

## 2.0.0 LEVEL PARTY ORGANIZATION, EQUIPMENT and FIELD PROCEDURES

Basic preparations must be performed before any leveling survey is conducted. Proper planning and thorough identification of the procedures are essential to the success of the leveling operation. Participating in preparatory work enhances the experience and increases the capabilities of the crew members. Some of the preparatory work is discussed in the following paragraphs.

### 2.1.0 Level Party Organization

The size of the leveling party is dependent upon such variables as the order of accuracy required and the number of experienced personnel available. Ordinarily, the smallest crew consists of two individuals: an instrumentman and a rodman. To improve the efficiency of the leveling operations, additional personnel are required. The addition of a second rodman to alternate on backsights (BSs) and foresights (FSs) speeds up the leveling operation. By adding a recorder, the instrumentman can take readings as soon as the rodmen are in position. In surveys requiring a shaded instrument, an umbrellaman is required.

### 2.1.1 Duties of the Instrumentman = level man

An instrumentman, or levelman, runs the level and makes adjustments required for proper operation. The instrumentman ensures no stations are omitted, turning points (TPs) are properly selected, and BMs are properly established and identified. The instrumentman is usually designated by the EA1 or EAC to act as the chief of the party. When a two-man leveling party uses a self-reading rod, the instrumentman is also the recorder. However, if a target rod is used, the rodman usually acts as the recorder. A good instrumentman keeps within the required limits of error.

The chief of the party must be alert to recognize common problems encountered in the field and be able and ready to solve them using the best solution. Sound judgment in determining the proper course of action in handling problems helps assure both the quality of the survey and the meeting of survey schedules.

### 2.1.2 Handling Leveling Instruments and Equipment

Leveling instruments, as well as all surveying instruments and equipment, must be cared for and handled properly. Pay special attention to avoid any sudden shocks, jolts, and bumps which will require retesting of the instrument. A damaged or disturbed scientific instrument, however minor, can adversely affect correct and accurate results. Before using leveling equipment, inspect for signs of physical damage.

An engineer's level is a precision instrument containing many delicate and fragile parts. All movable parts should work easily and smoothly when unlocked. When a part resists movement, do not use force; forcing a part to move will likely damage the instrument.



Do not over-tighten clamps, as doing so can cause unwarranted wear and possible damage.

To ensure easy movement, lubricate the threads and bearing surfaces on movable parts, and always clean the parts before lubricating.

When oiling the parts, use only fine instrument oil. Do not use too much oil; excess oil gathers dust and also thickens, which interferes with the movement of the parts. This is especially true in cold weather where low temperatures cause oil to congeal. Use graphite powder as lubricant in cold weather conditions.

Store the level in its case when it is not in use and when transporting it to and from the job site. Tighten the level and clamp screws enough to prevent motion of the parts when it is inside the case. The case's strong construction and padding are designed to reduce the effect of jarring and protect the level from damage. When transporting the level by vehicle, place the carrying case midway between the vehicle's front and rear wheels. This is the point where bouncing of the wheels is minimized.

Never lift the instrument out of the carrying case by grasping the telescope. Wrenching the telescope in this manner can damage a number of delicate parts. Always lift the instrument out of the case by grasping the footplate or the level bar.

When you carry the instrument and the tripod from one setup point to another, loosen the level and clamp screws slightly. The screws should be tight enough to prevent the telescope from swinging and the instrument from sliding on the footplate, but loose enough to allow "give" in case of an accidental bump against an obstacle. You can carry the instrument over your shoulder

like a rifle if the terrain to be traveled is free of obstacles, as shown in Figure -7.

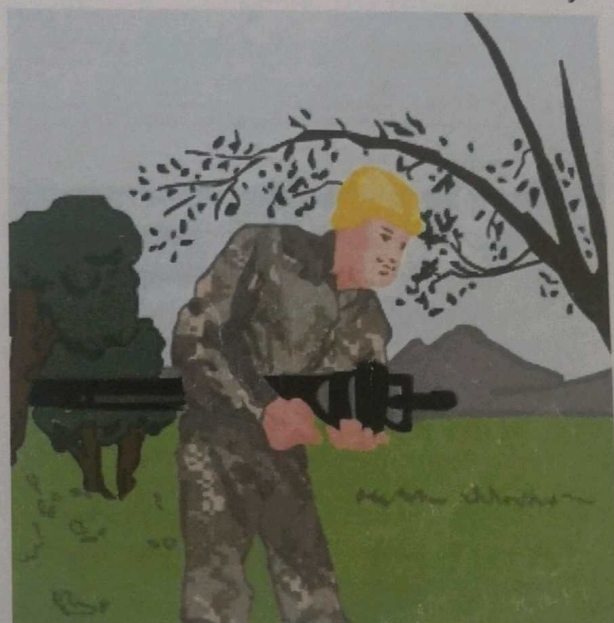


Figure -7 – Carrying surveying instrument.

A surveyor's umbrella should be used to avoid the effects of sunlight. If there is a great difference between the working temperature and the instrument storage temperature, the instrument should be acclimated to the actual working conditions approximately 15 minutes before observations begin.

### 2.1.3 Duties of the Rodman

The rodman is responsible for holding the leveling rod. The actions of a rodman in positioning and holding the rod affect the speed and accuracy of the leveling operation. The rodman is also responsible for taking care of the rod during and after the leveling operation. The rodman's duties include the following:

1. Clean the base (or shoe) of the rod before setting the rod on any point. Also clean the top of the point to ensure good contact between the rod and the point.
2. Place the rod firmly on the point, and then stand facing the instrument and slightly behind the rod; hold the rod in front of you with both hands, as shown in Figure -8. Space your feet approximately 1 foot apart for a comfortable stance.



Ensure the rod graduations are right side up and turned towards the instrumentman.

3. Hold the rod as vertical as possible. Place a rod level against the rod, and move the top end of the rod until the bubbles are centered. If a rod level is not used, balance the rod by using your fingertips to prevent it from falling. A properly balanced rod will stand for several seconds before starting to fall. This process of balancing the rod vertically is known as plumbing the rod.



Figure -8 – Correct stance for holding level.

4. Plumb the rod and hold it as steady as possible during strong winds. When windy conditions exist, the instrumentman may call for the rodman, to wave the rod. Wave the rod by pivoting it on its base and swinging it in a slow arc toward the instrument and away while keeping the shoe firmly seated. The motion of the rod permits the instrumentman to read the rod when it reaches a vertical position at the top of the arc and when the lowest reading appears on the rod.

5. Set the turning pin or pedestal firmly in contact with the ground when setting a turning point (TP). Unstable ground can sag under the weight of the rod and result in incorrect readings between the foresight (FS) and backsight (BS). During freezing and thawing weather conditions, the ground surface can heave in a short time. Pins and pedestals can be affected by the heaving between the FS and the following BS. For a higher order of accuracy in surveys, be aware of this possibility and select firm locations.

6. Extend the leveling rod to its maximum length when the instrumentman calls for extending the rod. The standard Philadelphia leveling rod can be read to 7.100 feet (2.164 meters) when collapsed and 13.000 feet (3.962 meters) when extended. An extended leveling rod is called a long rod.

A leveling rod is a precision instrument that has to be treated with care. Most rods are made of carefully selected, kiln-dried, well-seasoned hardwood with metal scale faces on which the scale graduations are painted. A rod should be handled with care; otherwise, the painted faces become scratched, dented, or damaged. Damage rods can make readings difficult and inaccurate.

Letting an extended rod close "on the run" by allowing the extended upper section to drop tends to damage both sections of the rod and the vernier. Always close an extended rod by easing down the upper section.