NEOMETRIX

Hydraulic Loading System

Product Catalog

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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

Introduction:

The Hydraulic Loading System (HLS) by Neometrix Defence is a state-of-the-art, skid-mounted test rig meticulously engineered to replicate the full spectrum of loading conditions encountered by engine-driven hydraulic pumps. With a maximum design pressure of 340 kg/cm² and flow capacity from 20 to 210 LPM, the HLS enables both static and dynamic load profiling—ranging from slow, steady back-pressure applications to high-frequency pressure cycling—ensuring that pumps perform reliably under every conceivable duty cycle.

Built on Neometrix's two decades of expertise supplying hydraulic test solutions to India's defence, aerospace and heavy-industrial sectors, the HLS integrates eight plug-and-play modules that can be rapidly reconfigured or scaled to match evolving test specifications. From the precision-filtered reservoir and pre-heat capabilities of the Oil Tank Module to the rapid actuation of the nitrogen-damped Loading Valve Module, each subsystem is optimized for minimal setup time, repeatable calibration, and seamless integration with on-board PLC/HMI control.

Operator safety and data integrity are at the heart of the HLS design philosophy. Redundant interlocks safeguard against over-pressure, over-temperature, and low-oil-level conditions, while built-in automated calibration routines and ISO-traceable sensors guarantee that every measurement—pressure, temperature or flow—is accurate to within industry-leading tolerances. Distributed Ethernet connectivity and secure remote-access protocols further enable real-time monitoring, predictive diagnostics and fault-logging, reducing unplanned downtime and accelerating qualification cycles.

Beyond its technical prowess, the HLS delivers significant lifecycle value. Its compact footprint and modular skidding allow rapid redeployment across multiple test bays or field sites, minimizing installation costs and maximizing utilization. A comprehensive factory acceptance test (FAT) package, followed by turnkey installation and operator training, ensures that customers achieve "first-run success" and sustained throughput from day one.

Purpose & Applications:

The Hydraulic Loading System (HLS) is engineered to serve as the definitive test platform for any hydraulic pump manufacturer or end-user seeking to validate performance, durability and safety under precisely controlled conditions. By reproducing the exact back-pressure seen on an engine-driven pump outlet, the HLS allows engineers to characterize pressure–flow curves, identify efficiency "sweet spots," and uncover any cavitation or thermal degradation issues before a pump ever enters service. Its ability to impose both steady-state loads and high-frequency pressure transients makes it equally suited for R&D laboratories developing next-generation fluid-power components and production lines conducting final acceptance testing on every unit.

Beyond baseline performance checks, the HLS plays a critical role in life-cycle management and maintenance planning. Fatigue cycling profiles can be tailored to simulate hundreds of thousands of duty cycles in a fraction of the time, revealing metal-fatigue hotspots, seal wear patterns and accumulator preload drift. Coupled with real-time data logging and automated calibration routines, this capability enables predictive maintenance strategies—allowing operators to schedule part replacements long before catastrophic failures occur, thereby reducing unplanned downtime and extending mean time between maintenance (MTBM).

Primary Functions:

- Variable Back-Pressure Simulation: Reproduce any operating curve from low-pressure cruise modes to peak emergency loads.
- Cyclic Endurance Loading: Execute custom pump fatigue scripts—step, ramp, sine or user-defined waveforms—at frequencies up to 2 Hz.
- Thermal & Contaminant Control: Maintain oil cleanliness to ISO 4406 standards and stabilize temperatures within ±2 °C to prevent viscosity-driven measurement drift.
- Data Integrity & Traceability: Capture every pressure, flow and temperature reading with timestamped, ISO-traceable calibration to support audit-grade reporting.

System Architecture:

The HLS is built around eight skid-mounted modules, each optimized for rapid setup and reliable operation:

- Oil Tank & Conditioning: 175 L stainless-steel reservoir with 5 µm filtration, level transmitter and over-temperature switch to protect against cavitation and contamination.
- Air Regulation: Two-stage moisture/oil removal and dual regulators supply 6–10 kg/cm² shop air for accumulator charging and valve actuation, with safety relief and quick-connect ports.
- Inlet Control: Suction-pressure transmitter ensures inlet vacuum stays below 10 bar; optional electric pre-heater maintains oil viscosity in cold conditions.
- Back-Pressure Generation: Coarse-range orifice bank (20–210 LPM) plus a fine-adjust globe valve deliver 270–295 kg/cm² working pressure, backed by a relief valve at 315 kg/cm².
- Load Cycling: Pneumatically driven valve manifold and nitrogen-charged accumulators enable pressure transients up to 2 Hz, with onboard flow meters for split-flow verification.
- Thermal Management: Shell-and-tube heat exchanger with PID-controlled coolant flow keeps oil $\leq$ 100 °C outlet and $\leq$ 80 °C inlet.
- Return & Sampling: 30 bar-rated return line with check valve and quick-disconnect port for fluid analysis.
- Portable Fill Station: 50 L trolley-mounted pump with flow metering and swivel fittings for bubble-free top-ups or flushes.

