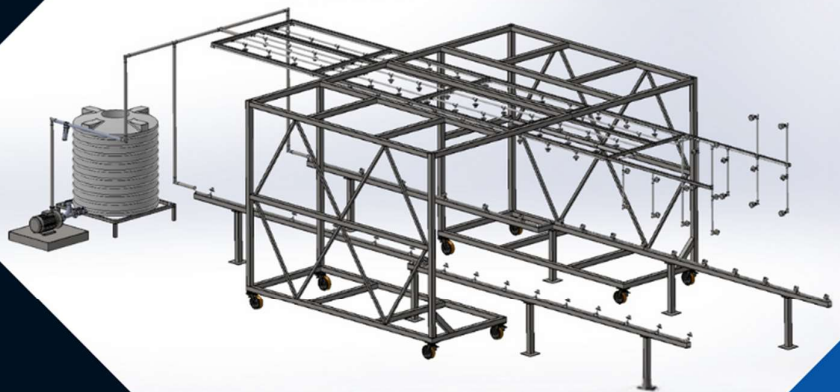


Rain Water Test Rig



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.

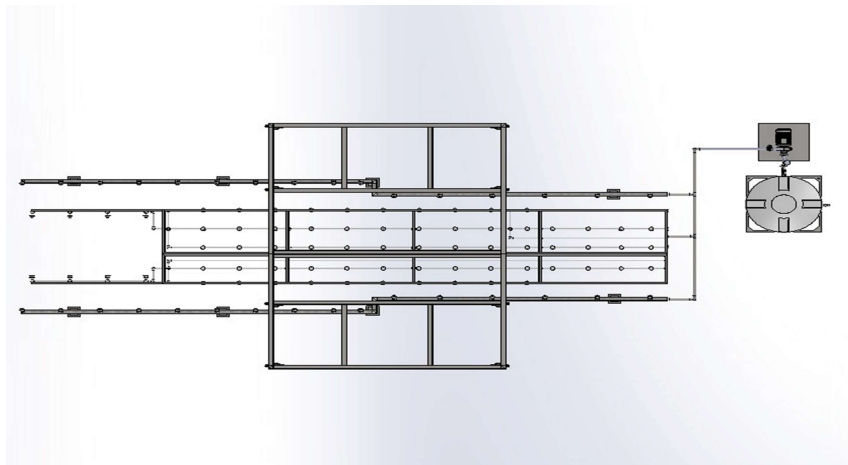
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Introduction:

The Rain Water Test Rig is engineered as a turnkey solution for simulating realistic rainfall conditions over full-scale aircraft assemblies and components. By precisely controlling droplet size, distribution and impact velocity, the system replicates light drizzle through torrential downpours, enabling qualification tests in accordance with MIL-STD “rain penetration” protocols and FAA standards for environmental exposure. With two 2 000 L supply tanks, a centrifugal pump capable of 250 L/min at up to 10 kg/cm², and an array of 114 stainless-steel nozzles, this rig validates structural integrity, seal performance and drainage efficacy across fuselage panels, canopy joints, avionics bays and under-carriage fairings. Integrated drain valves and programmable test sequences ensure repeatable, data-driven assessments of water ingress, run-off patterns and material resilience—essential for both prototype certification and high-volume production acceptance. Turnkey installation, remote diagnostics and a comprehensive documentation package (including FAT, QAP and calibration certificates) minimize deployment time and ensure seamless compliance for aerospace OEMs, MRO depots and climatic test laboratories.

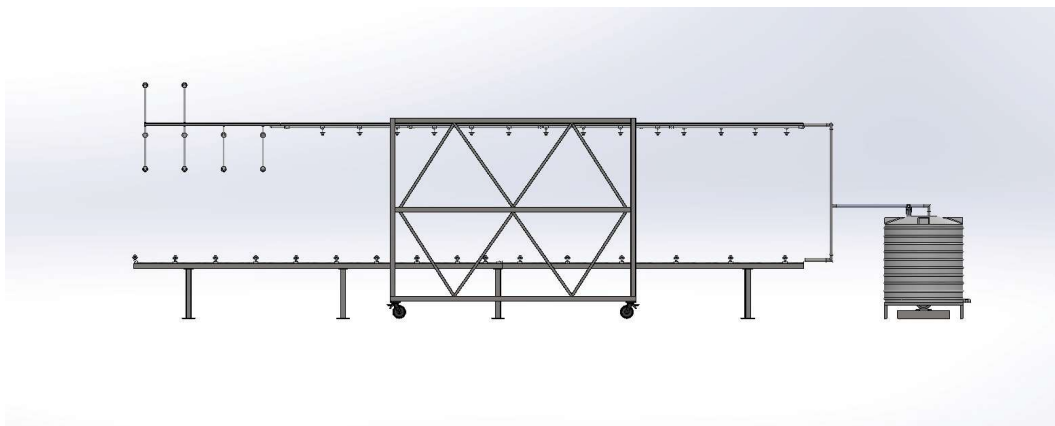
- Environmental Conditioning: Optional pre-cooling or heating of feed water (5 °C–60 °C) to evaluate icing, thermal shock and hot-rain scenarios.
- Automated Sampling Ports: Six strategically placed ports allow inline sampling of runoff for conductivity, pH or contaminant analysis, verifying sealant leach-out or corrosion inhibitors.
- Safety Interlocks: Flow-rate and pressure thresholds lock out the pump if any manifold exceeds $\pm 5\%$ of setpoint or if nozzles clog, protecting delicate test articles.
- Remote Monitoring & Control: Ethernet-connected SCADA permits off-site observation, alarm notifications via SMS/email, and recipe uploads from central QA servers.



