NEOMETRIX

Neometrix Optical Balloon Theodolite

Product Catalog

www.neometrixgroup.com

About us:

Neometrix Defence Celebrating 20 Years of Excellence! For the past two decades, Neometrix Defence has maintained its position as a premier provider of advanced test benches and rigs.

Our accreditation by the Directorate General of Aeronautical Quality Assurance, India (DGAQA) and Defence Research & Development Organization, India (DRDO) underscores our commitment to upholding the highest international defence industry standards.

Counting the Indian Air Force/Army/Navy, Ministry of Defence, Hindustan Aeronautical Limited, and DRDO among our esteemed clientele, we are recognized for delivering state-of-the-art solutions and unwavering performance reliability.

Strengths & Capabilities:

Neometrix Defence is a powerhouse of engineering brilliance, proudly serving every Indian Air Force station and partnering with the Indian Army, Navy, Railways, BARC, NPCIL, and ISRO. With a team of over 100 elite engineers and visionary founders from IIT Kanpur and IIT Delhi, we harness cutting-edge technology to set the gold standard in mechanical engineering.

We Don't Just Meet Industry Demands – We Define Them!

- We have established our presence in all Air Force stations across India. With the Indian Air Force as our leading customer, we are dedicated to upholding the highest standards of excellence in the aerospace industry.
- Our extensive clientele extends beyond the defence industry, including projects with the Indian Army, Navy, Railways, BARC, NPCIL, ISRO, and more. In essence, we excel in all aspects of mechanical engineering!
- Our team comprises over 100 graduate engineers, supported by a cutting-edge manufacturing site equipped with state-of the-art machinery, enabling us to meet the highest Engineering standards.
- The founders of our company are distinguished graduates from IIT Kanpur and IIT Delhi, bringing extensive expertise and a wealth of engineering knowledge to Neometrix Defence.

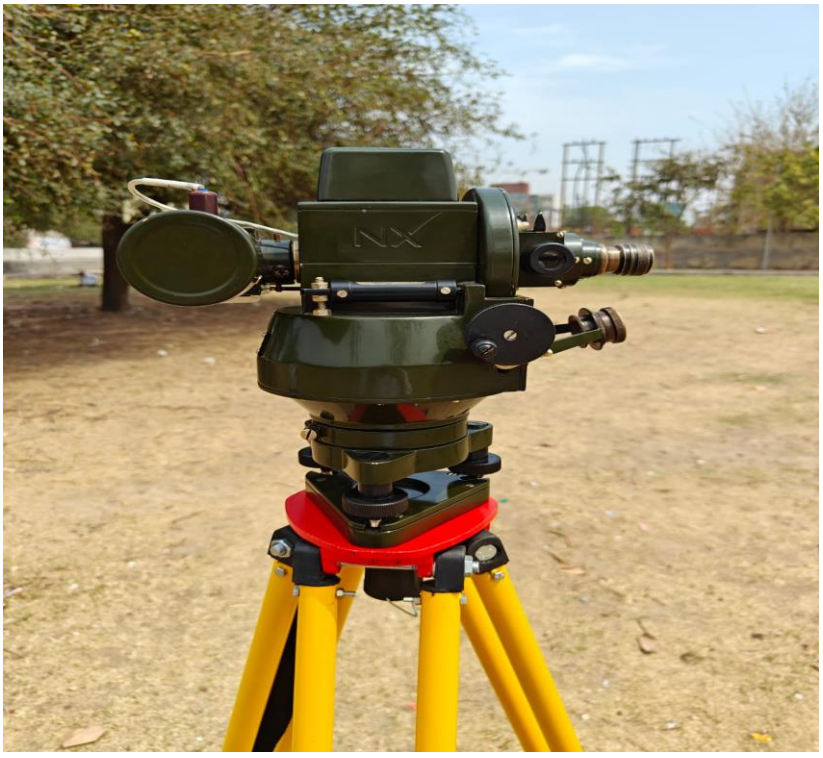
Table of contents

Sr No.	Description	Page no.
1	Introduction	1
2	Purpose & Application	2
3	System Architecture	3
4	Technical Specifications	4
5	Mechanical & Environmental Design	5
6	Operational Workflow	5-6
7	Safety, Compliance & Quality	6

Introduction:

The Neometrix Optical Balloon Theodolite is a turnkey ground-station instrument engineered for precision angular tracking of both tethered and free-flying balloons. It measures azimuth and elevation simultaneously to compute real-time wind vectors and cloud-base heights. Its rugged aluminium-alloy frame, vibration-damped mount, and sealed bearing design ensure stable readings in –10 °C to +50 °C environments, with up to 60 % relative humidity. Optical components include a bent-axis telescope with a precision-ground pentagonal prism to preserve collimation through 180° elevation swings, and a switchable mirror assembly delivering 5× (8° FOV) and 21× (2° FOV) views through a single ergonomic eyepiece. Graduations on closed, dust-proof circles are read to 0.1° via micrometre drums, while backlit scales and LED vial illumination allow low-light operation. A modular NiMH battery pack sustains up to 8 hours of continuous use in remote settings.

