

Laboratory **Offshore Testing & Inspection Services (I) Pvt. Ltd., W-147, MIDC
Pawane, Thane Belapur Road, Navi Mumbai, Maharashtra**

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

Certificate Number **TC-7683**

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|-----|----------------------------|-------------------------|---|--|
|-----|----------------------------|-------------------------|---|--|

CHEMICAL TESTING

| I. | METALS & ALLOYS | | | |
|-----------|---|------------------|------------------------|--------------------|
| 1. | Ferrous Alloys Cast Iron, Pig Iron | C | ASTM E 1019 | 0.80 % to 3.75 % |
| | | Si | ASTM E 351 | 0.1 % to 4.0 % |
| | | P | ASTM E 351 | 0.02 % to 0.60 % |
| | | S | ASTM E 1019 | 0.002 % to 0.35 % |
| 2. | Stainless Steel | C | ASTM E 1019 | 0.001 % to 1.50 % |
| | | | ASTM E 1086 IS 9879 | 0.01 % to 0.20 % |
| | | Mn | ASTM E 1086 IS 9879 | 0.2 % to 2.0 % |
| | | Si | ASTM E 353 | 0.05 % to 1.2 % |
| | | | ASTM E 1086 IS 9879 | 0.10 % to 1.50 % |
| | | P | ASTM E 353 | 0.02 % to 0.15 % |
| | | | ASTM E 1086 IS 9879 | 0.008 % to 0.050 % |
| | | S | ASTM E 1019 | 0.002 % to 0.35 % |
| | | | ASTM E 1086 IS 9879 | 0.002 % to 0.40 % |
| | | Cr | ASTM E 1086 IS 9879 | 10 % to 25 % |
| | | Ni | ASTM E 1086 IS 9879 | 0.20 % to 25.00 % |
| | | Mo | ASTM E 1086 IS 9879 | 0.02 % to 3.50 % |
| | | Cu | ASTM E 1086 IS 9879 | 0.008 % to 0.75 % |
| | N | IS 228 (Part 23) | 0.007 % to 0.25 % | |
| | Co | JIS G 1253 | 0.010 % to 0.50 % | |
| | Ti | JIS G 1253 | 0.020 % to 1.0 % | |

**Ravi Johri
Convenor**

**Alok Jain
Program Manager**

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| | | Nb | JIS G 1253 | 0.008 % to 1.2 % |
| | | Al | JIS G 1253 | 0.010 % to 0.5 % |
| | | V | ASTM E 1086 IS 9879 | 0.03 % to 0.3 % |
| 2. | Low Alloy Steel Carbon Steel Mild Steel | C | ASTM E 1019 | 0.001 % to 1.50 % |
| | | | ASTM E 415 IS 8811 | 0.05 % to 1.10 % |
| | | Mn | ASTM E 415 IS 8811 | 0.01 % to 2.00 % |
| | | Si | ASTM E 350 | 0.01 % to 3.5 % |
| | | | ASTM E 415 IS 8811 | 0.05 % to 0.5 % |
| | | P | ASTM E 350 | 0.02 % to 0.5 % |
| | | | ASTM E 415 IS 8811 | 0.005 % to 0.10 % |
| | | S | ASTM E 1019 | 0.002 % to 0.35 % |
| | | | ASTM E 415 IS 8811 | 0.002 % to 0.10 % |
| | | Cr | ASTM E 415 IS 8811 | 0.007 % to 1.7 % |
| | | Mo | ASTM E 415 IS 8811 | 0.002 % to 1.0 % |
| | | Cu | ASTM E 350 | 0.005 % to 1.5 % |
| | | | ASTM E 415 IS 8811 | 0.005 % to 0.6 % |
| | | Nb | ASTM E 415 IS 8811 | 0.003 % to 0.10 % |
| | | As | ASTM E 415 IS 8811 | 0.003 % to 0.1 % |
| | | Co | ASTM E 415 IS 8811 | 0.006 % to 0.50 % |
| | | Ti | ASTM E 415 IS 8811 | 0.001 % to 0.05 % |