Structural Overview:

At the heart of the Rain Water Test Rig lies a modular, corrosion-resistant frame fabricated from 304-grade stainless-steel square tubing. The base chassis (100 × 100 mm members) supports two detachable 2 000 L PVC tanks, while an upper support grid (50 × 50 mm tubing) carries the nozzle manifolds and header piping. Six heavy-duty swivel castors—each rated at 7 500 N and equipped with integrated brakes—allow precise positioning on hangar floors or test decks, yet lock securely during operation to prevent drift under hydraulic loading. Side-wing assemblies on adjustable hinges pivot through a $\pm 60^\circ$ arc, accommodating varied aircraft cross-sections and enabling targeted rain angles for wing roots, cargo doors or sensor apertures. Quick-release couplings on both the water supply and drain lines facilitate rapid teardown and relocation, while simple hand-tool access to all wetted components speeds routine maintenance and filter cleaning.

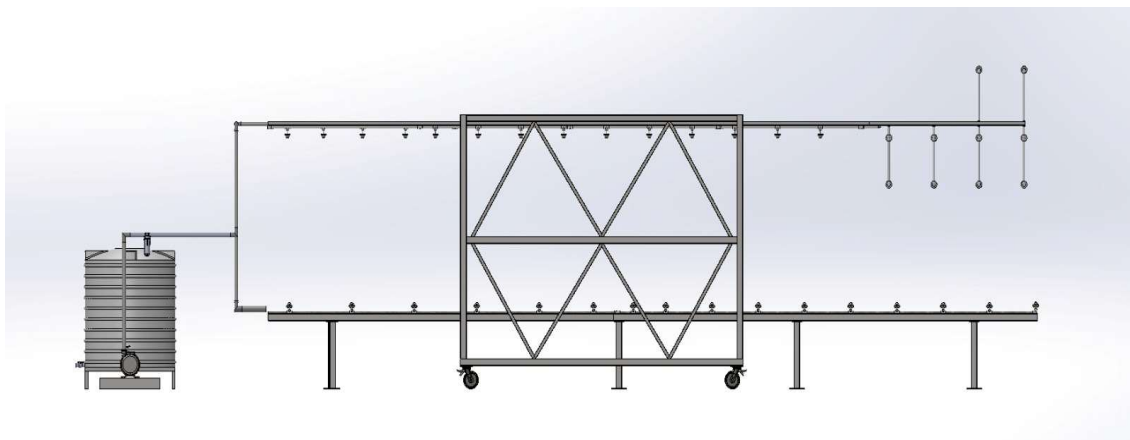
- Structural Stiffness: Finite-element-designed gussets at frame intersections limit deflection under full-tank loads (<1 mm).
- Anti-Vibration Mounts: Rubber isolators beneath pump and motor decouple floor-borne vibration, safeguarding sensitive avionics during in-situ testing.
- Corrosion Protection: All welds passivate post-fabrication; exposed fasteners are 316-grade stainless steel with anti-seize coating.
- Modularity for Scale-Up: Frame bolting pattern allows addition of extra side-wing modules or higher-capacity tanks without custom fabrication.



Hydraulic Circuit & Flow Path:

Water is drawn from the twin 2 000 L reservoirs through a 60-mesh stainless-steel strainer that protects downstream components from particulate fouling. A Grundfos CM 15-3 centrifugal pump —driven by a 4 kW, three-phase motor—boosts the fluid to test pressures up to 10 kg/cm² (1 MPa), delivering flow rates up to 250 L/min. From the pump discharge, 3" Schedule-80 uPVC main headers carry the pressurized water to two primary manifolds: one feeding the overhead nozzle bank, the other supplying the side-pivoting assemblies. Branch lines of 1" uPVC then distribute water evenly to each nozzle, calibrated to 1–2 L/min per orifice at 2 bar to achieve uniform droplet patterns. After impact, collected runoff drains through integrated floor channels into a catch basin; manual drain valves permit rapid depressurization and dewatering post-test. All pressure gauges, flow meters and valve positions are monitored in real time via the SCADA interface, ensuring precise control and data traceability throughout every test cycle.

