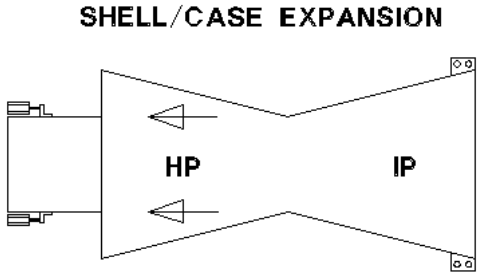
STI Vibration Monitoring Inc.

Field Application Note

Turbine Supervisory Instrumentation — Shell/Case Expansion

Shell or Case Expansion is a very important measurement as part of a Turbine Supervisory Instrumentation (TSI) System for large steam turbines. This measurement should be included in turbine retrofit plans when at all possible.



The Shell Expansion measurement is utilized by operators to monitor the proper thermal growth of the turbine's shell during startup, operation, and shutdown. The turbine's shell is anchored to the foundation at one end of the machine and allowed to expand or grow by sliding towards the opposite end. The expansion or growth of the turbine's shell Shell Expansion is the measurement of how much the turbine's shell expands or grows as it is heated. As large turbine cases grow or expand thermally, in some case up to several inches, and was usually supplied as part of the Original Equipment Manufactures TSI system supplied with the turbine.

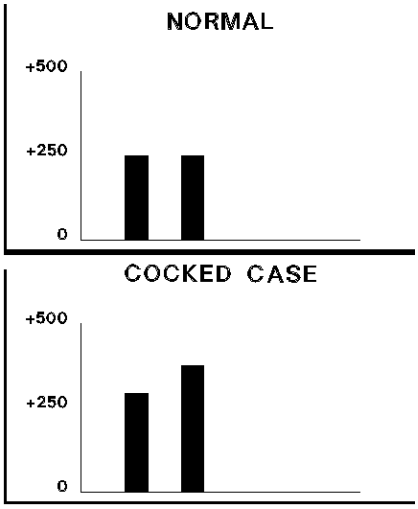
Used in conjunction with a Differential Expansion (DE) measurement (Case to Rotor) the thermal growth of both the case and rotor can be monitored to prevent costly rubs between the rotating and stationary parts of the turbine.

The recommended Shell Expansion measurement device is a SKF-CM LVDT (Linear Variable Differential Transformer) engineered and manufactured to provide long measurement ranges, long life and simple installation.

Both retrofit and new applications may be accommodated easily with SKF-CM's LVDT design as it incorporates a protective epoxy coated aluminum housing with mounting flanges and a spring-loaded plunger with an adjustable roller tip.

Occasionally due to improper turbine shell pre-heating, maintenance or the location of the steam inlets being used to preheat the turbine the turbine shell may become distorted which can cause internal damage.

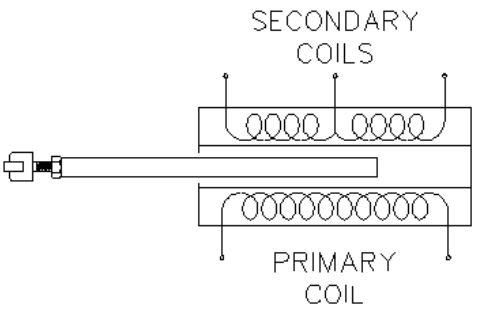
Turbine "Cocking" occurs when the turbine sliderhangs up or sticks on one side of the foundation and continues to grow or slide on the other. This condition sometimes corrects itself by breaking loose quite dramatically. To monitor for distortion or cocking two (2) LVDT's may be utilized and are installed on either side of the Front Standard or turbine case. If the Turbine Case does not grow evenly the case is allowed to cool and then reheated with more even heat distribution.

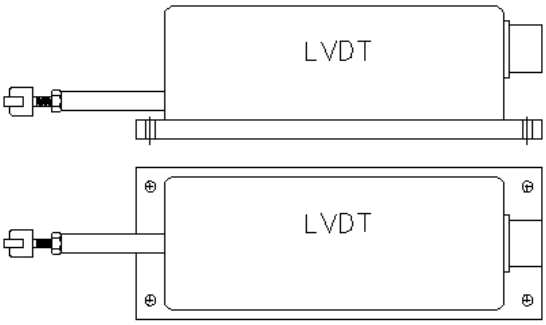


Theory of Operation

LVDT's are electromagnetic devices that have three coils of wire wound on a hollow tube and a metal rod moving inside the hollow tube. The primary coil of wire is excited by a supply voltage, which induces a voltage in the other coils as the rod, or plunger travels throughout its range. When the plunger is centered in its range the induced voltage of the two secondary coils is equal in magnitude, but opposite polarity. As the plunger moves to either side of the center position the voltage of one of the secondary coils increases while the other secondary coil experiences a decreased voltage. DC LVDT's differ from AC LVDT's in that they are manufactured with an internal carrier generator/signal-conditioning module and only require DC Power to operate.

