

The Leica TCRA1105 Reflectorless Total Station

F. Gaudreault, et al.

Presented at 8th International Workshop On Accelerator Alignment (IWAA 2004) ,
10/4/2004—10/7/2004, Geneva, Switzerland

Stanford Linear Accelerator Center, Stanford University, Stanford, CA 94309

Work supported by Department of Energy contract DE-AC02-76SF00515.

THE LEICA TCRA1105 REFLECTORLESS TOTAL STATION

Metrology Department, Alignment Engineering Group
Stanford Linear Accelerator Center

FRANCIS GAUDREULT, GEORG GASSNER, MICHAEL GAYDOSH, MICHAEL ROGERS

TCRA1105 SPECS

Distance measurement (IR: Infrared)

Range (average atmospheric conditions)
Round prism (GPR1): 3000 m
360° reflector (GR24): 1500 m
Mini prism: 1200 m
Reflective tape (60 mm x 60 mm): 250 m
Shortest measurable distance: 0.2 m to round prism (GPR1) / 1.5 m to a 360° reflector (GR24)
Accuracy (ISO 17123-4) / time for a measurement
Standard mode: 2 mm + 2 ppm / 1.0 sec Positioning accuracy: 5 cm at 100 m
Tracking mode: 5 mm + 2 ppm / 0.3 sec
Quick mode tracking: 10 mm + 2 ppm / < 0.15 sec
Display resolution: 1 mm
Method Principle of phase measurement (coaxial, invisible infrared laser)

Reflectorless and Long Range distance measurement (RL)

Range (average atmospheric conditions)
Reflectorless (extended range): 170 m (Kodak Gray Card, white side)
Reflectorless (standard range): 80 m (Kodak Gray Card, white side)
Shortest measurable distance: 1.5 m
Long Range to round prism (GPR1): 1000 m – 5000 m
Accuracy (ISO 17123-4) / time for a measurement
Reflectorless (standard mode): 3 mm + 2 ppm / type: 3–4 sec, max. 12 sec
Reflectorless (tracking mode): 10 mm + 2 ppm / type: 3–6 sec, max. 12 sec
Long Range: 5 mm + 2 ppm / type: 2.5 sec, max. 8 sec
Laser dot size
At 50 m: approx. 10 mm x 20 mm
At 100 m: approx. 15 mm x 30 mm
At 200 m: approx. 30 mm x 60 mm
Method Principle of phase measurement (coaxial, visible red laser)

Angle measurement

Hz, V (ISO 17123-3): 5" (1.5 mgon)
Display resolution: 1" (0.5 mgon)
Method absolute, continuous, diametrical
Electronic Guide Light (EGL)
Range (average atmospheric condition)
Working range: 5 m – 150 m
Accuracy
Quick mode: 5 mm + 2 ppm / 0.5 sec

General Data For TCRA1105:

Compensator Type 1105

Setting range: 4" (0.07 gon)
Setting accuracy: 1.5" (0.5 mgon)
Method: centralized dual axis compensator

Control unit

Display: 8 lines with 32 characters 256*64 pixels, graphic LCD
Keyboard: 30 keys (6 function keys, 12 alphanumeric keys)
Angle display: 360° + 360° (decimal), 400 gon, 6400 mil, %
Distance display: Meter, Int. Ft, Int. Ft/Inch, US Ft, US Ft/Inch
Numbers: 1 / 2 (optional)

Laser plummet

Accuracy: deviates from the plumb line 1.5 mm (2 sigma) at 1.5 m
Point diameter: 2.5 mm at 1.5 m

Battery

Type: Nickel Metal Hydride (NiMH)
Voltage: 6 V
Capacity (GEB121): 3.6 Ah
Number of measurements: 400 – 600

Working environment

Working temperature range: -20°C to +50°C
Storage temperature range: -40°C to +70°C
Humidity: max. 95% non-condensing Dust/water (IEC 60529): IP54

Telescope

Magnification: 30x
Free aperture of objective: 40 mm
Field of view: 1°30' (1.66 gon) / 2.7 m at 100 m
Focusing: 1.7 m to infinity

Data storage

Memory card: PCMCIA ATA Flash (16 MB) / PCMCIA SRAM (512 KB, 2 MB)
Number of data records: 18000 / 2 MB
Interface: RS232

Endless drive

Number of drives Hz / V: 1 / 1
Steps: infinite

Weight

Instrument: 4.7 – 4.9 kg (10.4 – 10.8 lbs)
Battery (GEB121): 0.4 kg (0.8 lbs)

Laser Classifications:

Electronic Guide Light (EGL)

LED class 1 acc.

