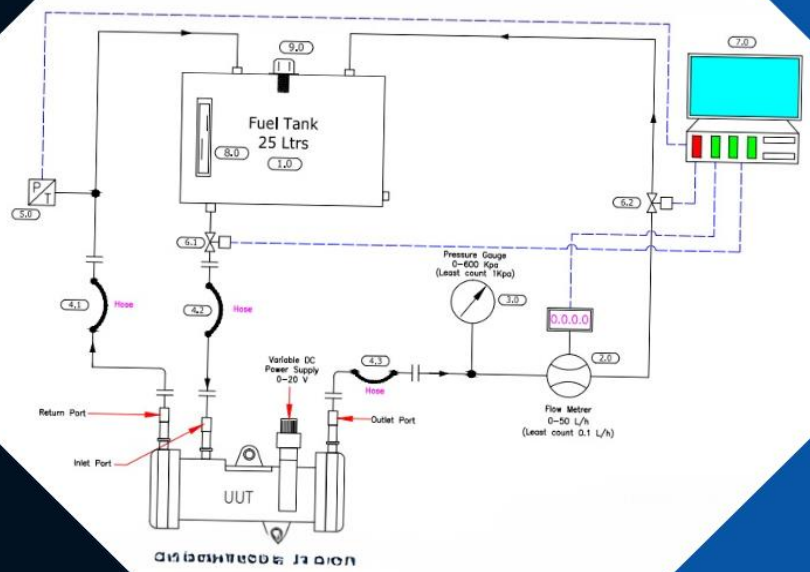
NEOMETRIX

Fuel Pump Test Rig



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.

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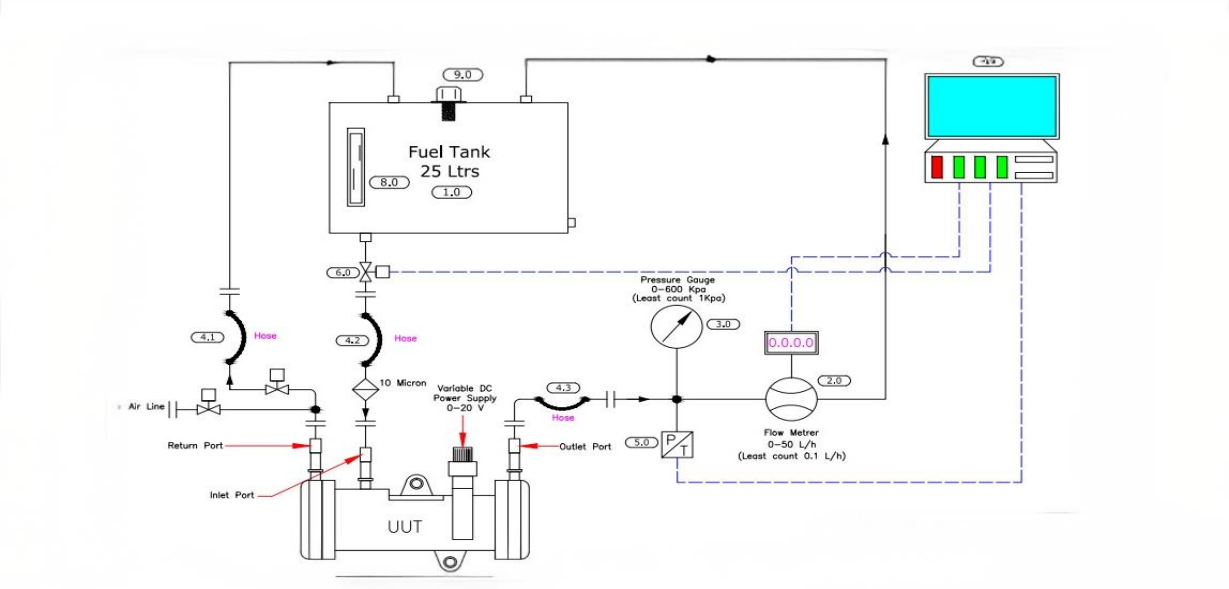
Introduction:

The Neometrix Fuel Pump Test Rig represents the culmination of over two decades of test-engineering expertise, designed to meet—and exceed—industry demands for precision, repeatability, and safety in fuel-pump validation. Built around a Siemens S7-1500 PLC and an industrial-grade PC running LabVIEW™ 2021 SP1, the rig delivers true “lights-out” operation. Operators simply load the pump and select a test recipe; the system then orchestrates every step—from pre-test leak checks and fluid pre-conditioning to dynamic load profiles, temperature cycling, and post-test diagnostics—without further intervention.

