TECHNICAL UPDATE # 005

Understanding shaft alignment

The subject of shaft alignment has been recorded in great depth by others over the decades and it is not for me to regurgitate the entire science (some may say a black art!)

What is laser alignment?

Laser alignment is the alignment of two shafts connected to 2 pieces of equipment within a tolerance, so that the connected equipment won't suffer from Energy over load, pull more power from the Electric Motor, or effect premature failure of ancillary products such as, Bearings, seals, V Belts, Pulleys, Couplings or gearbox failure, pump failure, fan failure for example on rotating equipment.

Why laser align?

In recent times laser alignment has become an industry standard for engineers and maintenance staff to improve the reliability of their plant and equipment. This is because misalignment between rotating shafts causes undue vibration, noise and wear for such items as shaft seals and bearings leading to significant reduction in their useful life. Studies also show that significant energy losses can occur when particular types of shaft couplings are misaligned due to the added side loads on the connected shafts.

Old Methods of alignment.

Old methods of alignment would use things like, piano wire, ruler, line of sight or dial indicators.

Modern methods of alignment and what they are:

While the advent of modern technology has enabled users to "plug and play" their alignment equipment (laser etc) to achieve a simple and quick result it is incumbent on us as technicians to understand the fundamentals of what is required and not just rely on a digital readout – sometimes erroneously.

2 methods of Alignment.

I like to categorise the requirement for shaft alignment into two distinct areas:

1. Requirement for STATIC Alignment - or while the machine is stationary
2. Requirement for DYNAMIC Alignment - that is when things start rotating

Clearly the majority of alignment methods can only focus on the first point – machines can only be aligned when stationary.

The importance of alignment and why.

It is here that every attempt is made to ensure coaxial alignment is achieved between the drive and driven shaft. This is usually done in both planes in line with the rotation axis with some degree of tolerance. The precision for alignment varies for the type of coupling involved however since many couplings have some type of flexural element involved any deviation from "perfect" will result in some degree of side loading being induced to the shafts proportional to amount of tolerance offset. The detrimental effects of misalignment (no matter how small) will be seen over time in component wear (seals, bearings etc), additional power consumption and eventual failure.

Why Coupling Manufacturers insist on tight tolerance values.

Most coupling manufacturers insist on such tight tolerance values to be adhered to for their product installation. They therefore take great effort (and expense) to align the shafts by either shimming motor or pump feet or making other adjustments to obtain coaxial alignment as far as practical.

Load cycles, flex or distort.

Great but now what happens when the machinery is energised, and various loading cycles undertaken? This is where the requirement for Dynamic Alignment is most important. As we know things flex or distort under dynamic actions such as:

- initial torque energisation of a motor in a DOL configuration
- fluctuations in torque when a pump is loaded or unloaded
- torque changes when the gearbox of a rolling mill is loaded or unloaded with product
- thermal expansion from connected pipework to machines such as boiler feed pumps or turbines
- etc

Other significant factors can also cause things to go out of alignment - as simple as loose mounting bolts, flexible machine support bases and even corroded foundations all giving rise to the term “soft foot”. Almost no amount of STATIC alignment can solve the issue of soft foot as the connected machinery will flex the coupling to suit the loaded conditions.

Excessive loads

Generally, it is hoped that these dynamic limits are of a low enough order that the coupling tolerance can accommodate the resulting flexure. BUT as mentioned the resulting flexure will place a burden in the form of side loading onto the connected shafts and create extra wear, consume additional power and cause premature failure of the drivetrain.

While most other coupling designers need to balance the flexural requirement within tight tolerances it still stands that precision alignment can be rarely achieved in an economical way when dynamics are present.

Is Laser alignment dead?

As technology moves so fast in other industries some industries move slower, the Mechanical coupling other than materials has not moved on much in the last 100 years, this type of technology seem to have not changed with the times and we move ever faster is their now an advancement in mechanical couplings that will NOT require laser alignment a coupling that can handle side loads, vibration, accept lager misalignment without effecting the connected equipment, it will be energy efficient even when misaligned and installation will be in the minutes not hours, if you read the next part there is a company who has made one of the biggest advancements in coupling technology in the last 300 years, that have solved all of the issues spoken about in this article, so the questions you may ask yourself, IS LASER ALIGMENT DEAD? That solely depends on if you as a engineer, designer engineer are will to embrace this new tech and move forward into a new of technology before your competitors do.

Biggest leap in coupling technology in the last 300 years.

The Thompson TCAE range of products has therefore been designed to eliminate the need for precision alignment in the first place, Furthermore its self-adjusting features permit dynamic forces such as thermal expansion and soft foot to be catered for without imposing damaging side loads on the shafts.

The unique double hinged internal mechanism transmits torque at constant velocity and reduces imposed vibrations from rigidly mounted machines. With its wide range of movement (radially +/- 5 degrees and axially up to +/- 15 mm) it also provides effortless installation with minimal downtime. Tests have also been conducted to prove the energy saving potential of the TCAE compared to other flexural element couplings when various degrees of misalignment are created. The result is the TCAE does provide a positive cost/benefit return for most plant, with quicker installation, energy saving, reduced repairs on connected equipment, able to handle vibration and less down time for plant and equipment, the benefits are massive for your plant operation production run time with minimum down time.

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