

Genauigkeit Laser Tool for Shafts Alignment

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Abstract: Shaft alignment tool are necessary for alignment of shaft in correct position. Genauigkeit laser tool is the best tool for correct alignment of shaft. This tool enables better precision and accuracy for the correct alignment between driven and the driver shaft. This paper provides with the problems and effects of misalignment with the solution, proposed design and application of Genauigkeit laser tool.

Keywords: Laser tool, shaft alignment, misalignment

1. Introduction

Genauigkeit means 'Precision' in German. So, Genauigkeit laser tool for shafts alignment means Precision laser tool for shafts alignment.

Shaft alignment is the process to align two or more shafts with each other to within a tolerated margin. It is an absolute requirement for machinery before the machinery is put in service. When a driver like an electric motor or a turbine is coupled to a driven like a pump, a generator, or any other piece of equipment, it is essential that the shafts of the two pieces are aligned. Any misalignment between the two increases the stress on the shafts and will almost certainly result in excessive wear and premature breakdown of the equipment.

This can be very costly. When the equipment is down, production might be down. Also bearings or mechanical seals may be damaged and need to be replaced. A proper shaft alignment or the use of disc couplings can prevent this. There are many tools used to achieve correct alignment. But, Genauigkeit laser tool shaft alignment methods are the best. I have made a prototype model of the tool and also a small environmental setup.

2. Problem Definition

Up to 50% of the damage to rotating machinery is directly related to misalignment of shafts. Misalignment of shafts in rotating machinery causes high cost to the industry as it causes premature damages to the machinery, loss in production and excessive energy is consumed. Misalignment is the most common cause of machinery malfunction. A poorly aligned machine could cost 20% to 30% of machine down time, replacement parts, and inventory and energy costs. Hence it becomes extremely important for the maintenance and engineering professionals to understand machine malfunctions caused by misalignment.

2.1 Causes for misalignment of shaft

Misalignment of shaft causes due to over loading. It is also caused due to thermal expansion of shaft due to high

temperature produced when the driver is operating for long time.

2.2. Effects of misalignment of shaft

When shafts are misaligned unbalanced forces are created and causes vibrations, noise, bearing damage, shaft damage, coupling damage and Looseness. In extreme cases the bending stresses applied to the shaft will cause the shaft to fracture and break.

Some effects of misalignment of shaft are.

- Misalignment of shaft puts strain on both machines.
- Looseness of foundation bolts and base-plates.
- Decrease the efficiency on the pump.
- High mechanical vibrations and temperatures leads to fatigue of machine components, results in premature failure, can shorten bearing and mechanical seal life.
- Coupling overheating and resulting component degradation.
- Premature bearing, seal, coupling and shaft failures.
- Extreme wear in gear couplings and component fatigue in dry element couplings.
- Pump and driver shaft fatigue failure.
- Pump and driver bearing overload, leading to failure or short bearing life Destructive vibration events.
- Excessive pump vibration High power consumption.
- High maintenance costs.

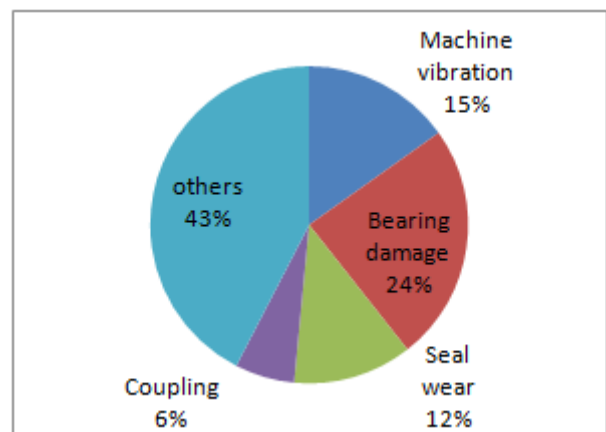


Figure 1: Effects of misalignment of shafts

2.3. Types of Misalignment of Shaft

Misalignment takes place in either driven or driver or both shafts. Here I have shown misalignment in driven shaft. There are two types of misalignment viz: parallel misalignment and angular misalignment. In parallel misalignment, the center lines of both shafts are parallel but they are offset. In angular misalignment, the shafts are at an angle to each other. The parallel misalignment can be further divided up in horizontal and vertical misalignment. Horizontal misalignment is misalignment of the shafts in the horizontal plane (plan view) and vertical misalignment is misalignment of the shafts in the vertical plane (end view).