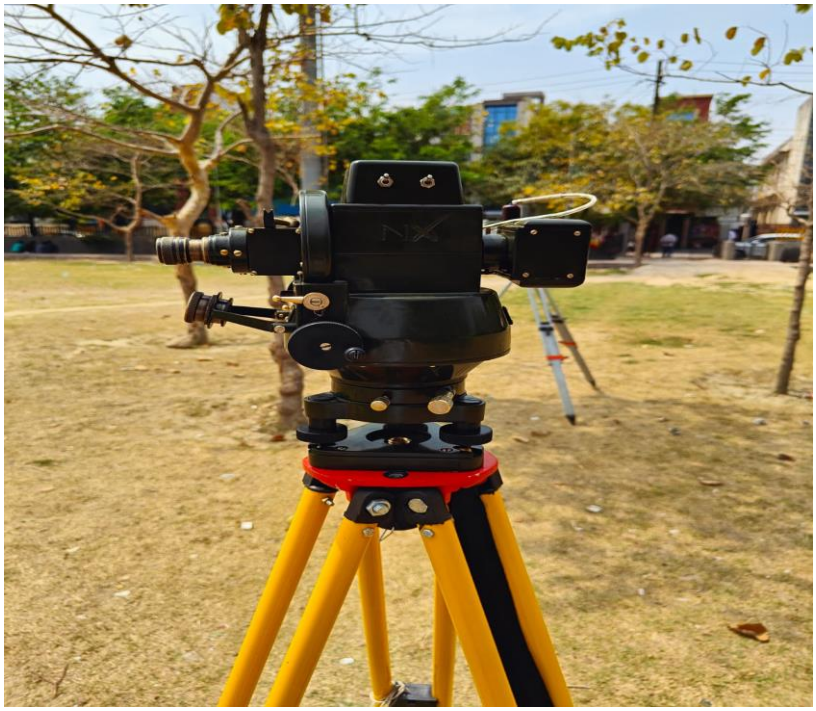
Designed with operator comfort and efficiency in mind, its lightweight ergonomic handle and counterbalanced pivots reduce fatigue during prolonged observations. Integrated data ports support direct connection to handheld data loggers or laptops for seamless transfer of angle readings, and optional software modules enable automated plotting of wind profiles and cloud-base charts. The instrument's quick-release tribrach mount allows rapid redeployment between sites, while its custom-moulded carrying case with shock-absorbing foam ensures protection during transport. Whether deployed for routine meteorological surveys, Defense calibration exercises, or academic field research, this theodolite delivers dependable performance and ease of use in the harshest conditions.



Purpose & Applications:

The Neometrix Optical Balloon Theodolite transforms simple angular observations into detailed environmental insights, making it a vital tool for meteorology and aviation safety. In wind profiling, operators release helium- or hydrogen-filled pilot balloons ascending at controlled rates (300–400 m/min) and log azimuth and elevation every 30–60 seconds. These sequential readings are converted via trigonometric algorithms into three-dimensional wind-speed and wind-direction profiles up to 3 km above ground, feeding numerical weather-prediction models, wind-turbine site assessments, and flight-planning decisions in complex terrains. For cloud-base determination, ceiling balloons tracked until burst provide elevation angles that, combined with known ascent rates, yield cloud-ceiling heights with ± 50 m accuracy—critical data for civil and military aviation, wildfire management, and agricultural spraying operations constrained by safety regulations.

Beyond meteorology, the theodolite supports defence calibration, atmospheric research, and education. Tethered or drifting balloons offer precise reference targets (0.1° accuracy) to calibrate ground-based radars, laser trackers, and missile-guidance systems, while training exercises simulate drift patterns to validate fire-control algorithms and operator response under realistic wind conditions. In environmental studies, sensor-equipped balloons map pollutant dispersion and turbulence in the boundary layer across urban, rural, and coastal sites, leveraging the instrument's portability for long-term campaigns with minimal downtime. Academic institutions integrate the device into surveying and meteorology curricula, where students master parallax correction, error analysis, and vector decomposition through hands-on balloon-tracking experiments, reinforcing theoretical concepts and best practices in field instrumentation.



