

## **CHAPTER 2**

### **SURVEY EQUIPMENT**

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**A) *RESPONSIBILITY***

The Department of Transportation has a large investment in valuable equipment. It is the responsibility of all employees using the equipment to treat it with the utmost care and maintain it in first class condition.

The survey chief is directly responsible for all equipment assigned to him. When any instrument or piece of equipment is released, exchanged or transferred, the Area Engineer shall make out transfer forms and submit copies to the Region Engineer, giving the serial numbers of the equipment and to whom it was transferred.

**B) *CARE OF INSTRUMENTS AND EQUIPMENT***

**Motor Equipment**

To operate a State vehicle, an employee must possess a valid South Dakota Driver License. Department vehicles must be operated in accordance with all applicable laws, regulations, and Department policies.

Vehicles are assigned to the Area Engineer. The Area Engineer delegates the responsibility for the care, maintenance, and operation of vehicles to assigned individuals. This individual is responsible to check the vehicle before starting operations each day, and to see that it is kept in safe operating condition. Any vehicle that is believed to be unsafe shall not be used until it is determined to be safe.

**Instruments**

Instruments should be kept in proper adjustment at all times.

If an instrument does require repair or major adjustments, the work should be completed by an individual qualified to do so. Field personnel may complete minor adjustments, using the instructional booklets supplied with various instruments.

It is the responsibility of the Survey Party Chief and all survey crewmembers to see that all equipment is handled and maintained properly.

## C) *ACCURACY CONCERNS*

Instrument errors, human errors, and natural errors all affect survey accuracy. Although errors cannot be eliminated, they can be reduced by an awareness of their causes.

### **Error in Total Station Work**

1. **Instrument Errors** - Errors in horizontal angles due to non-adjustment of plate levels or horizontal axis become large as the angle of inclination of the sight increases. Non-adjustment of the line of sight becomes of consequence only when the telescope is plunged. Errors due to instrumental imperfections or non-adjustments are all systematic. By proper methods of procedure, usually by double sighting, they may be eliminated or reduced to a negligible quantity. Double sighting and re-centering the plate bubbles between sights eliminates the systematic part of the error due to inclination of the vertical axis.
2. **Personal Errors** - Personal errors arise from the limitations of the human eye in setting up and leveling the Total Station, and in making observations. The Total Station may not be set up exactly over the point, the level bubbles may not be centered exactly, parallax may exist in focusing, and the line of sight may not be directed exactly at the point. All personal errors are accidental and hence cannot be eliminated. They form a large part of the resultant error in Total Station work.
3. **Natural Errors** - Sources of natural errors are caused by settlement of the tripod; unequal atmospheric refraction; unequal expansion of parts of the telescope due to temperature changes, and wind, which produces vibration in the Total Station.

### **Error in Level Work**

1. **Instrument Errors** - Adjustments, although carefully made, are never exact. The use of balanced back sights and foresights help eliminate any error in the instrument's line of sight. Instruments should be routinely checked to ensure that the line of sight is parallel to the leveling bubble.
2. **Personal Errors** - Personal errors arise from the limitations of the human eye in setting up, leveling the level, and reading the rod. Through constant checking, the instrument and rod reading errors can be held to a minimum.
3. **Natural Errors** - Natural errors for leveling work are the same as for Total Station work. Such errors can be held to a minimum by guarding against items that affect accurate levels. Bench levels should be run only on calm, slightly overcast days. Levels should be acclimated prior to use during cold weather to minimize unequal expansion or contraction of parts.