Angular misalignment (angularity) as shown in figure 2(a) is caused due to small angle difference between the driven and the driver shaft. The angle difference is in millimeters. Sometimes when the equipment is used for long time without any inspection in between the difference may be in inches.

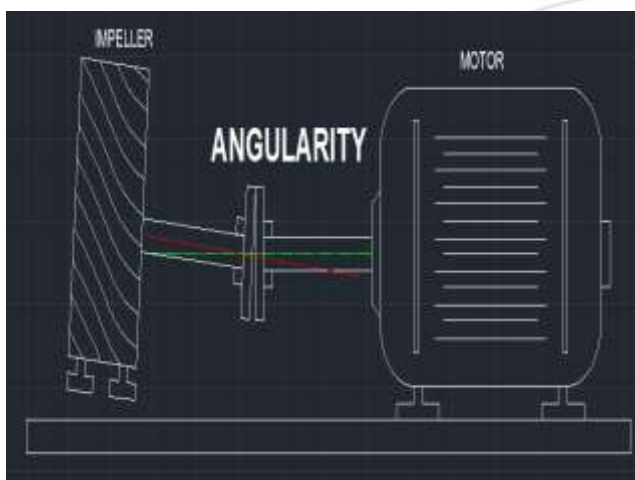


Figure 2(a): Angular misalignment

Offset misalignment as shown in figure 2(b) is caused due to the distance between the rotation axes of the driver shaft to the rotation axes of the driven shaft. The offset values varies depending upon the upon the location where the distance between the two shaft rotating axes is measured. The difference may be in millimeters or in inches.

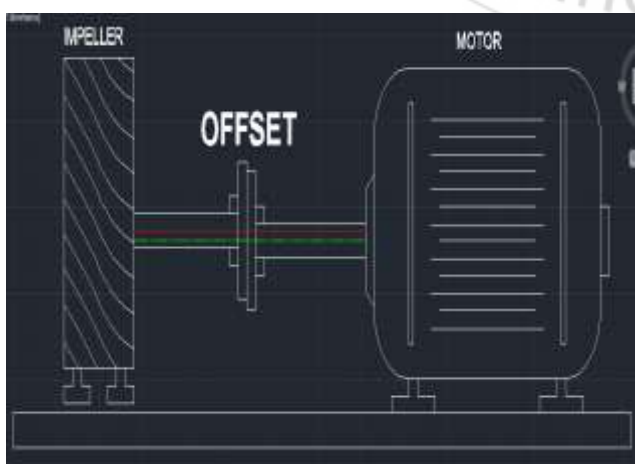


Figure 2(b): Offset misalignment

3. Proposed Design of Genauigkeit Laser Tool

The purpose of producing this design is to implement a good shaft alignment for the standard rotating machine system. The laser alignment is an essential component of a viable maintenance strategy for rotating machines. In isolation each strategy can help to reduce unexpected machine failure but taken together they form the hub of a proactive maintenance strategy that will not only incipient problems but allows extending machine operating life considerably.

Genauigkeit laser tool consists of a transmitter and a receiver. The transmitter has one LED bulb which emits Infra Red rays (IR rays). This rays are invisible to our naked eyes. The transmitter tool is shown in the figure 3(a). The receiver has five LED bulbs in the front to receive the transmitted IR rays as shown in the figure 3(b). At the back it has LED display which displays the type of misalignment caused as shown in the figure 3(c).



Figure 3(a): Transmitter



Figure 3(b): Receiver (front)



Figure 3(c): Receiver (back)

Now place the Genauigkeit laser tool on the equipment: Transmitter on driver shaft (motor) and the receiver on driven shaft (impeller) as shown in the figure 5.