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|-----------|--------------------------------|-------------------------|--|--|
| | | V | ASTM E 415 IS 8811 | 0.003 % to 0.5 % |
| | | Al | ASTM E 415 IS 8811 | 0.005 % to 0.10 % |
| | | B | ASTM E 415 IS 8811 | 0.0005 % to 0.015 % |
| | | N | ASTM E 415 IS 8811 | 0.0020 % to 0.015 % |
| | | Ni | ASTM E 415 IS 8811 | 0.01 % to 1.0 % |
| 3. | Tool Steel | C | ASTM E 1019 JIS G 1253 | 0.001 % to 3.00 % 0.20 % to 2.0 % |
| | | Si | ASTM E352 JIS G 1253 | 0.10 % to 2.5 % 0.10 % to 2.0 % |
| | | S | ASTM E 1019 JIS G 1253 | 0.002 % to 0.35 % 0.005 to 0.01 % |
| | | Cr | JIS G 1253 | 0.10 % to 13.0 % |
| | | Co | JIS G 1253 | 0.010 % to 11.0 % |
| | | Cu | JIS G 1253 | 0.020 % to 0.10 % |
| | | | WI/OTIS/CHE/19D (By AAS) Issue No.03 Date :-01-10-2015 Revision No.:-02 date :-17-06-2016 | 0.01 % to 2.0 % |
| | | Mn | JIS G 1253 | 0.10 % to 1.00 % |
| | | Mo | JIS G 1253 | 0.010 % to 10.0 % |
| | | Ni | JIS G 1253 | 0.020 % to 0.20 % |
| | | P | JIS G 1253 | 0.005 % to 0.050 % |
| | | W | JIS G 1253 | 0.010 % to 21.00 % |
| | | V | JIS G 1253 | 0.020 % to 2.00 % |
| 4. | Nickel & its Alloys | C | ASTM E 1019 JIS H 1288 | 0.001 % to 1.00 % 0.010 % to 0.40 % |
| | | Si | ASTM E 1473 JIS H 1288 | 0.05 % to 3.0 % 0.05 % to 2.0 % |

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| | | Mn | JIS H 1288 | 0.10 % to 1.5 % |
| | | P | JIS H 1288 | 0.005 % to 0.10 % |
| | | S | ASTM E 1019 | 0.002 % to 0.35 % |
| | | | JIS H 1288 | 0.004 % to 0.10 % |
| | | Cr | ASTM E 1473 | 5.0 % to 25.0 % |
| | | | JIS H 1288 | 0.10 % to 25.0 % |
| | | Mo | JIS H 1288 | 0.01 % to 29.0 % |
| | | Co | JIS H 1288 | 0.01 % to 3.5 % |
| | | Cu | JIS H 1288 | 0.10 % to 32.00 % |
| | | Fe | JIS H 1288 | 0.10 % to 32.00 % |
| | | V | JIS H 1288 | 0.01 % to 1.0 % |
| | | Ti | JIS H 1288 | 0.05 % to 1.5 % |
| | | W | JIS H 1288 | 0.1 % to 8.0 % |
| | | Fe | JIS H 1288 | 0.10% to 32.00 % |
| | | Cu | JIS H 1288 | 0.10 % to 32.00 % |
| | | Nb | JIS H 1288 | 0.10 % to 6.0 % |
| 5. | Aluminium & its Alloys | Si | ASTM E 1251 | 0.07 % to 16 % |
| | | Cu | ASTM E 1251 | 0.01 % to 7.5 % |
| | | Mg | ASTM E 1251 | 0.05 % to 6.0 % |
| | | Zn | ASTM E 1251 | 0.009% to 6.0 % |
| | | Sn | ASTM E 1251 | 0.01 % to 0.5 % |
| | | Ni | ASTM E 1251 | 0.005 % to 3.0 % |
| | | Fe | ASTM E 1251 | 0.05 % to 2.0 % |
| | | Mn | ASTM E 1251 | 0.008 % to 1.0 % |
| | | Cr | ASTM E 1251 | 0.01 % to 0.50 % |
| | | Pb | ASTM E 1251 | 0.005 % to 0.5 % |
| | | Ti | ASTM E 1251 | 0.008 % to 0.5 % |
| | | V | ASTM E 1251 | 0.002 % to 0.030 % |
| | | Co | ASTM E 1251 | 0.003 % to 0.10 % |
| | | Ca | ASTM E 1251 | 0.005 % to 0.025 % |
| 6. | Copper & its Alloys | Zn | BS EN 15079 | 0.10 % to 40.0 % |
| | | | ASTM E 478 | 5 % to 50.0 % |
| | | Cu | ASTM E 478-2017 | 40 % to 99.95 % |

