Alignment of Cardan Shaft Applications Featuring ROTALIGN® ULTRA

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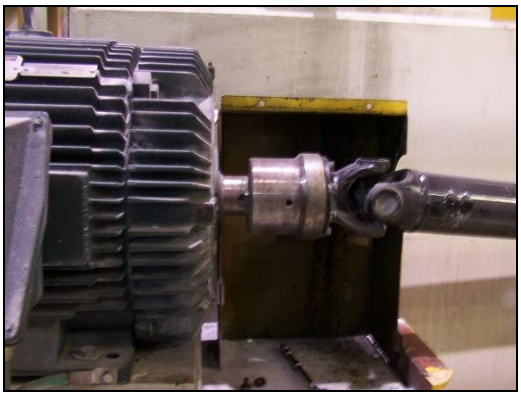
A cardan shaft, simply put, is a spacer shaft with a universal joint coupling on each end (see Application Photos 1 and 2). The name itself comes from 16th century Italian mathematician, Girolamo Cardano. A cardan shaft allows power to be transferred between two machines that are offset from each other.

Application Photo 1



Application Photo 2

Widely used in industry, cardan shafts have proven practical on applications where space is limited as well as situations where an element in the machine train (e.g. paper roll) may need to be actuated (dynamically positioned) to an alternate position when the machines are not running; the universal joint allows for limited movement without uncoupling. In order to ensure sufficient lubrication circulation, which in turn prevents the universal joints from seizing, cardan shafts are normally installed with an angle of from 4 to 6 degrees existing at the universal joints. However, experience has shown that the angle between the shafts of the driver and driven units should be kept to a minimum, preferably less than 4.36 mrads (0.25 degrees). Ideally the angles between the driver and driven shafts and the cardan shaft, shown as β_1 and β_2 in Figure 1 below, would be equal. Geometrically this would equate to zero angularity existing between the driver and driven unit. In other words, the shafts of the driver and driven machine would be parallel to each other.

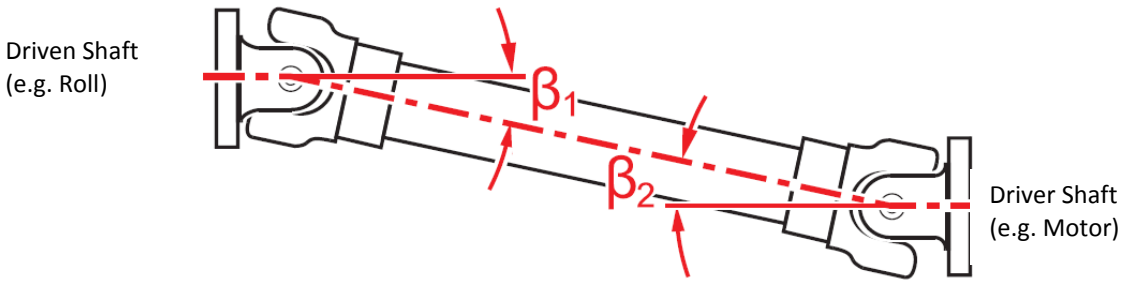


Figure 1

If excessive angularity does in fact exist between these components, the result will be a rapid fluctuation of the driven shaft RPM during operation. This in turn generates damaging vibration as well as an adverse load through the machine train, leading to premature wear of critical machine components. Precise alignment minimizes these rotational irregularities, so that uneven bearing loading during cardan shaft rotation is also minimized. Thus, the service life of the components is extended and the chance of unexpected machine failure is reduced.

Accurate laser shaft alignment of the driver to driven machine requires that the cardan shaft and its couplings be removed. Then, through the use of a laser alignment system and specially constructed cardan offset bracket, the angle between the machines can be easily determined and corrected. After removal of the cardan shaft, the cardan bracket (shown below in Figure 2) is mounted to the shaft face of the stationary machine. In the case of a motor connected to a roll, the bracket would be attached to the roll shaft (Figure 3). The bracket can be attached to the shaft using the coupling bolt holes or, if available, a threaded hole in the center of the shaft.

