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NEOMETRIX

Universal Hydraulic Test Rig

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.

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Introduction:

The Universal Hydraulic Test Rig from Neometrix Defence is engineered as a fully automated, high-precision laboratory platform to validate every aspect of hydraulic component performance. At its heart sits a 1 200 L SS-304 reservoir, meticulously machined and laser-welded for leak-free operation, which feeds dual 320 LPM pumps capable of generating pressures up to 350 bar. Integrated sight-glass level indicators and PT100 temperature sensors monitor oil condition in real time, while a duplex/simplex filtration loop ($\beta \geq 200$) and SS-304 plate heat exchanger maintain ISO 4406 cleanliness and ± 2 °C thermal stability. Ergonomically arranged operator stations, each with a Siemens Comfort Panel HMI, guide users through tool-free fixture changes, recipe selection and live data visualization—ensuring that every pump, motor, valve, cylinder and check valve undergoes rigorous performance, leakage and endurance testing under repeatable, field-relevant conditions.

Building on our two decades of expertise, this rig delivers fully traceable test reports complete with timestamped data, trend analysis and pass/fail criteria aligned to international standards (ISO, DIN, SAE). Its modular skid design and quick-release fixtures allow rapid reconfiguration between test programs, minimizing downtime. Furthermore, remote-access diagnostics and over-the-air software updates ensure your team can maintain peak performance and incorporate new test profiles seamlessly—maximizing both uptime and ROI.

Purpose & Applications:

Research & Development:

- In cutting-edge R&D environments, the rig's ability to reproduce complex test cycles—including ramp-soak sequences, variable-frequency drive control and hydrostatic burst testing—enables engineers to generate comprehensive P–Q, η–Q and power curves complete with uncertainty analysis. Automated report templates conforming to ISO 4401 and SAE J744 standards deliver digital certificates suitable for regulatory submissions and OEM qualification.

Production & Quality Control:

- On production lines, batch-testing protocols can be deployed to automatically cycle dozens of components per shift, with SPC charts tracking key metrics such as internal leakage, dynamic response time and efficiency. Fail-safe interlocks halt any test that drifts beyond tolerance, while consolidated "pass/fail" summaries and QR-coded certification labels streamline goods-out inspections.

Maintenance & Overhaul:

- For refurbishment workshops, the rig's endurance-cycling mode delivers up to 1 000 test cycles per hour, simulating years of field service in a matter of days. Condition-monitoring routines flag early signs of wear—such as rising leakage rates or shifting pressure–flow curves—so that maintenance teams can replace seals and bearings proactively, avoiding unplanned downtime.

Education & Training:

- Academic institutions benefit from guided lab exercises covering fluid-power fundamentals—efficiency mapping, valve hysteresis characterization and dynamic spill-bridge behaviour—while remote-access HMI sessions let instructors demonstrate complex test sequences to distributed student audiences.

System Architecture:

The Universal Rig's hydraulic circuit is divided into two primary loops: (1) the high-pressure test circuit and (2) the recirculation/cooling circuit. In the test loop, two Parker-sourced, 17-4PH stainless steel pumps deliver up to 320 LPM each at 350 bar, driven by 250 kW IE3 motors with integrated vibration sensors. A network of SS-304 tubes and push-fit hoses carries fluid through Wika-calibrated pressure transducers and Danfoss flow meters, then returns it through duplex and simplex $\beta \geq 200$ filters fitted with magnetic strainers to trap ferrous debris. Meanwhile, the cooling loop circulates 250 LPM at 10 bar through a plate-type SS-304 heat exchanger, maintaining oil within the set temperature band.

Control is centralized in a Rittal IP54 cabinet housing a Siemens S7-1500 PLC, Profinet I/O modules and a 9" Comfort Panel HMI—optionally upgradeable to 15" with multi-language support. The PLC communicates via OPC-UA to supervisory SCADA or MES systems, enabling Industry 4.0 integration and historian-level data archiving. Three modular test beds—dedicated to pumps, valves/cylinders and pump-motor assemblies—snap onto the shared reservoir skid via quick-release clamps, each with its own local E-stop, flow-control valves and adapter plates for NG-series valve mounting.