Key hardware highlights include a closed-loop flow circuit capable of 0–250 L/min at 350 bar, an integrated PID-controlled thermal jacket for –20 °C to +120 °C cycling, and SS 316L wetted paths for chemical compatibility with gasoline, diesel, ethanol blends, biodiesel, and specialty fuels. A modular solenoid manifold and quick-disconnect couplings allow tool-less swap-outs in under two minutes, minimizing downtime between batches.

On the software side, a drag-and-drop recipe builder, multi-run overlay graphs, real-time metadata tagging, and automated pass/fail evaluation ensure operators—from entry-level technicians to seasoned engineers—can configure, monitor, and interpret tests with equal ease. Remote-VPN access enables off-site troubleshooting, while built-in self-diagnostics and alarm thresholds protect both DUTs (devices under test) and test-stand hardware from over-pressure, thermal runaway, or vibration anomalies.

With rigorous CE/UL safety certifications, cGMP-compliant reporting options, and alignment to MIL-STD-810G, DO-160G, ISO 9001:2015, TS 16949, ASTM F2123, and ISO 12100 standards, the Neometrix Fuel Pump Test Rig is a turnkey platform that accelerates R&D cycles, maximizes production throughput, and simplifies audit-ready documentation for the automotive, aerospace, industrial, and calibration-lab markets.



Purpose & Applications:

Automotive R&D & Production

- Engine Simulation: Accurately reproduces crank-shaft coupling to test gear, vane, and plunger pumps under transient and steady-state conditions. Supports variable pulsation patterns, including dual-pulse and multi-pulse sequences up to 2 kHz.
- Endurance Testing: Automated fluid filtration and replenishment routines enable continuous 72 h+ runs, mirroring production-level batch volumes. Integrated turbidity and particulate sensors monitor fluid degradation, triggering cleaning or replenishment cycles.

Aerospace & Defence

- Qualification to MIL-STD & DO-160: Thermal cycling through –20 °C to +120 °C, combined with vibration profiles up to 15 g RMS, validate pump reliability in extreme flight envelopes.
- First-Article Inspection (FAI): Generates complete AS9102 reports, including dimensional checks, performance curves, and environmental-stress data, all consolidated in a single PDF.
- Redundancy Testing: Dual-pump fixtures allow simultaneous testing of primary and backup pumps, verifying switchover integrity under simulated failure modes.

Industrial Machinery

- Custom Duty Cycles: Creates complex profiles—ramp-dwell-spike sequences—to replicate generator start/stop cycles, compressor load swings, and marine-engine surge conditions.
- Altitudinal Simulation: Optional sealed chamber pressurizes test environment to simulate up to 3,000 m elevation, verifying performance under low-atmospheric-pressure scenarios.

Quality Control & Calibration Labs

- Batch Traceability: Barcode-scanned part IDs, operator e-signatures, and encrypted audit logs fulfill ISO 9001:2015 and IATF 16949 requirements.
- Sensor Calibration: Built-in zero/span routines and automated certificate generation for flow meters, pressure transmitters, and temperature probes, with certificates archived and printed on demand.

System Architecture:

1. Control & HMI
   - PLC Core: Siemens S7-1500 CPU with ET 200SP distributed I/O (64 digital inputs/outputs, 32 analog channels) ensures millisecond-level cycle determinism and safety interlocking.
   - Industrial PC: Intel® Core™ i7, 16 GB RAM, RAID-1 SSD array running LabVIEW™ 2021 SP1. Secure VPN endpoint enables remote diagnostics, recipe uploads, and firmware patching.
   - HMI Interface: 21″ IP65-rated touchscreen with multilingual GUI (EN, DE, FR, CN). Pop-up alarms, trend cursors, and contextual help streamline operation.

2 Fluid Circuit

- Pump Fixture: Universal clamps accommodate shafts from Ø6 mm to Ø20 mm; torque sensor module (0–200 Nm) measures mechanical input power.
- Flow Loop: SS 316L tubing rated to 400 bar; quick-disconnect fittings enable pump changeovers in <120 s. Bypass line with relief valve protects against over-pressure events.
- Thermal Jacket: Dual-zone PID control with separate heating and cooling circuits—5 kW chiller and 3 kW heater permit 10 °C/min transitions and ±0.5 °C stability.

3 Valve & Sensor Suite

- Solenoid Manifold: Five 24 VDC, 1 A solenoids for high-speed path switching (<10 ms transition).
- Manual Valves: Three metering needles for fine leak-down and micro-flow tests.
- Optional Modules: Plug-and-play ultrasonic flow meter (bi-directional), tri-axial accelerometer (±50 g), pressure pulsation transducer (0–1 kHz).