- Backflow Prevention: Spring-loaded check valves installed at each manifold inlet prevent cross-contamination when one bank is isolated.
- Flow Balancing: Adjustable orifice plates in each header fine-tune distribution to account for elevation or piping length differences.
- Leak Detection: Inline differential pressure sensors trigger automatic shut-off if any branch deviates by >10 % from baseline.
- Water Quality Monitoring: Optional turbidity and conductivity probes upstream of the pump verify feed-water purity before each test.



Key Features & Materials

Nozzle Array & Coverage: Eighty-two fixed overhead nozzles and thirty-two adjustable side nozzles, all machined from SS 304 for corrosion resistance, produce an 8-hole spray pattern with 2 mm orifices—optimized to simulate droplet sizes from 0.3 mm to 1.0 mm.

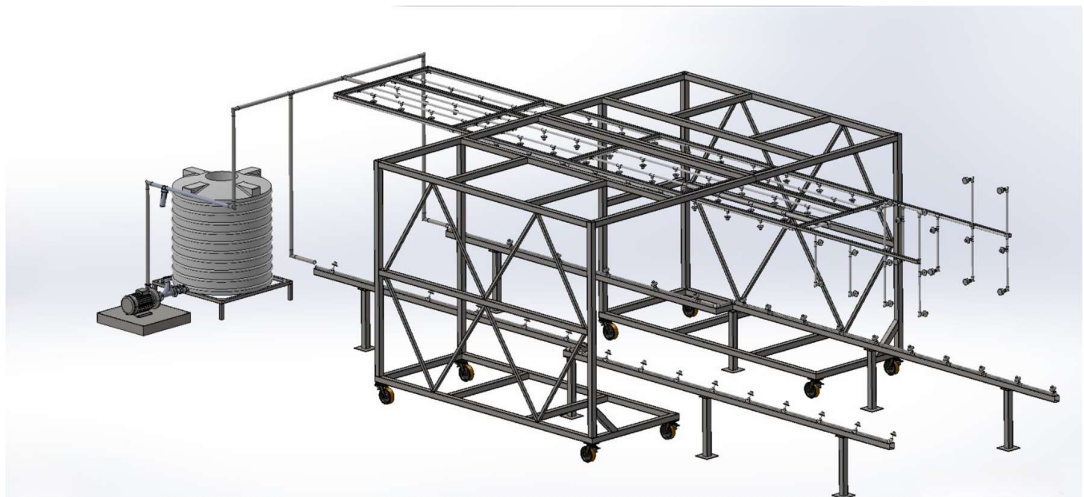
Flow & Pressure Control: A WIKA 232.50.100 glycerin-filled gauge provides continuous pressure feedback (0–10 kg/cm²), while manual ball valves and precision drain valves allow fine adjustment of local flow and rapid system isolation.

Filtration & Protection: The 60-mesh stainless-steel strainer (rated 250 LPM) upstream of the pump removes sediment and biofilm, extending the service life of both pump and nozzles. All wetted uPVC piping and SS 304 fittings resist scale buildup and microbial growth.

Modular Construction: Detachable tank frames, quick-release couplings and compass-style header unions permit tool-free disassembly for transport or expansion. The robust SS 304 structural tubing and solvent-welded uPVC joints ensure a lifetime of leak-free operation under cyclic loading.

Mobility & Installation: Lockable swivel castors enable one-person maneuvering of the fully laden rig, while modular panels and spring-latch covers provide rapid access to pumps, filters and valves for routine maintenance or calibration check.

- **Optional Upgrades:** Add-on temperature control skid (chilled/heated loop) for icing and hot-rain tests; UV lamps to test photo-degradation of sealants.
- **Corrosion Monitoring:** Zinc-free sacrificial anodes in the catch basin protect against electrochemical corrosion in recirculated systems.
- **Advanced Data Logging:** High-resolution flow and pressure timestamps synchronized to NTP server, enabling post-test CFD correlation or forensic analysis.
- **Spare-Parts Kitting:** Field kits include extra nozzles, sealing O-rings, strainer elements and sensor probes—ensuring sub-hour MTTR anywhere in the world.



