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Mechanical and optical tests of Zeiss THEO 010 and 020 nonmagnetic theodolites during the IAGA workshop 2018 at Conrad Observatory

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During the IAGA workshop 2018 at Conrad observatory, 30 nonmagnetic theodolites of the Zeiss THEO series were tested for their mechanical and optical properties. Next to an inspection of the instruments, the horizontal circle error (collimation error) and the vertical circle error were determined with the help of a surveyor's level. While half of the instruments were fine, the others were in need of adjustment or repair. Typical problems requiring repair are sluggish vertical axes and mechanical problems of the coaxial fine-tuning. Typical adjustment problems are the position of the image in the microscope and collimation and vertical circle errors.

The tests were performed by JK who was responsible for final control and adjustment at Carl Zeiss Jena. The tests started by mounting the theodolite on a tripod opposite of a surveyor's level (Figure 1) and a first visual inspection of the instrument.

Figure 1: Test of a steel-free converted Zeiss THEO 020A theodolite during the IAGA Workshop 2018. From left to right: Alan Berarducci, Jörg Krüger, Theo 020A, Carl Zeiss Jena Ni 002 collimator with green light source at ocular.

Mechanical inspection. First, the mechanical play of the vertical axis system was tested by slightly lifting the alidade up from the tribrach. Then, the vertical and horizontal axis rotation were tested for sluggishness. The clamps were tested by moving the alidade/telescope slightly under clamped conditions (a click-sound indicates proper clamp adjustment). The fine-tuning was tested, it should be easy to rotate and a click-sound should be heard when reaching the fine-tuning limit. The tuning of the micrometre plate (010 only) was tested.

Optical inspection. The optical images in the microscope were checked to have the right lateral position, size and focus. The images were checked for irregular structures that arise from degenerated glue of the optical parts, from fungus, or from dust/water/oil droplets.

Test with surveyor's level. A Zeiss Ni 002, the most accurate surveyor's level (compensator) by Carl Zeiss Jena (0.2 mm on 1 km or 0.04'' deviation) was used to determine horizontal (collimation) or vertical circle errors of the theodolites tested (Figure 1). By looking with the telescope to be tested into the objective of the Ni 002, a cross hair identical to the THEO cross hair can be seen. A tilt of the cross hair and an error of the vertical index can be diagnosed by this method. The angular difference between face left/face right (sensor up/sensor down) observations of that cross hair is noted. Small errors could be corrected by adjusting the cross hair of the THEO. In this process, all spirit levels were adjusted.

Results. About half of the instruments were found to be ok, while the other half needs adjustment or repair. Recommendations on the treatment of Zeiss THEO theodolites are given in Matzka et al., 2018.

Documentation and outlook. We documented all test results and the participants were informed about the results at the workshop and/or by email. We regard this article as a first step and hope to come up with a more comprehensive test strategy and documentation during the next workshop, based on the experience at the Conrad Observatory 2018 workshop.

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Matzka et al., 2018. How to treat the Zeiss THEO 010 and 020 nonmagnetic theodolites. This volume.

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