

Laboratory **Cosmo Analytical Lab, C-423, Sector-10, Noida, Uttar Pradesh**

Accreditation Standard **ISO/IEC 17025: 2005**

Certificate Number **TC-6379 (in lieu of T-3626 & T-3627)**

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CHEMICAL TESTING

| I. METALS & ALLOYS | | | | |
|-------------------------------|-------------------------------|----|-------------------|----------------------|
| 1. | Low Alloy Steel | C | ASTM E 415: 2017 | 0.01 % to 1.1 % |
| | | Si | | 0.02 % to 1.30 % |
| | | Mn | | 0.08 % to 2.0 % |
| | | P | | 0.003 % to 0.085 % |
| | | S | | 0.005 % to 0.32 % |
| | | Cr | | 0.01 % to 2.25 % |
| | | Mo | | 0.005 % to 0.60 % |
| | | Ni | | 0.01 % to 3.32 % |
| | | Al | | 0.01 % to 0.10 % |
| | | Cu | | 0.01 % to 0.22 % |
| | | B | | 0.0005 % to 0.0073 % |
| 2. | Stainless Steel | C | ASTM E 1086: 2014 | 0.017 % to 0.2 % |
| | | Si | | 0.18 % to 1.00 % |
| | | Mn | | 0.8 % to 2.00 % |
| | | P | | 0.021 % to 0.041 % |
| | | S | | 0.003 % to 0.032 % |
| | | Cr | | 12.0 % to 21.0 % |
| | | Mo | | 0.24 % to 3.00 % |
| | | Ni | | 5.00 % to 14.00 % |
| | | Al | | 0.003 % to 0.018 % |
| | | Co | | 0.02 % to 0.25 % |
| | | Cu | | 0.06 % to 0.5 % |
| Nb | 0.01 % to 0.24 % | | | |
| Ti | 0.005 % to 0.01 % | | | |
| 3. | Aluminium and Aluminium Alloy | Si | ASTM E 1251: 2011 | 0.07 % to 12.44 % |
| | | Fe | | 0.1 % to 1.04 % |
| | | Cu | | 0.001 % to 5.26 % |
| | | Mn | | 0.001 % to 0.65 % |
| | | Mg | | 0.03 % to 1.12 % |

Rahul Jain
Convenor

N. Venkateswaran
Program Director

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| | | Cr | | 0.002 % to 0.85 % |
| | | Ni | | 0.005 % to 0.38 % |
| | | Zn | | 0.01 % to 0.80 % |
| | | Ti | | 0.01 % to 0.12 % |
| | | Pb | | 0.05 % to 0.41 % |
| 4. | Copper and Copper Alloys | Zn | BS EN 15079: 2015 | 0.38 % to 43 % |
| | | Pb | | 2.18 % to 13.7 % |
| | | Sn | | 0.02 % to 9.09 % |
| | | P | | 0.005 % to 0.052 % |
| | | Fe | | 0.005 % to 0.016 % |
| | | Ni | | 0.014 % to 0.76 % |
| | | Si | | 0.007 % to 0.027 % |
| | | As | | 0.008 % to 0.161 % |
| | | Sb | | 0.008 % to 0.61 % |
| | | Bi | | 0.01 % to 0.062 % |
| | | Al | | 0.016 % to 0.058 % |
| 5. | Cast Iron | C | ASTM E 1999: 2011 | 2.1 % to 4.0 % |
| | | Mn | | 0.17 % to 0.74 % |
| | | Si | | 1.0 % to 2.50 % |
| | | P | | 0.05 % to 0.3 % |
| | | S | | 0.01 % to 0.18 % |
| | | Cr | | 0.03 % to 1 % |
| | | Cu | | 0.1 % to 1.0 % |
| | | Mg | | 0.035 % to 0.064 % |
| II. | BUILDING MATERIAL | | | |
| 1. | Cement (OPC, PPC) | Loss of Ignition | IS 4032: 1985 (RA 2014) | 0.1 % to 5 % |
| | | Insoluble Residue | | 0.2 % to 36 % |
| | | Silica | | 15 % to 35 % |
| | | Alumina | | 3 % to 7 % |
| | | Iron Oxide | | 0.5 % to 7 % |
| | | Calcium Oxide | | 50 % to 70 % |
| | | Magnesium Oxide | | 0.5 % to 5 % |

