भारत सरकार

Government of India

जल शक्ति मंत्रालय

Ministry of Jal Shakti

जल संसाधन, नदी विकास और गंगा संरक्षण विभाग

Department of Water Resources, River Development and Ganga Rejuvenation

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A State-of-the-Art Ingress Protection Testing Facility at CW&PRS for Sustainable Water Resources Management

Water Quality and Cost-effective Technologies: A Reliable and Sustainable Practice for Water Infrastructure Instruments Quality Assurance

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Background:

Ingress Protection test facility at CW&PRS Pune under NHP

- The Govt. of India is implementing National Hydrology Project (NHP) to improve the extent, quality and accessibility of water resources information and to strengthen the capacity of targeted water resources management institutions in the country.
- The expansion nationwide of a real time hydro-meteorological/hydrological data acquisition system will vastly increase the timeliness, reliability and quantity of water resources information .
- The state and central agencies are installing various instruments such as Automatic Weather Stations (AWS), Water Level Sensors, Flow Sensors, Data Loggers, Telemetry, Control Panels, Enclosures, etc.
- These instruments will have to experience various environmental stresses during their expected life in field condition.
- To sustain the different environmental conditions, these instruments have to be tested for Ingress Protection (IP XX) rating prior to the field installation.

INTRODUCTION - Problem

- The state and central agencies are installing various instruments under NHP & Jal Jeevan Mission (JJM)
- Sustainable & Smart water management needs continuous data from level sensors, flow meters, valves, WQ sondes, AWS, RTUs.
- Failure cause: Dust & water ingress -> sensor drift, short circuit, corrosion.
- Indian conditions: Monsoon flooding, dust storms, high humidity, temp variations
- Even minor ingress = data loss, compromised WQ monitoring, unplanned maintenance
- **IP Testing per IS/IEC 60529 verifies enclosure protection.**
- **Outcome: Reduced failures, extended life, less e-waste, data integrity**

NHP specifications: IP code

Real Time Data Acquisition Systems (RTDAS)



Typical installation of AWS system

Rain Gauge Sensors (IP 65 or NEMA 4):

Data from NHP website

NHP specifications: IP code

Electromagnetic Flow Sensor



EM Flow Sensor (IP 68)



Signal Converter (IP 67)

NHP specifications: IP code

Digital Water Level Recorder (DWLR)



Sensors (IP 68 or Better):
Data from NHP website



Data logger (IP 65):
Data from NHP website

CONCEPT:

Ingress Protection (IP code)

- Electric and electronic equipment deteriorate or malfunction when water or dust enters the device.
- **IP** code tests a product's ability to protect against the intrusion (ie. **"ingress"**) of **solid foreign objects and water** while handling **Electrical Power Supply**.
- **Standards related to IP testing:**

i. IS/IEC 60529:2001

ii. DIN 40050-9 / IP 69 K (High pressure steam jet)

iii. NEMA 250 (Electrical/Electronics) & UL 50 E

iv. MIL-STD-202 & MIL-STD-810 (military)

v. ISO 20653

Interpreting the IP code: As per IEC 60529



CW&PRS IP LAB - Objective

- IP Lab established at CWPRS Pune under National Hydrology Project
- NABL Accredited Facility [Certificate TC-17142, 24.11.2025 to 23.11.2029] with capability to test entire range of IP 11 to IP 69
- NABL Scope covers IS/IEC 60529 (Enclosures), IEC 60034-5 (Rotating Machines), IS 10322 (Part 1) (Clause 9.2) (Luminaires).
- It is the unique Lab in water sector providing full range of IP testing services for hydro-met instruments of RTDAS such as AWS, Level sensors, Flow sensors, Telemetry instruments, Control Panels deployed under NHP /JJM.
- Functions: Design validation, Procurement compliance, Lifecycle assessment
- Third-party verification against self-declaration

Development of Ingress Protection Laboratory at CW&PRS Pune under NHP









Old Ship Model Making Workshop to A Comprehensive IP Testing Lab since 2021

Development of Ingress Protection Laboratory at CW&PRS Pune under NHP







‘Swachhata Hi Seva’

IP Test Facilities at CW&PRS Pune



Dust Chamber (IP 5X & 6X)



Water testing facility (IP X1- IP X6)



IP X9K testing facility



Dielectric test facilities for IP acceptance



Test probes (IP 1X -4X)



Immersion tank for IP X7 & X8



200 kV Lightning Impulse Measuring System



15 kV Insulation Quality Analyzer

NABL Accredited Facility with capability to test entire range of IP 11 to IP 69

Unique Features of IP Testing Laboratory at CWPRS

TC-17142











Unique feature:

- The Ingress Protection (IP) Laboratory is a specialised facility equipped to test the degree of protection provided by Electrical, Electronic enclosures, Hydro-meteorological instruments, electric motors etc., against solid objects like dust particles and liquids like water.
- Solid object testing (IP 1X – 4X) and Dust chamber testing (IP 5X & 6X) facilities to test the sample size of 2.5m x 2.5m x 2.5m (W x L x H) & up to the weight of 1 ton.
- Water testing facilities (IP X1 – IP X8) to test the sample size of 2m x 2m x 2m & up to the weight of 1 ton.
- IP X9K facility with chamber size of 1m x 1m x 1m to test the sample of weight up to 100 kg for testing jet spray of 80 degree centigrade at 100 bar.
- High voltage facilities for IP XX acceptance test: AC/DC 0-100 kV, Impulse 0-200 kV, 20 kJ & 15 kV Insulation Tester.

