INSTRUMENTED COUPLINGS: THE WHAT, THE WHY AND THE HOW OF THE INDIKON HOT-ALIGNMENT MEASURING SYSTEM

by

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WHAT WE MEASURE

The Indikon System measures the accommodation being provided at each end of a flexible coupling set. What is thought of as a flexible coupling is, of course, two couplings joined together by a spacer piece. The angle between the spacer piece and the adjacent shaft is measured and then the X and the Y components of this angular misalignment is determined and displayed. An analog voltage or current is sent to a recorder or a data gathering network or a digital indicator. As part of the same measuring system, the distance at each end of the spacer across to the adjacent shaft end is determined.

If desired, the system can also measure related variables such as the axial vibration of the spacer piece, the sliding mesh-velocity of the gear, or, with bonded strain gages, the bending moment imposed upon the spacer by misalignment.

All of these measurements are made while the machines are running, as they warm up, as they pick-up load, and later on through the months and years of operation.

WHY WE MEASURE

The why of all of this relates to the relationship between the shafts of the driving and driven machines. By measuring the accommodation being afforded by the flexible coupling, an immediate index of hot alignment is obtained. Vital information as to how far the service life of the coupling itself is being approached can also be observed.

The instrumented coupling, or, more correctly, the instrumentation within the coupling, also serves as an immediate lock-up indicator, since with lock-up, its readings at that end of the spacer will go instantly to zeros in both the X and the Y planes. It has been observed that lock-up is a far more common phenomenon than has been suspected prior to this time. The why of instrumented couplings is probably going to raise a number of questions in the near future that will allow a better understanding of the interaction between machines, with foundations and supports, with piping forces, even with coupling lubrication. Since the measurements are of coupling accommodation, of coupling behavior, and ultimately of coupling well-being, there is bound to develop a better understanding of their application and their maintenance.

HOW WE MEASURE

Working together with the coupling manufacturer, part or all of the coupling is taken to the shops in Cambridge, Massachusetts. The design and installation of a system which uses the components shown in Figure 1 is made. Two proximity probes are installed at each end of the coupling spacer, arranged so as to measure the opening and closing of the gap with misalignment, seen by each probe as the coupling rotates. Two probes at each end are used, arranged differentially, so as to ignore axial vibration, which they would observe together, and to respond to misalignment changes in gap which they would see individually.

Located within the coupling spacer, cast in a solid monolith of epoxy, are the on-shaft electronic circuits used in the measurement. Two sets of rotary transformers are installed, with approximately 150 thousandths radial air gap between the rotating and stationary pairs. The transformer windings are encapsulated within a cured epoxy glass-type lamination that has been tested successfully to 39,000 G's. The coupling windings are dimensioned and arranged, so as to

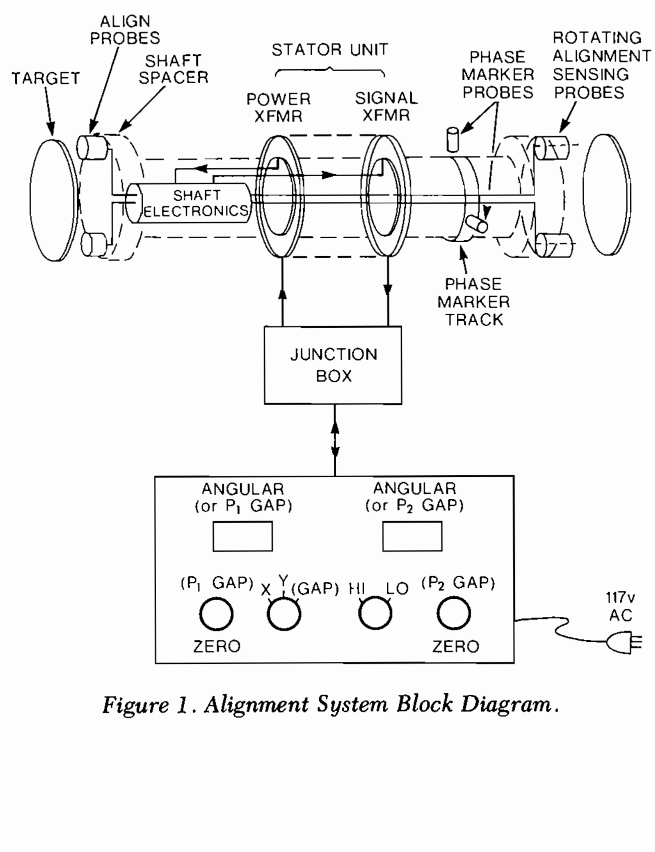

Figure 1. Alignment System Block Diagram.

accommodate the full axial travel designed into the coupling itself.

There are also provided X and Y marker probes within the stationary transformer structure, the stator, looking across the transformer gap to the rotor. Here, as part of the epoxy laminate system, is embedded a strip of metal foil, one half the rotor circumference in length. The X and Y probes being displaced radially by 90° "see" this phase marker strip, one 90° sooner than the other. The square wave signals generated by the probes are thus 90 degrees apart and are used as the 12 o'clock and 3 o'clock references within the system.

The probes measure the opening and closing of the gap which occurs with misalignment as the coupling rotates. The system compares the gap at 12 o'clock to that at 6 o'clock and from 9 o'clock to 3 o'clock, thus providing the angular X and Y displacements at each end.

The measurement is absolute. It does not take into consideration bench marks, where the foundation is, or has been, how much a machine case has grown, or has been twisted. It doesn't care that the sun is shining, or not shining, or that it is raining. It only measures what the shafts are doing relative to one another through the coupling.

Other systems are obviously needed so as to establish where the casings and bearing housings are, relative to the foundation. When one knowns where the shaft is, and wants to be, it is necessary to have the tools and the measurements to bring it back to that position after maintenance.