

# Hydraulic Drive of OSA



## 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 Hydraulic Drive for OSA systems represents the pinnacle of electro-hydraulic actuation technology tailored to the demanding requirements of vehicle-mounted short-range air-Defense radars. Originally engineered to replace legacy mechanical gimbals on the Soviet 9K33 “Osa” (NATO: SA-8 Gecko) launcher, our drive integrates a brushless synchronous motor, precision gear pump, proportional valve block, and dual high-accuracy pressure transducers into a single sealed housing. The unit accepts a standard 220 V, 400 Hz fire-control command signal—either analog voltage or synchro—and converts it into metered hydraulic flow that drives elevation ( $\mu$ -axis) and azimuth ( $\eta$ -axis) actuator cylinders with sub-degree pointing accuracy.

During each engagement cycle, the drive delivers up to 150 kgf/cm<sup>2</sup> at 600 LPM, generating the torque needed to slew the TAR (Target Acquisition Radar) from one bearing to the next in under 0.5 s and settle within 1 s, even under full recoil and vehicle vibration. Its closed-loop control—enabled by real-time feedback from inductive pressure sensors—maintains position to within 0.1°, preventing overshoot and ensuring continuous track on fast-moving aerial threats. Engineered to survive extremes from -40 °C to +50 °C, with salt-fog and MIL-STD vibration resistance, the drive’s modular design also makes field maintenance fast: captive bolts, quick-release fittings, and standard seals let technicians swap any major sub-assembly in under an hour.

Whether preserving the combat effectiveness of legacy Osa systems or empowering new radar, EO/IR, and LIDAR turrets, Neometrix’s Hydraulic Drive combines proven Soviet mechanical robustness with modern manufacturing precision, backed by comprehensive FAT/SAT testing and a lifecycle support program that spans decades of operation.



## Purpose & Applications:

Neometrix's Hydraulic Drive serves as the keystone actuator for a wide array of stabilization, positioning, and motion-control applications across defense, surveillance, industrial testing, and research domains. In its original mission on the 9K33 Osa-AK TELAR (Transporter-Erector-Launcher with Radar), the drive stabilizes and slews the TAR antenna assembly, maintaining lock on targets despite the launcher's movement, firing recoil, and battlefield shock. Its rapid slew ( $< 0.5$  s) and precise hold ( $\pm 0.1^\circ$ ) accommodate both single-target engagements and multi-threat scenarios, where rapid transitions are essential. Over-pressure safety valves and automatic fault inhibit protect the mechanical limits, ensuring continuous, damage-free operation

Beyond air defense, the drive's compact footprint and standardized 220 V/400 Hz interface make it ideal for mobile surveillance platforms: 4x4 or tracked vehicles equipped with EO/IR or LIDAR sensor turrets for border security, counter-insurgency, and peacekeeping missions. Its vibration-damped mounts and sealed housing withstand harsh road and climate conditions, while low EMI emissions enable integration alongside sensitive electronics.

Fixed-site coastal and perimeter radars also benefit: the drive's modular design simplifies installation on pedestals, and its high-torque output supports large antenna panels subject to wind and seismic loads. In industrial settings, the drive powers hydraulic test benches for pumps, valves, and cylinder fatigue testing—its proportional valve block and pressure feedback ports offering researchers the ability to script complex load profiles and gather performance data.

Finally, R&D labs leverage the drive as a development platform for next-generation digital hydraulics and machine-learning-based control algorithms, tapping its accessible sensor outputs and proportional control for rapid prototyping. From legacy retrofit to cutting-edge research, the Hydraulic Drive delivers versatility, precision, and reliability.



## System Architecture:

At the heart of the Neometrix Hydraulic Drive lies a carefully orchestrated assembly of mechanical, hydraulic, and electronic subsystems designed for seamless, closed-loop motion control. The brushless synchronous motor—rated for indefinite, maintenance-free operation—directly drives a high-pressure gear pump. This coupling eliminates belts and gearboxes, reducing backlash and ensuring immediate torque transmission. The pump delivers up to 150 kgf/cm<sup>2</sup> at 600 LPM to ports A and B, alternating to drive the actuator cylinder rod in elevation or azimuth.

Flow control is managed by an integrated valve block housing a pilot-operated safety valve and a proportional throttle orifice. The onboard safety valve opens at 160 kgf/cm<sup>2</sup> to protect against hydraulic lock or jam, while the throttle orifice offers fine flow modulation—controlled by either the embedded electronics or an external fire-control computer. Two inductive pressure transducers, one on each port, feed real-time pressure data back to the controller, enabling position-holding to  $\pm 0.1^\circ$  and rapid leak or blockage detection.