IP TEST PROCEDURES:

- ✓ IS/IEC 60529
- ✓ IS/IEC 60034-5
- ✓ IS 10322(Part1)
- ✓ ISO 20653

METHODOLOGY - Test Infrastructure IP 5X/6X

Dust chamber for IP5X/IP6X tests: 27 m^3, Talcum powder 2 kg/m^3, 2 kPa vacuum









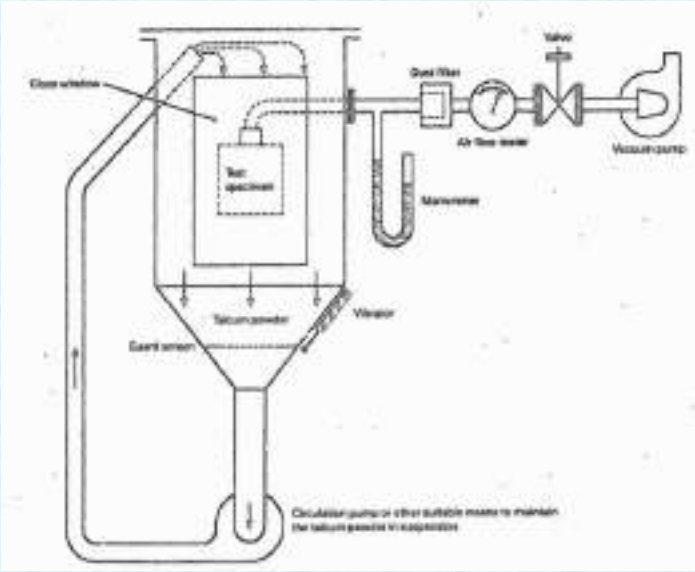
The typical sample enclosure before and after the dust test IP6X: Test - 8 hours, Pass: No ingress dust

IP Test Methodology-IEC 60529:

Test for protection against solid objects

- **IP5X**: Protected against harmful dust
- **IP6X**: Totally protected against dust

- IP 5X & 6X test will be carried out in dust test chamber.
- The talcum powder used shall be able to pass through a square-meshed sieve the nominal wire diameter of which is 50 µm and the nominal width of a gap between wires 75 µm, The amount of talcum powder to be used is 2 kg per cubic metre of the test chamber volume. It shall not have been used for more than 20 tests.



METHODOLOGY - Test Infrastructure for IP X5/X6

Water Jet: **IPX5**- 12.5L/min, nozzle-6.3mm &
IPX6- 100 L/min nozzle-12.5mm from 3m, 360° exposure

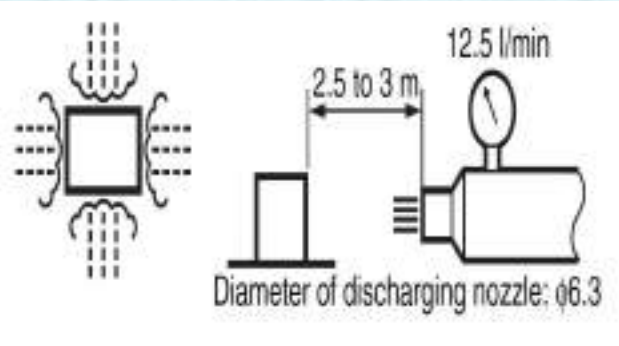


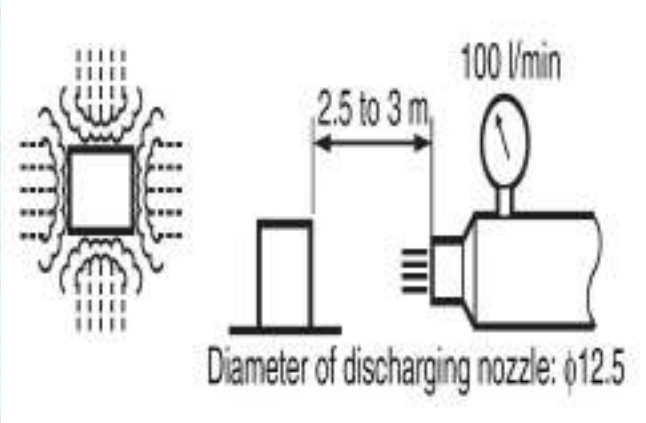


The typical sample enclosure under the water jet test IPX5: 1 min/m², total ≥3 min, Pass: No harmful ingress of water