1010 East Main Street, League City, TX 77573 Phone: 281.334.0766 Fax: 281.334.4255
www.stiweb.com / www.stiwebstore.com





Special Considerations

Operating Range

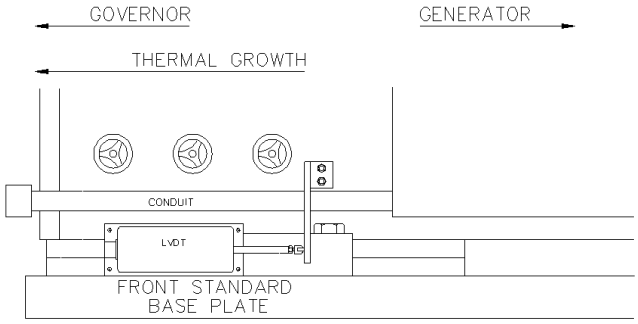
The standard SKF-CM LVDT has a standard operating range of 1.0, 2.0 or 4.0 inches. The most common used is 0-2 inches (0-50 mm) with an output of (-7.5)-0-(+7.5) VDC and an accuracy of ±0.5 % full scale. A shorter range may be selected by using the center portion of the LVDT standard operating range. Longer ranges are available on request.

Transducer Installation

The body of the LVDT is designed to be rigidly attached to the turbine foundation and the spring loaded roller tipped plunger is to press against a bracket that is attached to the Front Standard or Turbine Case. The bracket must be designed not to interfere with turbine operation and allow the roller tip of the plunger to ride against freely it throughout the entire range.

Measurement Convention

The SKF-CM LVDT operates on the standard instrument convention that as the plunger or rod is compressed into the LVDT body (motion towards the transducer) the signal output increases or goes more positive. The LVDT may be installed in either direction so that thermal growth causes a more positive going signal or a negative going signal. The monitoring system can be configured for either direction.



Conduit

Dedicated TSI System conduit should be provided in all installations for mechanical protection of the instrument cable. Rigid IMC conduit is required from the monitor location to the LVDT location. The final 2-3 feet of the conduit installation should be completed with flexible conduit to facilitate transducer removal. The SKF-CM LVDT body is equipped with a 3/4" NPT conduit fitting.

Instrument Wire

For LVDT applications a 4-conductor, twisted, shielded, insulated, instrument wire should be utilized between the monitor location and the LVDT. This wire should be a continuous run and not be spliced. Alternately two (2) individual twisted, shielded pair wires may be used with extreme care taken to properly tag the cables to prevent improper connection.

The following wiring connection convention should be followed:

Red -18 VDC
White Signal
Black Power Ground
Green Signal Ground

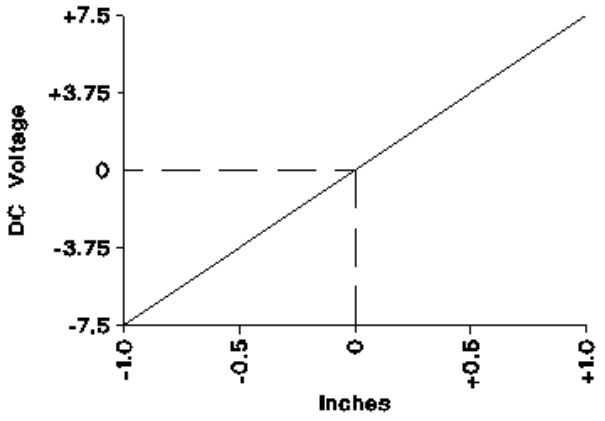
The following Belden Part# have been provided for your convenience. They may be cross-referenced to other wire manufactures.

	Belden Part Numbers		
Pair	Nom. O.D.	4-Cond.	Nom. O.D.
18 AWG	8760	0.22" 9418	0.25"
20 AWG	8762	0.20" N/A	

Calibration

The SKF-CM 2" LVDT is designed to be installed so that when the plunger is centered in its operating range the LVDT output voltage will be 0 VDC. This calibration may be accomplished by temporarily inserting a block whose thickness is equal to exactly one-half (1/2) the desired range (for 2" range use a 1.0" block) under the plunger tip when the turbine case is in it's cold position and adjusting the roller tip, located at the end of the plunger, until 0 VDC is obtained at the transducer output. Alternatively, the entire body of the LVDT may be repositioned.

1010 East Main Street, League City, TX 77573 Phone: 281.334.0766 Fax: 281.334.4255
www.stiweb.com / www.stiwebstore.com



Shell Expansion Checklist

1. Number of LVDT,s, One or Two
2. Operating Range
3. Transducer Location(s)
4. Measurement Convention
5. LVDT Installation Documented
6. Correct Instrument Wire
7. Metal IMC Mainline Conduit
8. Flexible Conduit
9. Calibration

1010 East Main Street, League City, TX 77573 Phone: 281.334.0766 Fax: 281.334.4255
www.stiweb.com / www.stiwebstore.com