

LVDTs and ambient magnetic fields: A cautionary observation

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Experience with LVDTs used for reading septum positions in proximity to a high current DC buss in the Tevatron shows that the position reading is affected by the magnet current.

A bench test was conducted to verify suspicions of the nature of this effect. A commercial LVDT was placed within a solenoid which provided approximately ten gauss when connected to a small current source. The LVDT was held within a micrometer calibration fixture to allow precise adjustment of the plunger. Readings were taken at several positions across a one inch range, a field off reading and a field on reading for each position. The readings were subtracted to yield the position change due to the ambient B-field at each value of displacement.

The following plot shows the results. The ferrite plunger in the LVDT exhibits a nonlinear permeability, which causes a gain change with ambient field. In addition, the nonzero coercivity of the ferrite results in a possibility of a small permanent magnetization, producing an internal field which offsets the external field. Both characteristics can be seen in the plot.

The conclusion drawn here is that in applications in proximity to moderate or high ambient magnetic fields, ferrite LVDTs may not be an appropriate technology to use. Alternatives include a moving-coil LVDT or an eddy current LVDT, which use no ferromagnetic materials. Neither is apparently commercialized at this time, so additional R&D along these lines may be appropriate.

**LVDT position error
10 gauss field - zero gauss field
(hundreds of mils)**