IP Test Methodology-IEC 60529:
Test for water ingress IP X5 / X6

- **IPX5**: Protection from water jets, No harmful effect of water splash from all direction. Nozzle of 6.3 mm diameter, Jet the water at flow rate of 12.5 lit./min. from all direction to the object surface for 1 m^2/min, at least for 3 min in total



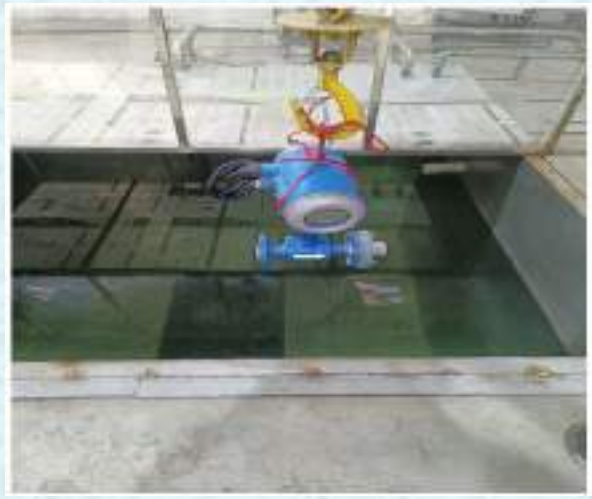


- **IPX6**: Protection from strong water jets, No harmful effect of strong water jets from all direction. Nozzle of 12.5 mm diameter, Jet the water at flow rate of 100 lit./min. from all direction to the object surface for 1 m^2/min, at least for 3 min in total

METHODOLOGY - Test Infrastructure for IP X7/X8

Immersion Tanks: IPX7- 1m, 30 min & IPX8: up to 18m, > 30 min

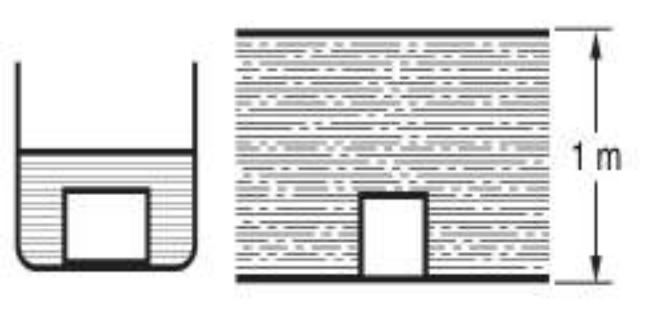




The typical sample flowmeter for the immersion test IPX7 : Complete submersion, post-test functional check, Pass: No harmful ingress of water

IP Test Methodology-IEC 60529:
Test for water ingress IP X7 / X8

- **IPX7**: Protection from water dip, No harmful effect of water dip in certain level of pressure and length of time. Dip into 1 m depth water for 30 min.



- **IPX8:** Protection from water sink, No harmful effect against water sink which the condition is decided between customer & manufacturer (in severer condition comparing to IPX7)

IP Test Methodology-IEC 60529:
Acceptance Test

Flowmeter for Pre/post test visual verification & Functionality check after IP 67





The typical sample enclosure is under insulation and high voltage test after the IP 55 test

DISCUSSION – IP Test Impact on Sustainability

- Data Integrity: Verified IP68 eliminated drift in long-term deployments
- Lifecycle Cost: Single RTU replacement ~₹1.2 lakh incl. logistics.
- IP testing reduced replacement frequency
- E-Waste Reduction: Life extended from 2 years to 5+ years
- Network Resilience: Maintains data availability during monsoon, flood, dust storms

DISCUSSION –
IP Rating vs Real-World

- Manufacturer-declared ratings = best-case lab conditions
- Real factors: Installation practices, cable entry, gasket aging, pressure-equalization vents
- IPX5/IPX6 jet tests more aggressive than rainfall - exposes weaknesses early

CONCLUSION

- CW&PRS - IP Lab facility addresses critical gap in instrumentation reliability
- Provides standardized testing capability for entire range of IP 11 to IP 69 tests as per IS/IEC 60529, IEC 60034-5, IS 10322 (Part 1) (Clause 9.2) with NABL certification.
- Pre-deployment verification reduced ingress-related failures significantly in pilot studies
- Policy Implication: Mandatory IP compliance in NHP & Jal Jeevan Mission tenders
- Supports data-driven, climate-resilient water management & sustainability goals

सत्यमेव जयते

Together we can make green Environment and better Sustainable World



Thank you!

For any technical support for ORGANIZATIONS, Please Contact:

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