All hydraulic and electrical components reside within a sealed, corrosion-resistant enclosure, featuring dual quick-release hydraulic fittings and a MIL-spec multi-pin electrical connector that supports both 0–10 V analog and 400 Hz synchro command inputs. The housing is internally coated with rust-inhibiting primer and externally finished in polyurethane paint, with vibration-damped mounting feet and a vent-filter to equalize pressure without admitting contaminants.

Modularity is key: motor, pump, valve block, and transducers are bolted assemblies on captive studs. Technicians can replace any module—using standard O-rings, seals, and filters—in under one hour, minimizing field downtime and ensuring mission continuity.



## Technical Specifications:

Parameter	Specification
Dimensions (L×W×H)	340 × 290 × 220 mm
Weight	≈ 35 kg
Input Power	220 V, 400 Hz AC
Max. Operating Pressure	150 kgf/cm <sup>2</sup>
Max. Flow Rate	600 LPM
Hydraulic Fluid	ISO VG 46–68 mineral oil
Temperature Range	–40 °C to +50 °C
Control Interface	0–10 V analog or 400 Hz synchro
Cycle Endurance	1 hr continuous; 20 full-stroke cycles
Coating	Epoxy-primer + polyurethane topcoat

## Mechanical & Environmental Design:

Neometrix's design ethos unites rugged mechanical construction with environmental hardening to guarantee reliable performance in the harshest theaters. The housing is fabricated from S355J2 carbon-steel, welded per EN 1011 standards, and coated inside with zinc-rich epoxy primer. The outer shell receives a polyurethane topcoat rated for UV, salt-fog, and chemical exposure. Internally, critical wetted components use SS-304 and nickel-plated steel to resist corrosion and galvanic action.

Dynamic seals employ multi-lip polyurethane elements with PTFE back-up rings—selected for low friction and long life across  $-40\text{ }^{\circ}\text{C}$  to  $+150\text{ }^{\circ}\text{C}$ . Static seals are HNBR O-rings sized to ISO 3601-3 tolerances. All fasteners are stainless steel with Loctite® adhesive to prevent loosening under vibration. Mounting feet incorporate elastomeric vibration dampers tuned to attenuate 20–500 Hz vehicle and firing harmonics.

Environmental validation includes salt-fog testing per ASTM B117 (500 hr), thermal cycling ( $-40\text{ }^{\circ}\text{C} \leftrightarrow +50\text{ }^{\circ}\text{C}$ , 10 cycles), vibration and shock qualification per MIL-STD-810G, and dust/water ingress resistance to IP65. A vent/filter assembly allows internal pressure equalization without contaminant ingress. Units pass a helium leak test ( $< 1 \times 10^{-6}$  mbar·L/s) to certify sealing integrity before dispatch.

## Operational Workflow

### Site Preparation & Foundation:

- Install a reinforced concrete pad per the supplied anchor-bolt template. Ensure the pad is level within 5 mm over the drive mounting footprint. Place vibration isolators and secure the drive using M16 studs torqued to 200 Nm.

### Installation & Hookup:

- Purge the drive housing with dry nitrogen to expel contaminants. Connect hydraulic supply and return lines using the quick-release fittings; ensure O-ring seals are lubricated and free of debris. Torque fittings to 35 Nm. Attach the multi-pin electrical connector, verifying gasket integrity and pin alignment.

### Commissioning:

- Fill the hydraulic circuit with ISO VG 46 oil; bleed air until flow is bubble-free. Energize the unit at 220 V/400 Hz and run a zero-pressure loop test,

verifying proportional valve response and transducer readings. Conduct a 20-cycle full-stroke endurance trial, monitoring temperature rise ( $< \pm 2$  °C) and checking for leaks.

#### Daily Operation:

- Operators should perform a pre-shift “cock-and-bleed” check: cycle the actuator slowly through  $\pm 5^\circ$  to confirm smooth movement and pressure stability. Log any transient spikes beyond  $\pm 0.5$  bar.

#### Preventive Maintenance:

- Monthly: Inspect hydraulic hoses, fittings, and visible seals.
- Annually: Calibrate pressure transducers and inspect proportional valve clearances.

### Safety, Compliance & Quality:

- Pressure Safety: Dual redundancy system with spring relief valves (API 520-compliant) and burst discs; manual selector valve for isolation.
- Certification & Traceability: Each tank laser-etched with serial number; digital dossier includes FEA reports, FAT certificates, component lot numbers, and test logs.
- Quality Assurance: 100% weld inspection via radiography; helium leak detection for inner vessel; hydrostatic test at  $1.5\times$  design pressure.
- Compliance Standards: EN 13458, ASME VIII, PED 2014/68/EU, ISO 9001 quality management, ISO 14001 environmental management.
- Emergency Response: Pressure safety training, PSSR documentation, and local authority notification templates provided as part of the delivery package.