Level Rod Re-Calibration

Procedure Number: SOP # 6.2.1.1.2
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Purpose

This document has been written to ensure that bar code level rods are kept in an accurate and reliable condition, and conform to the Federal Geodetic Control Subcommittee's (FGCS) specifications. The FGCS' document, Specifications and Procedures to Incorporate Electronic Digital / Bar-Code Leveling Systems, version 4.1 dated 5/27/2004 (http://www.ngs.noaa.gov/FGCS/tech_pub/Fgcsvert.v41.specs.pdf) was referenced to complete this document. The FGCS document states "Rod calibration should be repeated whenever the rod is dropped or damaged in any way." In order to ensure the level rod's calibration is accurate and kept current, a maximum time limit between calibrations has been established. For first-order leveling, the time requirement is every three years, provided the rod is not dropped or damaged prior to that date. The Center for Operational Oceanographic Products and Services (CO-OPS) has established their own internal re-calibration schedule for second-order, first class levels. This schedule is based off of the above requirements, through communication with members of the FGCS, and the acknowledgement of the amount of bumps and vibration the rods are subjected to during travel between water level stations. Provided the rod is not dropped or damaged prior to the re-calibration date, the requirement is re-calibration will occur every five years. CO-OPS highly recommends that contractors performing work for our office follow our guidelines. CO-OPS will follow the FGCS standards for all other level orders. All level rods that will be leveling to first-, second-, and third-order standards will need to be initially calibrated before leveling to these standards.

This document will list the processes required to ensure the level rods are sent to the calibration facility in the proper condition and ready for immediate re-calibration.

Background/History

In order to ensure a level of accuracy for the three most precise leveling orders, the FGCS has established calibration standards. These calibration requirements are put into the federal government's level rod purchase contracts to ensure they are performed. After the level rods are manufactured, if calibrations are required, the manufacturer sends the rods to be initially calibrated. If calibration was not performed prior to receiving the new level rod, the equipment owner may contact a calibration facility to have calibrations performed.

Scope/Applicability

This SOP applies to the CO-OPS divisions, and the private companies with current and/or future contracts with CO-OPS, that own and/or have CO-OPS equipment that is under their control.

Main Processes

1. Make an Appointment
2. Clean Invar Strip
3. Clean Level Rods
4. Clean Bottom Foot Plate
5. Remove Struts
6. Pack for Shipment
7. Paperwork Recordkeeping

Detailed Sub-Processes/Checklists

1. Make an Appointment

If a level rod needs to be re-calibrated, the first step in the process is to make an appointment. One optional calibration facility is SLAC National Accelerator Laboratory in California (aka SLAC). SLAC has an agreement with the Department of Energy, and provides calibration services for government agencies and their contractors at no cost. SLAC provides only the calibration and does not plumb the level bubbles. They are able to calibrate Leica, Trimble/Zeiss, and Topcon (DL101) bar code rods, as well as all optical rods. When contacting SLAC, ask what time in the month (beginning or middle) they are available, and how many rods they are able to accept at that time. Their address with point of contact is:

Mr. Georg Gassner
Meteorology Department
SLAC National Accelerator Laboratory
2575 Sand Hill Road
Bldg 283, MS 21
Menlo Park, CA 94025

(650) 926-3689 Voice
(650) 926-4055 Fax
gassner@slac.stanford.edu
www.slac.stanford.edu/grp/met

Another option is to use the calibration facility at Laval University in Quebec, Canada. Unlike SLAC, this facility calibrates any brand of bar code level rod, as well as any brand of optical rod. They also check and adjust the level bubbles (at no cost) to ensure that the rod will be plumb when set up. At the time of writing, the minimum cost for calibration is $550 per rod ($500 for calibration and $50 for the RILOAD file). If an adjustment is needed, an extra $100 will be required for this service (total $650). There is no limit to the number of rods that can be sent at one time, and the turnaround time is approximately two weeks. Lastly, a sticker is included that lists the date of calibration. The preferred method of contact is via email, but a phone number with requested contact name is included.

The Director of this laboratory is:

France Plante, Ph.D., Eng.
France.Plante@scg.ulaval.ca

Laboratory of Metrology, PEPS
2300, rue de la Terrasse, local 00421
Universite Laval
Quebec, Canada
G1V 0A6

Phone: (418) 656-2295 Ask for Guy Montreuil

Ensure your organization's name, with the initials following in parenthesis (i.e. CO-OPS, WHG, etc.) are received by the calibration facilities. The initials are important, as NGS enters into its database whatever is listed on the final report. For example, NOAA was listed on some of our final reports, and our rods were entered into NGS' database as belonging to NOAA, instead of CO-OPS.

2. Clean Invar Strip

The invar strip should be clean of all dust and dirt. The preferred method is to wipe the invar strip with water and a soft cloth. If soap or detergent is needed, add water to dilute the mixture. Follow the soap/detergent with the plain water cleaning noted above to ensure any soap/detergent residue is removed.

3. Clean Level Rod

The level rod should be wiped down, both front and back, as noted above for the invar strip.

4. Clean Bottom Foot Plate

The bottom foot plate is very important to accurate leveling, and should be inspected and cleaned on a regular schedule. Being "chrome-alloy, chemically nickel-plated steel," the foot plate is susceptible to rust when subjected to salt water. If the rust is bad enough, pits in the plate can occur, possibly affecting leveling accuracy.

The foot plate must be clean, both on the bottom and the sides, and free of any pits. Figure 1 below is from a final report, and shows a bad foot plate.