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| | | Total Sulphur (as SO ₃) Chloride | | 0.5 % to 5 % |
| | | | | 0.01 % to 0.15 % |
| 2. | Bitumen/ Emulsion | Solubility in Trichloroethylene | IS 8887: 2004 (RA 2014) | Upto 100 % |
| 3. | Admixture | Dry Material Content | IS 9103: 1999 (RA 2013), Annexure E | 20 % to 35 % |
| | | Ash content | | 9 % to 15 % |
| | | Relative density | | 1.0 to 2.0 |
| | | pH | | 6 to 9 |
| 4. | Flyash | Silicon dioxide (SiO ₂) | IS 1727: 1967 (RA 2013), Amendment 2 | 15 % to 70 % |
| | | Al ₂ O ₃ | | 1 % to 45 % |
| | | Fe ₂ O ₃ | | 0.5 % to 10 % |
| | | Magnesium oxide (MgO) | | 0.5 % to 5 % |
| | | Total Sulphur as Sulphur trioxide (SO ₃) | | 0.5 % to 5 % |
| 5. | Silica Fume | SiO ₂ | IS 1727: 1967 (RA 2013), Amendment 2 | 10 % to 100 % |
| | | Moisture content (%/mass) | | 0.1 % to 10 % |
| | | Loss on ignition | | 0.1 % to 10 % |

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MECHANICAL TESTING

| I. | BUILDINGS MATERIALS | | | |
|----|----------------------------------|--|----------------------------------|--|
| 1. | Concrete Cube | Compressive Strength | IS 516: 1959 (RA 2013) | 5 N/mm ² to 60 N/mm ² |
| 2. | Burnt Clay/ Flyash Bricks | Compressive Strength | IS 3495 (Part 1): 1992 (RA 2011) | 5 N/mm ² to 35 N/mm ² |
| | | Water Absorption | IS 3495 (Part 2): 1992 (RA 2011) | 5 % to 30 % |
| | | Efflorescence | IS 3495 (Part 3): 1992 (RA 2011) | Qualitative |
| | | Dimension: a) Length b) Width c) Height | IS 1077 (Part 4): 1992 (RA 2011) | 4500 mm to 4700 mm 2100 mm to 2300 mm 1300 mm to 1500 mm |
| 3. | Coarse Aggregate | Sieve Analysis | IS 2386 (Part 1): 1963 (RA 2016) | 2.36 mm to 80 mm (0 to 100) % |
| | | Flakiness Index | | 5 % to 60 % |
| | | Elongation Index | | 5 % to 60 % |
| | | Specific Gravity | IS 2386 (Part 3): 1963 (RA 2016) | 2 to 4 |
| | | Water Absorption | | 0.10 % to 10 % |
| | | Bulk Density | | 1 g/cc to 3 g/cc |
| | | Impact Value | IS 2386 (Part 4): 1963 (RA 2016) | 5 % to 60 % |
| | | Crushing Value | | 5 % to 60 % |
| 4. | Fine Aggregate | Loss Angeles Abrasion value | | 5 % to 70 % |
| | | 10 % Fine Value | | 10 to 40 tonnes |
| | | Particle Size (Sieve Analysis) | IS 2386 (Part 1): 1963 (RA 2016) | 0.15 mm to 10 mm (0 to 100) % |
| | | Bulk Density | IS 2386 (Part 3): 1963 (RA 2016) | 1 g/cc to 3 g/cc |
| | | Specific Gravity | | 2 to 4 |
| | | Water Absorption | | 0.10 % to 10 % |
| | | Deleterious material: | | |