Technical Specifications:

Item	Specification
Reservoir	1 200 L SS-304; 6 mm laser-welded shell; magnetic drain plug; sight glass; electronic level switch
Gauges & Sensors	Wika 0–400 bar transducers (±0.25 % FS); 700 mm borosilicate level gauge; 4″ PT100 thermometer (±1 % FS)
High-Pressure Pumps	2×320 LPM @ 350 bar; Parker piston pumps with 17-4PH manifolds; 250 kW IE3, TEFC, IP55 motors; vibration monitoring
Cooling Pump	250 LPM @ 10 bar; 5.5 kW TEFC motor; mechanical seal; integrated flow/temperature bypass valve
Valves & Relief	Main relief @ 400 bar; cooling relief @ 10 bar; all valves Parker/Rexroth with DIN 24342 flange connections
Filtration	Duplex β 200 return filters; simplex β 100 pressure filters; magnetic trap elements; clog indicators
Piping & Fittings	SS-304 tubing (DIN 2361); push-fit vibration-damped hoses; SAE/JIC quick-disconnect couplings
Controls & DAQ	Siemens S7-1500 PLC; Profinet/EtherCAT; Comfort Panel 9″ HMI; 16-ch 24-bit DAQ; 10 Hz sampling; CSV/PDF/XML export
Electrical Panel	Rittal IP54; MCCB/RCD/MCB protection; surge arrestors; 24 V/0–10 V/4–20 mA isolated supplies
Physical	1800×1200×1600 mm (L×W×H); ~1 250 kg skid; lockable castors & leveling pads
Environment & Power	+10 °C to +50 °C; 10–90 % RH non-condensing; 415 VAC ±10 %, 50 Hz, 3-phase, 4-wire + PE

Mechanical & Environmental Design:

Skid & Frame

- The entire rig is built on a heavy-duty 6 mm SS-304 base plate welded to a structural SS-304 tubular frame. All load-bearing welds undergo full-penetration TIG welding and 100 % dye-penetrant inspection for maximum strength and leak resistance. The skid surfaces receive an epoxy powder-coat finish to resist corrosion, chemical spills and wear over years of shop-floor use. Integrated forklift pockets and lifting lugs are rated for the fully laden unit (> 1 400 kg) to simplify installation and relocation without the need for external rigging points.

Mobility & Vibration Isolation

- Lockable swivel castors (500 kg capacity each) mount to reinforced plate brackets at each corner, permitting smooth repositioning on workshop floors. Once in place, each castor's lock lever secures the rig firmly. Additionally, four adjustable leveling pads with neoprene vibration-damping mounts decouple the test bench from ground-borne shocks and motor-induced vibrations. This isolation protects sensitive pressure and flow sensors, improves test repeatability, and reduces wear on rotating equipment.

Enclosure & Access

- The hydraulic circuit and instrumentation reside within an IP54-rated enclosure, featuring a 6 mm safety-glass viewing window for unobstructed observation of live tests. The enclosure doors use gas-strut assists and quick-release hinges for tool-free access during setup and maintenance. Inside, high-output, energy-efficient LED work lights illuminate the test area without generating heat. Acoustic-dampening panels line the interior walls to contain noise—keeping sound levels below 75 dB(A) during high-pressure operation—and protect operators in adjacent workspaces.

Optional Environmental Chamber

- For applications requiring extreme temperature or humidity conditions, an optional environmental chamber can encase the entire test area. This chamber provides a controlled envelope from –20 °C to +60 °C with ±1 °C stability, and humidity control from 10 % to 90 % RH. An integrated inert-gas purge system prevents oxidation or moisture ingress during sensitive tests, such as hydraulic fluid cold-start performance or high-temperature seal degradation studies. Chamber access panels and pass-throughs allow quick

change-over of specimens and sensor cables without compromising environmental integrity.

Operational Workflow

Startup & Calibration

- Automated leak-down checks, zero/span calibration for flow/pressure sensors

Recipe Selection

- Choose or create test sequences via drag-and-drop HMI, set thresholds & dwell times

Execution & Monitoring

- PLC executes ramps, soaks and holds; live charts for pressure, flow, temperature and torque

Alarm Handling

- Audible alarms, visual indicators, automatic shutdown on critical thresholds

Data Review & Reporting

- Generate batch reports with summary tables, graphs, statistical analysis, digital signatures

Shutdown & Maintain

- Auto-purge routine, filter clog self-test, maintenance alerts via HMI and email notifications

Safety, Compliance & Quality:

- Safety Features: E-stops at each station, dual-channel safety relays, light curtains (optional), emergency power-off
- Compliance: ISO 12100, EN 60204-1 (Electrical Safety), BS EN 55011 (EMC), MIL-STD-810G (Environmental)
- Quality Control: IQ/OQ/PQ protocols, FAT/SAT checklists, 3rd-party NDT reports, traceable calibration certificates