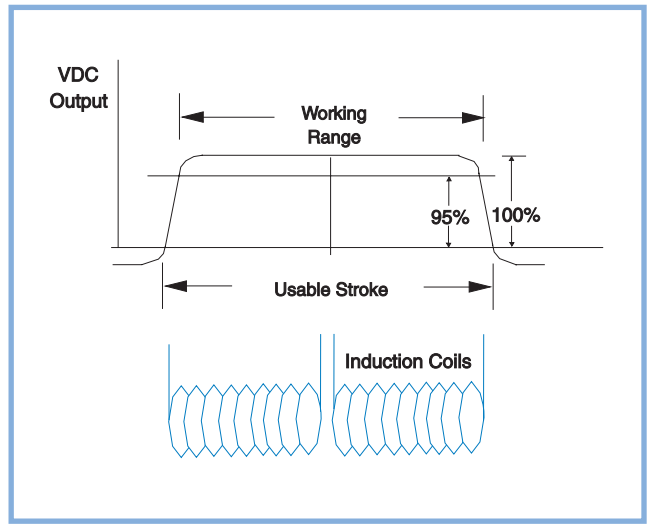
Linear Velocity Transducers (LVTs)

Inductive Technology

Trans-Tek manufactures and designs Linear Velocity Transducers using inductive technology. Moving a magnet through a coil of wire will induce a voltage in the coil according to Faraday's and Lenz's Laws. This voltage is proportional to the magnet's velocity and field strength. Trans-Tek LVTs use this principle of magnetic induction, with a permanent magnet and a fixed geometry coil, so the output voltage of the coil is directly proportional to the magnet's relative velocity over its working range.

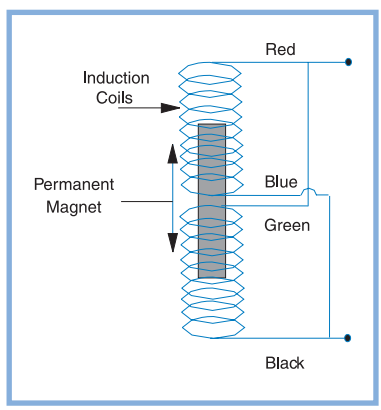
During operation in the working range of the transducer, both ends of the magnet are inside the coil. With a single coil this would give zero output because the voltage generated by one pole of the magnet would cancel the voltage generated by the other pole. To avoid this, the coil is divided into two sections, so the N (North) pole of the magnet will induce a voltage in one coil and the S (South) pole will induce a voltage in the other coil. These two coils are then connected in series-aiding, to obtain a DC voltage output proportional to the magnet's velocity.

OUTPUT CURVE



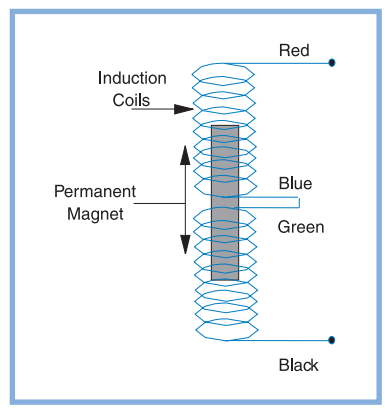
COILS IN PARALLEL

Parallel operation is achieved by tying the black and blue leads together, and the green and red leads together. The two connections create the terminals for the output. This configuration cuts the sensitivity in half, and reduces the source impedance by a factor of 4. The benefits of this arrangement are: lower output (for use in high speed applications); lower output impedance (for compatibility with electronics with a low input impedance); and higher frequency response (for a given load impedance).



COILS IN SERIES

For series operation, the blue and green leads are tied together and the output is taken from the black and red leads. With the coils wired in series, the output is summed, producing the maximum sensitivity. Besides a high sensitivity, the transducer exhibits excellent noise immunity, attributed to the coils being wound in series opposition. Noise generated on one coil will be equal in magnitude but opposite in polarity to the other coil.



MAGNETS

The LVT's performance is directly associated with the condition of the magnet, or magnet assembly. In order to maintain optimum performance it is necessary to preserve the integrity of the magnet used with the transducer.

Trans-Tek uses two different magnetic materials in the LVT's:

ALNICO and CUNIFE

ALNICO is made from sintered metal, and is characterized by its high sensitivity, brittleness, plated surface, and threaded brass endcaps.

CUNIFE is machined from bar stock, and is characterized by its lower sensitivity compared to ALNICO, ruggedness, visible draw marks, and internal threads on each end of the magnet.

Subjecting the material to a very strong electromagnetic field of predetermined polarity aligns the molecule's charges. The strength of the magnetic field is a function of the strength of each molecule's charge, the number of molecules aligned and the path that the field takes. Proper care of the magnet is primarily a matter of guarding against changes in molecular alignment and magnetic field.

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HELPFUL HINTS

Changing the internal field path of the magnet

Inducing internal stresses by bending or gripping the magnet with pliers, or altering the magnetic path by scratching the magnet, will change the internal field path.

Operating in very strong electromagnetic fields

If a strong electromagnetic field is introduced that interrupts the magnet's field, it may disrupt the alignment of the molecules - resulting in a loss of magnetization. The duration and strength of exposure to the secondary electromagnetic field will determine how much magnetic field strength is lost.

Approaching or exceeding the Curie Temperature

The Curie Temperature of a magnet is the point at which the molecules return to their natural random polarization. For ALNICO magnets it is 540°C; for CUNIFE magnets it is 840°C. The recommended operating ranges for these magnets are 300°C and 540°C, respectively. If operating between the recommended operating range and the Curie Temperature, there will be some permanent loss of magnetic field strength which will equate to loss of sensitivity. Operation at or above the Curie Temperature will result in permanent loss of all magnetic field strength.

Contacting another strong magnet

This has the same effect as subjecting the magnet to a very strong opposing magnetic field.

Subjecting the magnet to a physical shock

A shock force of substantial magnitude will disrupt the alignment of the molecules. The amount and permanency of the loss depend on factors such as the magnitude and direction of shock force as well as duration.

Crack(s) in the magnet

Cracks in a magnet disrupt the continuity of the field and result in the loss of strength. ALNICO magnets are particularly susceptible to cracking if dropped.

COMMONLY ASKED QUESTIONS

How do I read the output?
Since the output of these transducers is DC voltage, the output can be read with a digital volt meter, A/D board, strip chart recorder or any other instrument capable of reading DC voltages. Since the output is generated only when there is motion, Trans-Tek recommends the use of a data recording device for applications requiring the analysis of velocity data.

How do I scale the output signal?
The output can be scaled by using a voltage divider across the leads. The resistance of the voltage divider as seen by the LVT should be kept above 10x the impedance of the transducer's coils.

Do I need an excitation voltage?
NO! These units generate a DC voltage output.

Is there a minimum velocity threshold?
No. Since this is an analog device, the resolution is dependent only on the instrumentation used to read the signal. However, speeds less than 0.01 in/sec can be difficult to read with standard commercial equipment.

Is there a maximum velocity threshold?
Yes. Maximum velocity of the transducer is limited only by the maximum permissible generated voltage of 500 VDC.

Which magnet material should I select?
ALNICO is usually selected for its high sensitivity - most beneficial in applications where velocity is going to be very slow. CUNIFE is selected for its ruggedness, and typically has one half the sensitivity of the ALNICO magnets.

Are extension rods available for these transducers?
Yes. There is a detailed list of extension rods published in the Accessories portion of the catalog. These rods can be purchased separately.