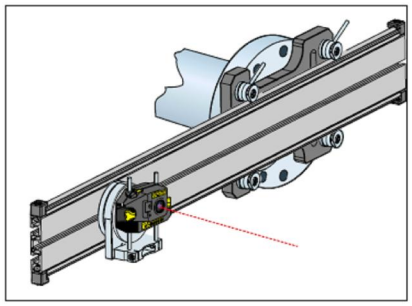


Figure 2

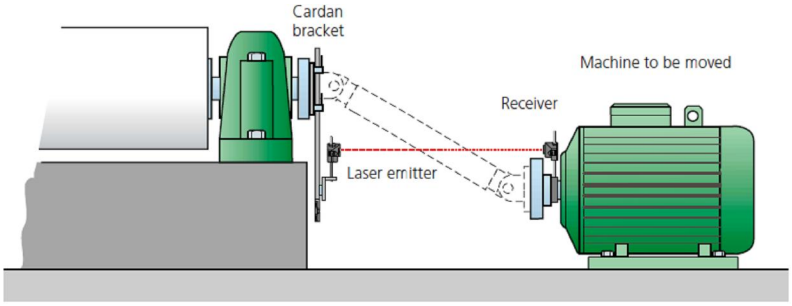


Figure 3

The cardan bracket enables virtual positioning of the rotational axis of the stationary machine in line with the rotational axis of the moveable machine. The laser is then mounted on the cardan bracket and receiver mounted normally on the shaft of the driver, either with the standard compact chain brackets, compact magnetic brackets or other optionally available brackets. Measurements are taken and the alignment condition is determined. The Pruftechnik ROTALIGN® ULTRA is the ideal laser alignment system for this application. This system features wireless communication as well as a cardan shaft alignment mode which allows the user to focus only on the angularity that exists between the driver and driven shafts. The Pruftechnik ROTALIGN® ULTRA system also calculates the necessary corrections required to remove the angularity and monitors alignment corrections in real-time as adjustments are made.

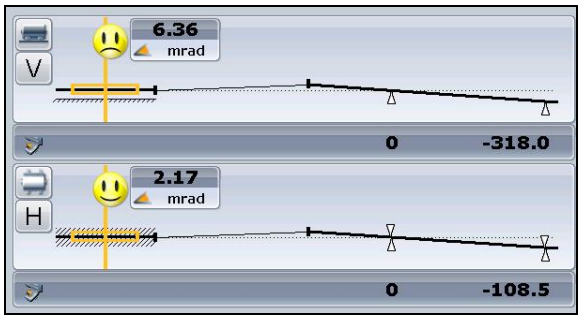


Figure 4: Initial Alignment Results

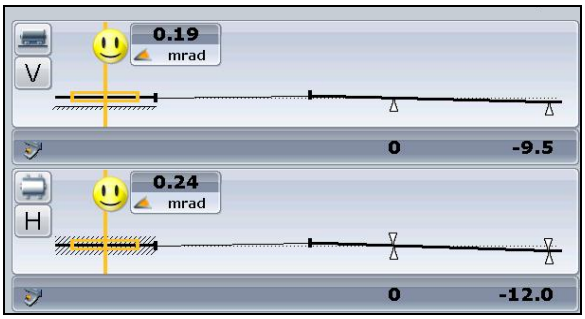


Figure 5: Final Alignment Results

Figure 6: Sample dimensions screen from the Pruftechnik ROTALIGN® ULTRA cardan shaft alignment program

About the author: Brad Van Schyndel is an applications engineer for Centerline, Inc. in Appleton, WI and has over 19 years of field experience with laser alignment of rotating machinery. He can be reached at (920) 730-0615 or info@ctrline.net.