System Architecture:

- Opto-Mechanical Core
    - Bent-axis telescope with precision-ground pivot points maintains optical collimation through a full 180° elevation sweep.
    - Pentagonal prism assembly redirects light without introducing angular error, ensuring identical sightlines in both elevation runs.
    - Concentric closed-circle discs for horizontal and vertical axes are fully sealed against dust and moisture, preserving graduation integrity and preventing drift over time.
- Magnification Switching
    - Mirror-guided optical path flips between two fixed objectives—5× wide-angle (8° FOV) for rapid target acquisition and 21× narrow-angle (2° FOV) for fine centering.
    - Single-eyepiece design eliminates the need to swap oculars, reducing operator fatigue and minimizing setup time.
    - Positive-lock detent ensures each magnification setting clicks firmly into place, preventing intermediate positions and guaranteeing repeatable imaging.
- Precision Drives
    - Bronze-on-bronze tangent screws engage with minimal backlash, enabling sub-arcminute control in both azimuth and elevation adjustments.
    - High-pitch gearing delivers smooth, incremental motion—ideal for tracking slowly moving targets such as ascending balloons.
    - Ergonomic focusing knobs are positioned for natural hand placement, allowing one-handed fine adjustments while stabilizing the instrument.
- Illumination Subsystem
    - Dual 2 V/3 V miniature lamps mounted behind each axis' scale provide uniform backlighting of etched graduations in low-light or overcast conditions.
    - LED-lit tubular vial ensures levelling bubbles remain visible during nighttime operations or inside tents and shelters.
    - On-instrument switch offers three positions (off, lamp only, lamp + LED) and is shrouded against accidental toggling.

- Power & Mounting

  - Detachable NiMH battery module slots into the base housing; hot-swappable design allows uninterrupted illumination—up to 8 h runtime per charge.
  - Universal 5/8″–11 UNC tribrach interface simplifies mounting on standard surveying tripods, with quick-release clamps for rapid repositioning.
  - Integrated bubble-level retainer under the tribrach accommodates additional levelling aids (e.g., electronic inclinometers) without adding bulk.

Technical Specifications:

Parameter	Specification
Drive Type	Bronze-on-bronze tangent screws; zero backlash
Magnification	5× (8° FOV) / 21× (2° FOV)
Objective Diameter	12.5 mm (finder) / 40 mm (main telescope)
Angular Resolution	0.1° (micrometre drum reading)
Levelling Vials	Plate vial; circular vial (10′ sensitivity); tubular vial (5′)
Illumination	2 × 2 V/3 V miniature lamps + LED vial backlight
Battery Life	Up to 8 hours continuous (NiMH pack)
Weight	6.7 kg
Tripod Interface	5/8″–11 UNC tribrach mount
Operating Temperature	–10 °C to +50 °C
Humidity (Operating)	Up to 60 % non-condensing

Mechanical & Environmental Design:

Encased in a corrosion-resistant aluminium-alloy housing with a matt-black, hard-anodized finish, the instrument withstands prolonged UV exposure and chemical vapours without surface degradation. The closed-circle discs are sealed to IP54 standards, preventing ingress of dust, sand, and light moisture, while foam-filled lens caps further safeguard the optics when not in use. Sealed roller bearings on both axes eliminate metal-to-metal play and ensure smooth, repeatable movement even after thousands of cycles. A dual-stage vibration-damped base, incorporating elastomeric isolators and precision-tuned springs, decouples the telescope assembly from ground shocks and wind gusts, maintaining target lock under challenging conditions.

All external fasteners are machined from aviation-grade 17-4 PH stainless steel, offering superior corrosion resistance and tensile strength in marine or coastal deployments. Internal electronics are mounted on shock-absorbing gaskets and feature conformal-coated PCBs to repel humidity and salt spray. The ergonomic rubberized handle and low-temperature grease ensure comfortable handling and consistent torque in subzero environments. The custom-moulded, impact-resistant carrying case includes integrated desiccant packs, a humidity indicator card, and room for optional wind-shield shrouds and sun-shade accessories—providing complete protection and rapid deployment for global field campaigns.

Operational Workflow

Setup & Levelling: Secure tribrach to a sturdy tripod. Use the plate vial to level coarse elevation, then fine-adjust with the circular vial. Lock levelling screws once centred.

Parallax Elimination: Cap the objective; focus the eyepiece on the reticle. Cap the eyepiece; focus the objective on a distant object. Repeat until reticle and target are sharp simultaneously.

Balloon Launch & Tracking: Inflate a standard 40 cm pilot balloon. Release in line with the instrument's horizontal plane. Begin recording azimuth/elevation every 30 s using the built-in stopwatch hook.

Data Logging & Transfer: Manually note readings in the field notebook or upload to digital logger via USB interface (optional accessory).

Analysis: Apply trigonometric formulas to convert angular data and known ascent rates into altitude and wind-vector components. Graph results in spreadsheet or meteorological software.

Safety, Compliance & Quality:

- Standards: MIL-STD-810G shock & vibration; IP54 ingress protection.
- Certifications: DGAQA & DRDO-approved; ISO 9001 & AS 9100 certified.
- Calibration: Supplied with a calibration certificate. Annual recalibration recommended to maintain 0.1° accuracy.
- Documentation: Comprehensive user manual, maintenance guide, and test reports included.