Together, these modules form a compact, fully instrumented test stand that can be reconfigured or expanded to suit any hydraulic pump size or duty-cycle profile, all controlled via an integrated PLC/HMI interface.

Technical Specifications:

Parameter	Specification
Design Pressure	340 kg/cm² (4 834 psi)
Working Pressure Range	270–295 kg/cm² (3 837–4 195 psi)
Flow Capacity	20–210 LPM (5.3–55 gpm)
Hydraulic Fluid	MIL-H-5606 / FH-51
Kinematic Viscosity	15 cSt @ 40 °C
Reservoir Volume	175 L; pressurizable to 10 kg/cm²
Air Supply	6–10 kg/cm² (85–142 psi)
Temperature Limits	Inlet ≤ 80 °C; Outlet ≤ 100 °C
Power Requirements	3-phase 415 VAC, 50 Hz, 10 kW
Control Interface	7” HMI + PLC (Modbus/ProfiNet)

Mechanical & Environmental Design:

- Frame & Skid: Carbon-steel chassis with epoxy powder-coat.
  Designed with integrated forklift pockets and lifting lugs for rapid relocation and secure installation.
- Piping & Fittings: SS 316L, welded joints, vacuum insulation where needed.
  All welds 100% dye-penetrant inspected to ensure leak-free operation at full design pressure.
- Valves & Manifolds: Stainless-steel, pilot-operated check valves, precision orifices.
  Modular manifold blocks allow quick replacement or reconfiguration of valve assemblies without pipe disassembly.
- Heat Exchanger: Copper-nickel tubes in SS shell for low pressure drop.
  Removable tube bundles simplify cleaning and maintenance, ensuring consistent thermal performance.
- Seals & Hoses: PTFE/Aerospace-grade elastomers rated to 350 bar.
  All hoses are externally reinforced and tested to 1.5× maximum working pressure for safety margin.
- Corrosion Protection: Epoxy primer + UV-stable polyurethane topcoat.
  External surfaces treated to resist salt-spray and chemical washdown in harsh marine or industrial environments.
- Operational Temperature: –20 °C to +55 °C (MIL-STD-810G).
  Components and electronics are selected and qualified for extreme thermal cycling without performance degradation.

Operational Workflow

- Setup: Position skid; connect inlet/outlet hoses to test pump.
- Ensure the skid is leveled and all hydraulic and electrical connections are torque-checked per checklist.
- Fill & Purge: Top up oil via portable module; purge air from lines.
- Monitor sight-glasses and pressure gauges to confirm bubble-free, fully primed fluid pathways.
- Parameter Entry: Load test script on HMI (static, ramp, cyclic profiles).
- Validate all setpoints against the test plan and lock the HMI screen to prevent accidental changes.
- Test Execution: PLC drives valve cycling; accumulator dampens transients.
- Observe accumulator charge pressures and actuator response times to verify correct sequencing.
- Monitoring: Live pressure, flow, temperature displayed; alarms for out-of-range.
- Acknowledge and log any warnings, then adjust test parameters or pause the run as needed.
- Data Logging: Automatic export via USB/Ethernet for post-test analysis.

- Confirm data file integrity and backup to the networked server immediately after export.
- Shutdown & Flush: Isolate modules; return oil; drain and store.
- Perform a final system rinse with clean fluid, then tag and lockout the rig per maintenance protocol

Safety, Compliance & Quality:

- Safety Valves: Over-pressure relief on inlet, outlet and accumulator Periodic proof-testing during FAT and site acceptance ensures valves re-seat correctly at set pressures.

- Automatic Interlocks: Shutdown on low-oil-level, over-temp, over-pressure Built-in self-test routines verify interlock circuits at power-up and before each test sequence.

- Manual Override: Hand-pump capability for emergency lowering Clearly labelled, lockable override lever allows controlled depressurization during maintenance.

- Standards Compliance: ISO 9001, ASME B31.3 (pressure piping), MIL-STD-810G Full documentation package—including material certificates and test reports—supports regulatory audits.

- Traceability: Serialized units; full QA/QC logs, radiographic weld inspection Barcode-linked digital records track every component from procurement through delivery.

- Warranty & Support: 3-year standard warranty; AMC options for consumables Service-level agreements (SLAs) guarantee 24-hour response for on-site support and parts replacement.