Distance meter (IR, ATR and Power Search)

Laser class 1 acc.

Distance meter (RL, standard range) and laser plummet:

Laser class 2 acc.
Laser class II acc.
620-690nm/0.95mW max.

Distance meter (RL, extended range):

Laser class 3R acc.
Laser class IIIa acc.
620-690nm/4.75mW max.

This poster provides an overview of SLAC's TCRA1105 reflectorless total station for the Alignment Engineering Group. This instrument has shown itself to be very useful for planning new construction and providing quick measurements to difficult to reach or inaccessible surfaces.



NOTE: Above photo and Specification information was retrieved from Leica Geosystems web site which states the descriptions and technical data are not binding and may be changed without notice.

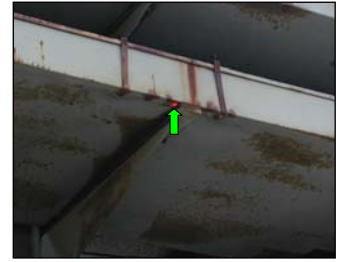
TCRA1105 Application Examples



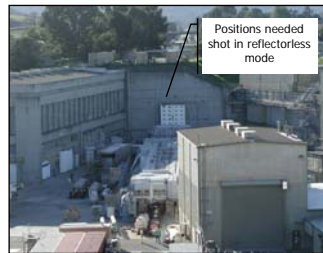
Once the instrument has been oriented utilizing the programs available on the instrument such as **Free Station**, edges and corners can be picked up fast and efficiently without the aid of a second person holding a prism in reflectorless mode. Selecting the REDL (Red Light) assists the operator in locating where the instrument is pointing; as seen by the red dot of light above.



Sighting a target is unnecessary with the REDL mode on, allowing quick accurate observations. This is demonstrated in the above photo as the ceiling is shot almost directly above the instrument setup.



Getting ready to observe the cable tray and columns located along side of the instrument in the picture to the left, for designing a wire test simulation for the LCLS. It was found that occasionally you would receive erroneous information if the beam didn't shoot enough of the part you were aiming at. This is also attributable to the angle the part is shot at; along with the type of material being shot. The more reflective a material, the less signal you get back.



The distance from the end of the END Station C Wall to the front of the steel painted white is shot quickly in reflectorless mode, avoiding having a person climbing on the roof for the LCLS project.

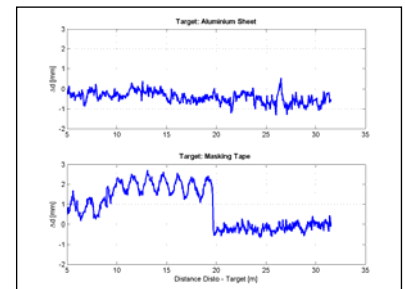


SSRL needed the location of all columns within there various buildings. Some of the columns were inaccessible due to Experimental Hutches. This was no problem in reflectorless mode. If there was too many obstructions you could get interference resulting in a bad observation.



Here the instrument is being used in its robotic mode, allowing an individual to run the instrument from the prism pole. Data collection is done with the **Allegro CE** computer and **SurvCE** software or with the onboard data collection software of the TCRA1105.

Calibration Results in Reflectorless mode



Here are several runs on the calibration bench with respect to the interferometer. In the bottom graph the target material was masking tape. Disconnected areas on the graph are attributed to the masking tape. In the top graph an aluminum sheet was used as a target with no disconnects. Both materials met Leica's specifications of +/- 3mm.