Technical Specifications:

Parameter	Value
Dimensions (L×W×H)	12 600 × 2 000 × 3 500 mm
Tank Capacity	2 × 2 000 L PVC
Pump & Motor	Grundfos CM 15-3, 4 kW (5.36 HP), 3-phase, 50 Hz
Max Flow	Up to 250 L/min
Per-Nozzle Flow	1-2 L/min @ 2 bar
Working Pressure	Up to 10 kg/cm ² ; test typically at 1-2 bar
Nozzle Material & Size	SS 304; Ø 2 mm holes (8-place)
Filter Mesh Size	60 mesh (250 LPM capacity)
Frame Material	SS 304 square tubing
Piping	Schedule-80 uPVC
Mobility	6 × lockable caster wheels (7 500 N each)
Operating Voltage/Temp.	180-240 VAC; 15-24 °C ambient
Weight	Approximate per GA drawing

Bill of Materials & Sourcing:

Major purchased items include:

- Water Tanks (PVC, 2 000 L × 2) – Sintex/Supreme
- Pump & Motor – Grundfos CM 15-3 assembly
- Filter Strainer – Neometrix NEFILT60, SS 304, 60 mesh
- Pressure Gauge – WIKA 232.50.100 (0-10 kg/cm²)
- Nozzles – Neometrix NENZ114 SS 304 (82 top + 32 side)
- Piping & Fittings – Supreme uPVC Schedule-80 (1"-3"), solvent, unions, tees, elbows
- Caster Wheels – Eles Ganter RE.F5 200-SSL-H (750 mm height)

Quality Assurance Plan (QAP) & Factory Acceptance Test (FAT):

- Under Contract GEM/2023/B/3091277, every bought-out and in-house component undergoes 100% inspection:
- Certificates: COC from manufacturers; calibration records for pump/motor and filter; visual checks for piping and nozzles.
- Process Audits: Witness points for welding, painting (SA-2.5 prep; powder coat DFT 80–100 μm) and final assembly.
- Documentation: Test reports, compliance certificates and internal inspection reports archived for each rig detailed description.

FAT validates performance per spec before shipment:

- Visual verification of dimensions, frame alignment, detachable halves and wheel locks.
- Technical checks: side-wing pivot $\pm 60^\circ$; max pressure 1.4 kg/cm²; flow measurement compliance.
- Leak-proof checks at 1–2 bar to verify no seepage from joints or nozzles.
- Certificate review: all COCs, calibration and compliance documents on file

Applications & Use Cases:

The Rain Water Test Rig's precise control over droplet size, flow rate and impact velocity makes it a versatile platform for a broad spectrum of aerospace and related testing scenarios. Below are the principal application domains, each leveraging the rig's programmability, data-capture fidelity and modular construction to ensure both regulatory compliance and operational excellence.

1 Aerospace Structural & Seal Certification

- Regulatory Mandates: Complies with MIL-STD-810G Method 506 ("Rain Penetration") and FAA 14 CFR 25.673 requirements for water-ingress resistance.
- Test Profiles: Simulates rainfall intensities from 2 mm/hr (drizzle) up to 100 mm/hr (torrential downpour), with droplet velocities matching 250 kt flight conditions.
- Targeted Exposures: Sequentially subjects fuselage panels, cockpit canopies, access hatches and fairings to overhead and oblique rain angles via adjustable side-wing assemblies.

- Leak Detection: High-resolution differential pressure sensors and moisture probes detect ingress at joints to <0.1 L/hr, while post-test inspections (dye-penetrant, borescope) localize seal failures.
- Data Reporting: Auto-generated certification reports include water-ingress maps, leak-rate curves and compliance matrices for type-certificate validation.

2 Environmental Qualification of Avionics & Subsystems

- Wet-Soak Cycling: Programmable soak phases (0–60 minutes) at user-defined temperatures (optional 5 °C–60 °C loop) verify sealant resilience and conformal-coating adhesion.
- Runoff Analysis: Integrated sampling ports collect runoff for conductivity, pH and particulate analysis, assessing corrosion inhibitor efficacy and contamination risk.
- Component-Level Testing: Side nozzles direct rain onto pitot-static probes, antenna housings, ventilation inlets and latching mechanisms, confirming ingress protection per RTCA DO-160G Section 9.
- Thermal Shock Scenarios: With optional heater/chiller skid, the rig alternates between hot-rain and icing conditions, characterizing seal performance during rapid temperature transitions.

3 Maintenance Training & Procedural Validation

- Hands-On Drills: Technicians practice canopy resealing, O-ring replacement and drain-channel clearing under realistic rain patterns, building muscle memory and reducing error rates.
- Procedure Optimization: Measured drainage-time metrics and residual-moisture scans inform updates to maintenance manuals, defining clear go/no-go criteria for water egress.
- Safety Protocols: Emergency-stop and over-pressurization interlocks teach crews proper response to nozzle clog or pressure excursions, enhancing shop-floor safety.

4 Production Acceptance & Quality Control

- Batch Testing: Before delivery, each fuselage section or modular assembly undergoes a standardized rain test—ensuring uniform quality across production lots.
- Statistical Process Control: Collected leak-rate and run-off data feed SPC charts, driving continuous improvement in sealant application and joint fabrication.
- Rapid Throughput: Quick-release couplings and modular tank frames enable >10 units/day cycle times for high-volume acceptance testing.