4 Data Acquisition & Reporting

- DAQ Hardware: 16-bit resolution, 1 kHz/channel sampling on up to 32 channels. Synchronous timestamping across all signals ensures correlation of multi-sensor events.
- Software: LabVIEW™ dashboards with multi-run overlays, automated pass/fail logic, and metadata tagging. Export formats: CSV, SQL, PDF, XML.
- Report Generator: Template-driven assembly of performance graphs, statistical summaries, compliance checklists, and digital signatures in a single dossier.

Technical Specifications:

Parameter	Specification
Flow Capacity	0–250 L/min; 0.1 L/min turndown; ±0.2 % FS accuracy
Pressure Range	0–350 bar (standard); optional 0–400 bar; ±0.5 % accuracy
Thermal Range	–20 °C to +120 °C; 10 °C/min ramp; ±0.5 °C stability
Torque Measurement	0–200 Nm; ±0.5 % accuracy
Wetted Path	SS 316L tubing; Viton® seals; optional PTFE lining
Chassis & Enclosure	Powder-coated 304 SS; IP54; heavy-duty swivel castors
Power	400 VAC, 50 Hz, 3×20 A; integrated power-monitoring module
Cooling	5 kW chiller; 3 kW heater; ambient 5–40 °C operation
Air Supply	6–8 bar dry, oil-free compressed air for pneumatic valves
Safety & EMC	CE (EMC/LVD); UL 508A
Quality Standards	ISO 9001:2015; IATF 16949
Environmental & Durability	MIL-STD-810G; DO-160G; ASTM F2123; ISO 12100
Traceability	cGMP-compliant audit trails

Mechanical & Environmental Design:

The test rig's mechanical design balances rigidity, accessibility, and environmental protection. The IP54-rated 304 SS enclosure shields critical electronics and fluid components from dust, splash, and salt-spray environments. Removable side panels and front hatches provide tool-less access to valves, filters, sensors, and DAQ modules, reducing maintenance times by up to 40 %. Color-coded tubing and quick-release clamps eliminate cross-connection errors during fluid line changes.

A forced-air cooling system maintains the PLC, PC, and DAQ at <50 °C, regardless of ambient conditions up to 40 °C. Swivel-caster mounting with locking brakes allows precise positioning on uneven shop floors, while vibration-isolating mounts under the main base decouple the rig frame from overly harsh floor vibrations.

Optional environmental chamber integration permits full-system testing from –20 °C to +60 °C ambient, enabling both DUT and rig qualification under extreme climates. Internal LED lighting and exterior status panels ensure safety and visibility during nocturnal or emergency operation.

Operational Workflow

Installation & Commissioning

- Site survey to verify power, cooling, air, and floor-loading requirements.
- FAT at Neometrix facility, followed by on-site SAT with customer's engineer.

Setup & Calibration

- Single-point hookup for electrical, chiller, and compressed air.
- Automated zero/span routines for flow, pressure, temperature, and torque sensors.
- Test Recipe Creation
- Use drag-and-drop HMI to define pressure ramps, flow sweeps, dwell times, and temperature cycles.
- Save custom recipes with version control; import/export via USB or VPN.

Execution & Monitoring

- Start tests via HMI or remote script. Real-time dashboards display up to 8 simultaneous plots.
- Audible/visual alarms and automated shutdown if any parameter exceeds predefined thresholds.

Data Analysis & Reporting

- Automatic pass/fail evaluation against tolerances.
- One-click generation of compliance dossiers, including performance curves, statistics, and audit trails.

Maintenance & Calibration

- Scheduled reminders for filter changes, valve servicing, and sensor recalibration.
- Built-in “health check” routines to verify DAQ integrity and PLC status.

Safety, Compliance & Quality:

Neometrix places safety and quality at the forefront. The rig includes:

- Emergency-Stop Interlocks: Instantly isolates pneumatic and electrical supplies.
- Over-Pressure Relief: Spring-loaded valves set at 16 bar to protect against unintended pressure spikes.
- Door Interlocks & Light Curtains: Prevent access to moving or high-pressure zones during operation.
- Automated Leak Detection: Monitors pressure decay; halts test and alerts operator on detecting >1 bar/min leak rate.

Full IQ/OQ/PQ documentation, FAT/SAT protocols, calibration certificates, and user manuals accompany every delivery. Our quality management system is certified to ISO 9001:2015 and IATF 16949, and all processes conform to cGMP guidelines where applicable.