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| 5. | Cement (OPC/PPC) | a) Finer than 75 μ IS Sieve | IS 2386 (Part 1): 1963 (RA 2016) | 1 % to 10 % |
| | | b) Clay Lumps | IS 2386 (Part 2): 1963 (RA 2016) | 0.1 % to 5 % |
| | | c) Coal & Lignite | IS 2386 (Part 2): 1963 (RA 2016) | 0.1 % to 5 % |
| | | Consistency | IS 4031 (Part 4): 1988 (RA 2009) | 20 % to 40 % |
| | | Fineness (By Blaine Air Permeability) | IS 4031 (Part 2): 1999 (RA 2008) | 100 m ² /kg to 600 m ² /kg |
| | | Setting Time: | IS 4031 (Part 5): 1988 (RA 2009) | |
| | | a) Initial Setting Time | IS 4031 (Part 5): 1988 (RA 2009) | (30 to 250) minutes |
| | | b) Final Setting Time | IS 4031 (Part 5): 1988 (RA 2009) | (100 to 600) minutes |
| | | Soundness (By Lechatelier Method) | IS 4031 (Part 3): 1988 (RA 2014) | 0.1 mm to 10 mm |
| | | Soundness (By Autoclave) | IS 4031 (Part 3): 1988 (RA 2014) | 0.1 % to 1 % |
| 6. | Bitumen | Compressive Strength | IS 4031 (Part 6): 1988 (RA 2009) | 5 N/mm ² to 70 N/mm ² |
| | | Density | IS 4031 (Part 11): 1988 (RA 2014) | 2.5 g/cc to 3.5 g/cc |
| | | Penetration | IS 1203: 1978 (RA 2004) | [30 to 90] (1/10 mm) |
| | | Flash Point | IS 1209: 1978 (RA 2004) | 180 ^o C to 250 ^o C |
| 7. | Bituminous mix | Softening Point | IS 1205: 1978 (RA 2004) | 40 ^o C to 70 ^o C |
| | | Ductility at 25 ^o C | IS 1208: 1978 (RA 2004) | 10 cm to 90 cm |
| | | Binder Content | IRC: SP11-1988 (Appendix 5) | 0.5 % to 20 % |
| 8. | Flyash | Fineness- Specific surface by Blaine's permeability method | IS 1727: 1967 (RA 2013) Amendment 2 | 200 m ² /kg to 430 m ² /kg |
| | | Fineness by wet sieving (45 micron IS Sieve) | IS 1727: 1967 (RA 2013) Amendment 2 | (0 to 50) % |
| | | Lime reactivity- Avg. compressive strength | IS 1727: 1967 (RA 2013) Amendment 2 | 2 N/mm ² to 20 N/mm ² |
| | | Compressive strength at 28 days | IS 1727: 1967 (RA 2013) Amendment 2 | 2 N/mm ² to 50 N/mm ² |

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| 9. | Bentonite | Soundness by autoclave test | | 0.02 % to 1.5 % |
| | | Specific Gravity | | 0.5 to 3 |
| | | pH at 2 % suspension | IS 2720 (Part 26): 1987 (RA 2011) | 2 to 14 |
| | | Liquid limit | IS 2720 (Part 5): 1985 (RA 2015) | 50 % to 800 % |
| | | Swelling Index | IS 2720 (Part 40): 1977 (RA 2011) | 10 % to 600 % |
| 10. | Silica Fumes | Fineness by wet sieving (45 micron IS sieve) | IS 1727: 1967 (RA 2013) | 1 % to 75 % |
| | | Compressive Strength | IS 1727: 1967 (RA 2013) | 2 N/mm ² to 25 N/mm ² |
| II. | SOIL & ROCK | | | |
| 1. | Soil | Heavy Compaction Test a) Maximum Dry Density b) Optimum Moisture Content | IS 2720 (Part 8): 1983 (RA 2015) | 1.5 g/cc to 2.5 g/cc 6 % to 25 % |
| | | Light Compaction Test a) Maximum Dry Density b) Optimum Moisture Content | IS 2720 (Part 7): 1983 (RA 2015) | 1.0 g/cc to 2.0 g/cc 3 % to 20 % |
| | | Atterberg Limit: Liquid Limit | IS 2720 (Part 5): 1985 (RA 2015) | 15 % to 50 % |
| | | California Bearing Ratio (CBR) | IS 2720 (Part 16): 1987 (RA 2011) | 1 % to 50 % |
| | | Grain Size Analysis | IS 2720 (Part 1): 1983 (RA 2010) | (0 to 100) % |
| III. | MECHANICAL PROPERTIES OF METALS | | | |
| 1. | Ferrous & Non Ferrous Materials, alloys & Products | Tensile Strength | IS 1608: 2005 (RA 2011) | 50 MPa to 1500 MPa |
| | | | | 200 MPa to 1250 MPa |
| | | | | 350 MPa to 1000 MPa |

