The Technical Side : Instrument Overhaul

by Chris Cothrun, Service Technician, Ingenuity, Inc.

In the last issue of the Technical Side, we discussed some of the reasons you need to have your instruments serviced occasionally. In this issue we will cover what exactly most reputable repair shops do to your instrument to keep it working as it should. When an instrument comes in for service it is first evaluated. The instrument is checked for any pre-existing problems, and its condition is evaluated to determine the extent of service it needs. The amount of dust and dirt on and inside the instrument, the extent of wear on the tangents and bearings, and any repairs that are needed determine what service is to be performed. It is checked for tight or very loose tangents and excess movement in the focus assemblies and telescope bearings. If the instrument is in good shape and has no major problems, a "minor cleaning" is all that is needed. On the other hand, if it is extremely dirty, showing signs of wear on the bearings or other critical mechanical assemblies, or requires disassembly for other repairs, it would be recommended for the complete service.

The "minor cleaning," as we call it, involves cleaning the tribrach, the tangents, the focus assemblies, the exterior of the instrument, as well as the case and accessories. These assemblies receive the most wear and are the components that have the most exposure to dust and dirt. The tribrach and tangents are removed from the instrument and disassembled. The tribrach level screws and tangent parts are marked during disassembly so matching parts are put back together during reassembly. The fine threads develop individual wear patterns during use and must be matched back up during reassembly. If they are not matched up, the wear increases and the threads can even bind. The focus assembly is disassembled and cleaned. This keeps it clean and smooth and ensures your line of sight does not change while focusing the instrument. After disassembly, the metal parts are run through an ultrasonic solvent bath and then washed clean. The optics and plastic parts are cleaned by hand so they will not be damaged in the solvent. The clean parts are reassembled with new wide-temperature range lubricants. The reassembled tangents and focus assemblies are put back in the instrument, the tribrach goes on, the exterior is cleaned, and the instrument is ready for final collimation.

The major overhaul is much more involved. After the initial evaluation, the instrument is completely taken apart.

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Again, many of the parts are marked to assure they are properly matched up when reassembled. On any optical angle reading instruments, the prisms and optical assemblies must have their positions marked to make the optical reassembly and adjustment much easier. On electronic instruments, the angle reading electronics and the circle positions are marked to make reassembly and adjustment easier. Once the instrument is taken apart, most of the parts go through the ultrasonic solvent bath and then the washing process described above. The remaining optics, circles, electronics, and the other miscellaneous parts that cannot be immersed are cleaned by hand. The reassembly of the instrument is then started.

During reassembly, some of the moving parts or bearings may need to be refit. The most common bearing-wear problem is telescope side play. Critical components are precisely ground steel assemblies. Whether free floating or loaded with pressure, steel bearing side play may ultimately depend on a brass bushing. This bushing wears and needs to be refit or, in some cases, replaced. Bearings, even steel, do wear and can place angle reading optics in different positions from where they were when originally manufactured.

Realignment for optical instruments is done when adjusting the prisms and lens assemblies. Electronic angle reading systems are realigned electronically, usually with an oscilloscope or on/offboard computer software. Bearing play is so critical for electronic instruments that trouble-shooting and adjustments can only be done with electronic test equipment.

Electronic equipment requires adjustment of circuit boards to meet manufacturers' specified waveforms. Electronic total stations may require focus and alignment of EDM to infinity. All the other components, such as compensators and micrometers, are reassembled and adjusted to factory specifications. Since the instrument was completely disassembled, everything must be readjusted. Final collimation and calibration are performed on a collimator system that allows infinity targets to be observed inside an office or instrument facility.

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