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| | | | IS 4027 (Part 1) | |
| | | Pb | BS EN 15079 | 0.008 % to 10.0 % |
| | | | ASTM E 478-2017 IS 4027 (Part 1) | 0.02 % to 8.0 % |
| | | Sn | BS EN 15079 | 0.005 % to 10.00 % |
| | | Mn | BS EN 15079 | 0.01 % to 3.00 % |
| | | Ni | BS EN 15079 | 0.02 % to 32.0 % |
| | | Al | BS EN 15079 | 0.005 % to 10.0 % |
| | | Fe | BS EN 15079 | 0.02 % to 5.00 % |
| | | Si | BS EN 15079 | 0.02 % to 0.40 % |
| | | As | BS EN 15079 | 0.001 % to 0.50 % |
| | | S | BS EN 15079 | 0.01 % to 0.10 % |
| | | C | BS EN 15079 | 0.006 % to 0.050 % |
| | | P | BS EN 15079 | 0.004 % to 0.4 % |
| | | Co | BS EN 15079 | 0.030 % to 0.20 % |
| II. | PMI TESTING | | | |
| 1. | Identification of Fe, Cu, Al, Ni & Base Metal Alloy | PMI TESTING (Identification of Fe, Cu, Al & Ni Base metal) | ASTM E 1916 | Qualitative |
| III. | METALLIC COATINGS & TREATMENT SOLUTIONS | | | |
| 1. | Zinc Coated iron and Steel Articles | Mass of Zinc Coating | IS 6745-72 | 10 gm/m ² to 1000 gm/m ² |

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MECHANICAL TESTING

| I. | MECHANICAL PROPERTIES OF METALS | | | |
|----|--|---|--|--|
| 1. | Ferrous & Non Ferrous material & Products [Steel Flats, Rods, Bars, Tubes and Pipes, High Strength Deformed Steel Bars (Tor Steel)] | Tensile Test (0.2 YS 1% YS, UTS % E %RA) | ASTM A 370 ASTM E8/E8M IS 1786 IS 1608 ISO 6892-1 BS EN ISO 4136 ASTM B 557/557m IBR Rule 2016 in force IS 1367 (Part 3) By Offset Method /Proof Stress | 50 N/mm ² to 1700 N/mm ² (0.2 Proof Stress) 50 N/mm ² to 1700 N/mm ² (1% Yield Stress) 50 N/mm ² to 2000 N/mm ² (UTS) % EL : 1 % to 70 % % RA : 1 % to 70 % |
| | | Thick Tensile Test (%RA) | ASTM A 770 – 03 BS EN 10164 | 1 % to 70 % |
| | | Elevated Temperature Tensile (YS UTS % E %RA) | ASTM E 21-17 ISO 6892-2-2018 | 50 N/mm ² to 1700 N/mm ² (1% Yield Stress) 50 N/mm ² to 2000 N/mm ² (UTS) % EL : 1 % to 70 % % RA : 1 % to 70 % |
| 2. | Welded Specimen (Ferrous & Non Ferrous) | (YS UTS %E %RA) (0.2%, 1% Yield) | ASME SEC.II Part C IS 814 IS 1608 BS EN ISO 5178 By Offset Method /Proof Stress | 50 N/mm ² to 1700 N/mm ² (0.2 Proof Stress) 50 N/mm ² to 1700 N/mm ² (1% Yield Stress) 50 N/mm ² to 2000 N/mm ² (UTS) % EL : 1 % to 70 % % RA : 1 % to 70 % |