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|-----------|--|--|---|--|
| | (Steel, Stainless Steel , Cast Iron, Copper, Aluminium) | Yield Strength | | 50 MPa to 1350 MPa |
| | | Elongation % | | 100 MPa to 1100 MPa |
| | | Reduction Area % | | 200 MPa to 1100 MPa |
| 2. | Welded specimens | Transverse in Tensile | ASME Sec. IX: 2015 | 2 % to 70 % |
| | | Bend Test | | 400 MPa to 1200 MPa |
| 3. | Steel | Bend Test | IS 1599: 2012 (RA 2015) | Qualitative [Mandrel dia.: (16, 24, 32, 44, 52, 60, 70, 80, 100, 125) mm] |
| | | Brinell Hardness Test | IS 1500 (Part 1): 2013 | [120 to 550] HBW (10/3000) |
| | | Rockwell Hardness Test: | IS 1586 (Part 1): 2012 | (50 to 82) HRA |
| | | HRA | | (20 to 100) HRBW |
| | | HRB | | (20 to 70) HRC |
| | | HRC | IS 1501 (Part 1): 2013 | (50 to 450) HV0.1 |
| | | Microvickers Hardness Test (10 gm to 1 kg) | | (50 to 800) HV0.2 |
| | | | | (50 to 800) HV0.3 |
| | | | | (50 to 800) HV0.5 |
| | | | | (50 to 800) HV1.0 |
| | Izod Impact "V" Notch | IS 1598: 1977 (RA 2015) | (2 to 160) J | |
| | Charpy Impact "V" Notch [25 ⁰ C to (-) 50 ⁰ C] | IS 1757 (Part 1): 2014 | (2 to 300) J | |
| 4. | Reinforced steel bar | Mass per meter | IS 1786: 2008 (RA 2013) | (0.2 to 3.0) kg/m |
| | | Rebend Test | | Qualitative [Mandrel dia.: (16, 24, 32, 44, 52, 60, 70, 80, 100, 125) mm] |

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| IV. | METALLOGRAPHY TEST | | | |
| 1. | Austenite Stainless Steel | Intergranular Corrosion Test: Practice A | ASTM A 262: 2015 | Qualitative (250X / 500X) |
| | | Practice E | | Qualitative (Close Bend/ 1T Magnification: 20X) |
| | | | | |
| 2. | Materials, Alloys & Products (Steel, Stainless Steel, Copper, Aluminium) | Microstructure | ASM Handbook Vol. 9: 2004 | Qualitative (Magnification: 100X, 200X, 500X) |
| 3. | Steel | Grain Size by Comparison Method | IS 4748: 2009 (RA 2012) | Grain Size: 1 to 10 (Magnification: 100X) |
| | | Inclusion Rating | IS 4163: 2004 (RA 2010), Method A | (0 to 3)/ 100X A, B, C & D Type Thin & Thick series |
| | | Depth of Decarburized Layer by Microscopic Method | IS 6396: 2000 (RA 2012) | 0.01 mm to 0.1 mm (Magnification: 100X) |
| | | Determination of Case Depth by Microscopic & hardness traverse Method | IS 6416: 1988 (RA 2012) | 0.01 mm to 10.0 mm |
| 4. | Cast Iron | Designation of microstructure of graphite in cast iron by form, size & distribution by comparison method | IS 7754: 1975 (RA 2012) ASTM A 247: 2016a | Qualitative (Magnification: 100X) |

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