Figure 5: Genauigkeit laser tool

4. Solution for Misalignment of Shaft

4.1. Pre-Alignment Check:

- First of all check whether the power source is off before keeping hand on the equipment.
- Be aware of the pre-operational shaft positions to allow for any known thermal expansion.
- Before commencing work, observe proper lock-out, tagging and isolation procedures. This may include purging of pumps and eliminating all stored energy.
- Ensure all tools are in good condition and correct for the job, decide on correct method of alignment to be used.
- Ensure the gap between shafts and coupling in the axial plane is correct.
- Loosen all holding down bolts prior to moving any machine. Replace any missing or broken bolts, washers etc.
- Ensure all dowels have been removed and when put back in at end of alignment are in good condition.
- Check and eliminate excessive pipe stress.
- Prior to alignment ensure shafts can rotate freely, lubricate if necessary.
- Ensure all shims to be used are in good condition
- The environmental setup is shown in the figure 4.

Switch on the LED bulb on both the transmitter and the receiver. Now the transmitter starts to transmit IR rays to the receiver. As soon as the receiver receives the IR rays it starts to show the type of misalignment on the display. If it is angular misalignment then it shows angularity as shown in the figure 6(a). And if it is offset misalignment it shows offset as shown in figure 6(b).



Figure 6(a): LED display showing Angular Misalignment



Figure 4: Environmental setup



Figure 6(b): LED display showing Offset Misalignment

4.2. Correct Alignment Position

Based on the type of misalignment shown we should adjust the setup till we achieve the correct alignment of shaft.

4.2.1 Procedure for Correcting Misalignment

Correcting misalignment only requires that we get the shafts to align in the vertical and horizontal planes.

Step-1 Measuring the misalignment in the horizontal and vertical planes.

Step-2 Calculating the moves required to correct the misalignment.

Step-3 Making the prescribed adjustments.

Once we have achieved the correct alignment of shaft as shown in figure 7(a). Then the LED display shows linearity as shown in the figure 7(b).

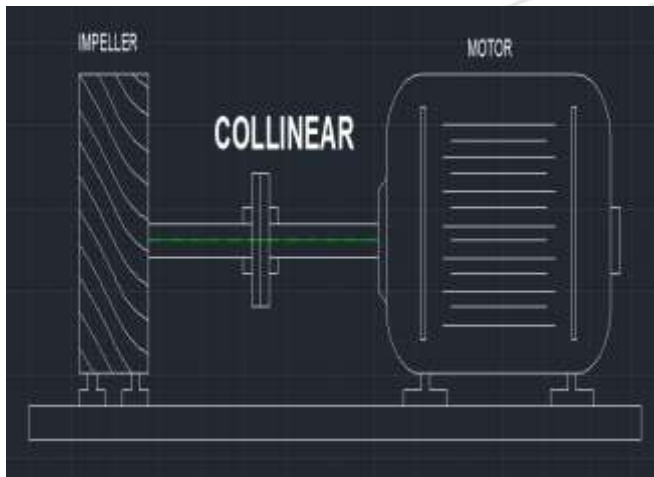


Figure 7(a): Collinear alignment of shafts



Figure 7(b): LED display showing Collinear alignment

5. Applications

- This Genauigkeit laser tool is highly suited for small and medium scale industries.
- They are best suited where driver-driven shaft are alignment for long distances.

6. Advantages

Some of the advantages of using Genauigkeit laser tool are as follows.

- They do not require as much operator skill.
- They have high accuracy and precision.
- Center-to-center pump alignment can be achieved without paying attention to thermal growth.
- Since it is possible to feed in the thermal growth data for compensation and laser alignment can allow the operator to check the pump when it is running and up to temperature, this is not possible with dial indicator, it is free of gravitational hardware sag.
- It can work with the couplings in place or uncoupled.
- It is fast & easy to mount.
- It can detect & measure the extent of a soft foot.
- It feeds misalignment data to a microprocessor for horizontal and vertical corrections.
- Moderate cost.
- Easy to use.
- Gives quick results.

7. Conclusion

Even though there are several approaches to achieve the correct alignment of shaft Genauigkeit laser tool is best. This tool enables better precision and accuracy for the correct alignment between driven and the driver shaft.

8. Future Scope

Genauigkeit laser tool will be employed in many industries all around the world in future for best alignment of shafts.

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