**Linear Variable Differential Transformer (LVDT)**

**Definition of LVDT**

The term LVDT stands for the Linear Variable Differential Transformer. It is the most widely used inductive transducer that converts the linear motion into the electrical signals. The output across secondary of this transformer is the differential so it is called so. They are very accurate inductive transducers as compared to other inductive transducers.

**Construction of LVDT**

Main features of construction are as:

1. The transformer consists of a primary winding P and two secondary windings S1 and S2 wound on a cylindrical former (which is hollow in nature and will contain core).
2. Both the secondary windings have equal number of turns and are identically placed on the either side of primary winding
3. The primary winding is connected to an AC source which produces a flux in the air gap and voltages are induced in secondary windings.
4. A movable soft iron core is placed inside the former and displacement to be measured is connected to the iron core.
5. The iron core is generally of high permeability which helps in reducing harmonics and high sensitivity of LVDT.
6. The LVDT is placed inside a stainless steel housing because it will provide electrostatic and electromagnetic shielding.
7. The both the secondary windings are connected in such a way that resulted output is the difference of the voltages of two windings.



**Principle of Operation and Working**

As the primary is connected to an AC source so alternating current and voltages are produced in the secondary of the LVDT. The output in secondary S1 is e1 and in the Secondary S2 is e2.

So the differential output is, e(out)=e1-e2

This equation explains the principle of operation of LVDT.

Now three cases arise according to the locations of core which explains the working of LVDT are discussed below as:

**CASE-I:** When the core is at null position (for no displacement)

When the core is at null position then the flux linking with both the secondary windings is equal so the induced emf is equal in both the windings. So for no displacement the value of output e(out) is zero as e1 and e2 both are equal. So it shows that no displacement took place.

**CASE-II:** When the core is moved to upward of null position (for displacement to the upward of reference point)

In this case the flux linking with secondary winding S1 is more as compared to flux linking with S2. Due to this e1 will be more as that of e2 and due to this output voltage e(out) is positive.

**CASE-III:** When the core is moved to downward of Null position (for displacement to the downward of reference point) In this case magnitude of e2 will be more as that of e1

Due to this output e(out) will be negative and shows the output to downward of reference point.



\***Some important points about magnitude and sign of voltage induced in LVDT**

1. The amount of change in voltage either negative or positive is proportional to the amount of movement of core and indicates amount of linear motion.
2. By noting the output voltage increasing or decreasing the direction of motion can be determined
3. The output voltage of an LVDT is linear function of core displacement.

**Advantages of LVDT**

1. High Range - The LVDTs have a very high range for measurement of displacement they can used for measurement of displacements ranging from 1.25 mm to 250 mm.
2. No Frictional Losses - As the core moves inside a hollow former so there is no loss of displacement input as frictional loss so it makes LVDT as very accurate device.
3. High Input and High Sensitivity - The output of LVDT is so high that it doesn’t need any amplification. The transducer possesses a high sensitivity which is typically about 40V/mm.
4. Low Hysteresis - LVDTs show a low hysteresis and hence repeatability is excellent under all conditions
5. Low Power Consumption - The power is about 1W which is very as compared to other transducers.
6. Direct Conversion to Electrical Signals - They convert the linear displacement to electrical voltage which are easy to process.

**Disadvantages of LVDT**

1. LVDT is sensitive to stray magnetic fields so they always require a setup to protect them from stray magnetic fields.
2. They are affected by vibrations and temperature.
3. It is concluded that they are advantageous as compared than any other inductive transducers.

**Applications of LVDT**

1. They are used in applications where displacements ranging from fraction of mm to few cm are to be measured. The LVDT acting as a primary transducer converts the displacement to electrical signal directly.
2. They can also acts as the secondary transducers as for example the Bourbon tube which acts as a primary transducer and converts pressure into linear displacement then LVDT converts this displacement into electrical signal which after calibration gives the ideas of the pressure of fluid.