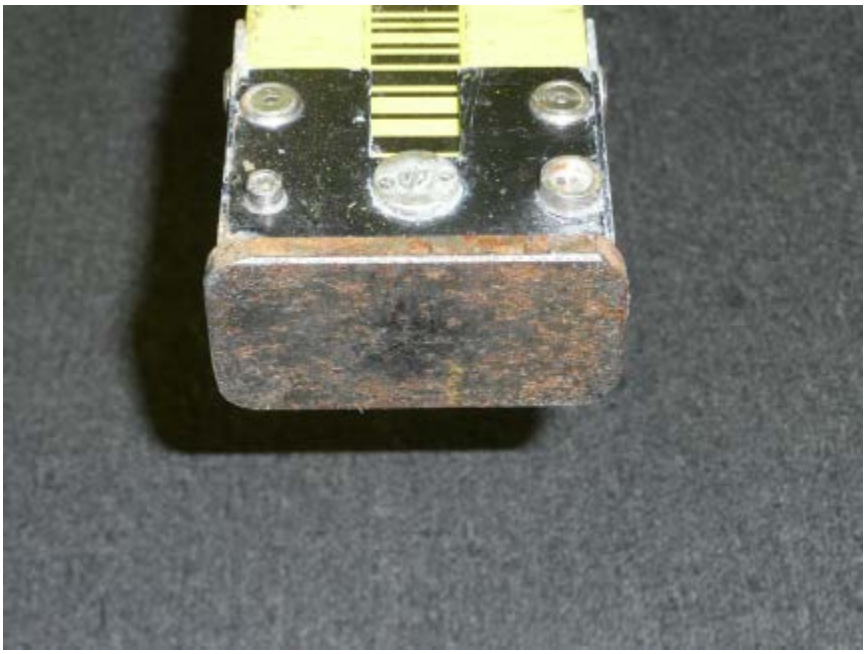

Figure 1: Leveling rod with a rusty foot plate.

"The rod's footplate has multiple gouges. It is not recommended to use the rod for any high precision surveys without repairing the footplate."

Rust can be cleaned off many ways, including chemicals, polishing, and sanding. However, if the rust is sanded off, ensure fine grits are used when finishing in order to leave a smooth finish on the foot plate. Sanding is to be used only when preparing the rods for re-calibration.

5. Remove Struts

The struts (or legs) are to be removed before shipping, as they will not be needed. The rods will be put in fixtures, and the struts interfere and prevent the rod from fitting correctly.

6. Pack for Shipment

If possible, the rods should be packed in their original wooden cases. Attach one centering shoe with the hole offset toward the invar strip to one of the rods in the case. Please see figure 2 below.

Figure 2: Wrong centering shoe for the rod. Correct centering shoe on top.

"The bottom centering shoe has a hole at the center of the footplate. The correct spot to set up the rods for calibration is not the center of the footplate; see the centering shoe at top. The rods should be set up in line with the scale itself, indicated with a green dot in the picture above. This minimizes errors if the rod is not set up perfectly."

Protect the wooden case by either using the original cardboard shipping box or by wrapping it with cardboard. "Fragile" or "Scientific Instrument" stickers on the outside of the cardboard are recommended, as shipping companies' employees tend to handle the cases roughly, believing the wood can take the harsh treatment.

7. Paperwork Recordkeeping

Upon completion of the level rod's calibration, the equipment owner should receive both a hard copy and an electronic copy of the calibration report. An electronic copy of the RI load file must be sent to the CO-OPS task manager or technical representative. The electronic RI load file will be entered into the National Geodetic Survey's (NGS) database. Until this occurs, the level rod will not be considered to have been calibrated. The equipment owner will need to update their copies of Translev, specifically the "Rods.dat File." This file contains the level rods that have been calibrated and are entered into NGS' database. In order to update this file, the user can click on the WebTools drop-down menu button, then Update, and finally Rods.dat File. A pop-up box will appear asking if the user wants to include optical rods, this is their choice. The user will need to close and re-open Translev for the changes to occur. To view the Rods.dat File, the user can click on the Edit drop-down menu button; the selection is at the bottom.

Quality Assurance/Control

As noted above in the Purposes section, this standard operating procedure is enacted to meet standards that have been set by the FGCS, a subcommittee of the Federal Geographic Data Committee (FGDC). Additionally, CO-OPS has established internal calibration standards for bar code rods leveling to second-order first class requirements. "The Federal Geodetic Control Subcommittee (FGCS) exercises governmentwide leadership in coordinating the planning and execution of geodetic surveys, in developing standards and specifications for these surveys, and in the exchange of geodetic survey data and technical information. FGCS coordinates agency responsibilities which include standards setting, testing new geodetic instrumentation and operational systems, coordination of user agency requirements, and dissemination of government data to user agencies."

"The Federal Geographic Data Committee (FGDC) is an organized structure of Federal geospatial professionals and constituents that provide executive, managerial, and advisory direction and oversight for geospatial decisions and initiatives across the Federal government. In accordance with Office of Management and Budget (OMB) Circular A-16, the FGDC is chaired by the Secretary of the Interior with the Deputy Director for Management, OMB as Vice-Chair. The FGDC's structure is represented in the graphic below and further details on the committees and their membership follow."

Management/Responsibility

The responsibility for ensuring that level rods are calibrated lies with the entity that owns or controls that particular piece of equipment. If Government-loaned level rods are returned in a condition which cannot be re-calibrated or fails re-calibration, then the entity or contractor the equipment was loaned to is responsible for replacement or repairs.