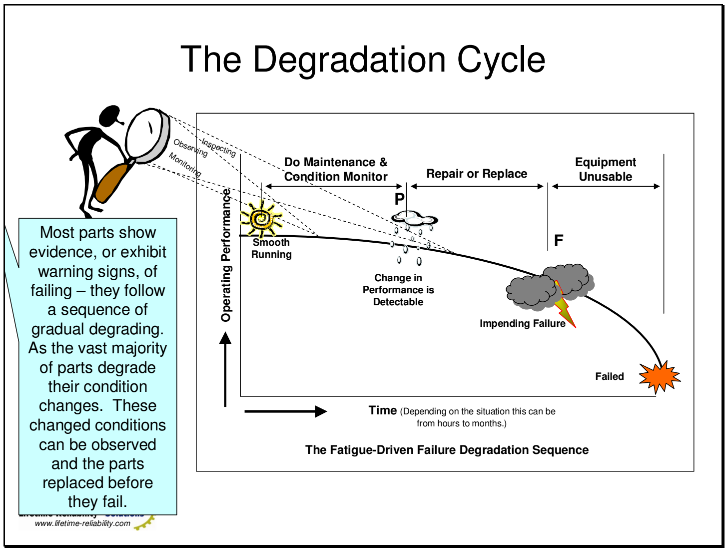
Theoretically if the strength of materials are well above the loads they carry, they should last indefinitely. In reality the load-bearing capacity of a material is probabilistic - i.e. there will be a range of stress-carrying capabilities. We can show the probabilistic nature of parts by drawing a curve from the stress level at which the first part failed to the stress required to make the last part fail. If a part with a low stress capability is used in a situation where the probability of experiencing high loads is greater, then there is a chance that a load will arise that is above the capacity of the part and it will fail.

Many materials degrade with time, or from the local environment service conditions, or from accumulated fluctuating stresses. The parts fatigue and they are no longer able to carry the original loads and stresses. In such situations the probability that the item will see stresses above its remaining capacity to sustain them increases. Eventually the part will fail.

Note that the y-axis is probability (the chance that a thing could happen). The curve is a probability density function of 'probability v stress/strength'.



Wear-out failures are any failure mechanism that result from parts weakening with age. Included are processes involving material fatigue, wearing between surfaces/substances in contact, corrosion, degrading insulation, and wear-out in light bulbs and fluorescent tubes. Initially the strength is adequate for the applied load, but over time the strength deceases. In every case the average strength value falls and the spread of strength distribution widens. This makes it very difficult to provide accurate predictions of operating life for such items.



The degradation cycle shows the failure sequence for fatigued parts. From normal operation they go through recognisable stages of degradation. This is the basis of condition monitoring, which is also known as Predictive Maintenance. The degradation curve is useful in explaining when and why condition monitoring is used. Knowing that equipment parts show evidence of developing failure it is possible to inspect at regular time intervals for signs of changes in behaviour. The point at which degradation is first possible to detect is known as the potential failure, 'P', point. The point at which failure has progressed beyond salvage is the failure 'F' point. We must condition monitor frequently enough to detect the onset of failure so we have time to address the failure before it happens. Some items, like electronic parts, can fail without warning. Situations of huge, sudden stress or overload can also cause parts to immediately fail without warning. We must control the conditions and environment in which parts work if we want to reduce failure.

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