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|-----|---|-------------------------------|--|---|
| | | Transverse Weld Tensile (UTS) | API 1104 IS 2825 IBR Rule 2016 in force ISO 4136 ASME SEC IX AWS D 1.1 BS EN 895 BS EN ISO 15614-1 | 50 N/mm ² to 2000 N/mm ² |
| 3. | Welded Specimen (Ferrous & Non Ferrous) | Fracture | AWS D 1.1 ASME SEC IX | Qualitative |
| 4. | Cladded Plate | Shear Strength | ASTM A 263 SA 263 ASTM A 264 SA 264 ASTM A 265 SA 265 | 10 N/mm ² to 500 N/mm ² |
| 5. | Ferrous & Non Ferrous material & Products [Steel flats, rods, bars, tubes and pipes, High Strength Deformed Steel Bars (Tor Steel)] | Bend | ASTM E 290 ASTM A 370 IS 1599 IS 1786 IBR RULE : 2016 in force IS 2329 | Qualitative (Mandrel Dia – 2, 4, 5, 6, 7, 9, 10, 11, 12, 16, 20, 23, 25, 28, 32, 33, 36, 38, 40, 43, 45, 48, 50, 55, 60, 63, 64, 65, 75, 80, 84, 90, 113, 120, 128, 140, 160, 227 mm) |
| 6. | Welded Specimen (Ferrous & Non Ferrous) | Bend | IS 7310 (Part 1) IS 2825 ASTM E 190 ASME Sec. VIII (Div.1) ASME SEC IX API 1104/AWS D1.1 IBR RULE: 2016/ API 5L BS EN ISO 5173 BS EN 910 | Qualitative (Mandrel Dia – 2, 4, 5, 6, 7, 9, 10, 11, 12, 16, 20, 23, 25, 28, 32, 33, 36, 38, 40, 43, 45, 48, 50, 55, 60, 63, 64, 65, 75, 80, 84, 90, 113, 120, 128, 140, 160, 227 mm) |

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|-----|--|-------------------------|--|--|
| 7. | High Strength Deformed Steel Bars | Rebend | IS 1786 | Qualitative |
| 8. | Metals & Alloys (Tube to Tube Sheets) | Pull Out | ASME SEC VIII DIV.1 | Qualitative (10 kN to 1000 kN) |
| 9. | High Strength Deformed Steel Bars (Tor Steel)] | Mass/Unit Length | IS 1786 | 0.1 kg/m to 30 kg/m |
| 10. | Welded Specimen (Ferrous & Non Ferrous) | Nick Break | API 1104 IBR RULE : 2016 in force & IS 2825 | Qualitative (4 mm to 28 mm) |
| 11. | Ferrous & Non Ferrous material & Products [Steel Flats, Rods, Bars, Tubes and Pipes] | Reverse Bend | ASTM A 370 IS 1716 | Qualitative (2 mm to 40 mm) |
| 12. | Ferrous & Non Ferrous Materials [Tubes & Pipes] | Flattening | ASTM A 370 ASTM A 450/450M ASTM A 513 ASTM A 530 ASTM A 1016 ASTM B 111/IS 2328 IBR Rule : 2016 in force IS 2501 ASTM A999/A999M | Qualitative (4 mm to 1000mm OD pipe) |
| | | Reverse Flattening | ASTM A 370/ASTM A 450 ASTM A 1016/IS 2328 | Qualitative (20 mm to 600 mm OD) |
| | | Flaring / Drift | ASTM A 370 ASTM A 513 IS 2335/ASTM B153 IBR RULE:2016/API 5L IS 2501 | Qualitative (20 mm to 125 mm OD) |

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|-----|---|-------------------------------------|--|---|
| | | Flange | IS 2330 ASTM A 370 IBR 2016 | Qualitative (20 mm to 125 mm OD) |
| 13. | Ferrous & Non Ferrous materials/ Metal & Alloys (Boiler/Pressure Tubes) | Crushiiing Strength | ASTM A 370 | Qualitative (10 kN to 1000 kN) |
| 14. | Ferrous & Non Ferrous Materials [Sheet & Strip] | Erichson Cupping | IS 10175 (Part 1) ISO 20482 | Qualitative (0.2 mm to 2 mm Thick & Width 90mm or more) |
| 15. | Ferrous & Non Ferrous materials [Carbon and Alloy Steel - Bolts] | Proof Load | ASTM A 370 ISO 3506-1 ISO 3506-2 IS 1367 (Part 3) | Qualitative (10 kN to 1000 kN) |
| 16. | Ferrous & Non Ferrous materials [Carbon and Alloy steel Nuts] | Proof Load | ASTM A 370 ISO 3506-1 ISO 3506-2 IS 1367 (Part 6) | Qualitative (10 kN to 1000 kN) |
| 17. | Ferrous & Non Ferrous material & Products [Steel Flats, Rods, Bars, Tubes and Pipes] | Brinell Hardness | IS 1500 (Part 1) ASTM E10/ASTM A 370 BS EN ISO 6506-1 | 50 HBW to 400 HBW 2.5 /187.5 |
| | | Rockwell Hardness (HRA, HRBW & HRC) | ASTM E18 ASTM A 370 IS 1586 (Part 1) BS EN ISO 6508-1 | 20 HRA to 88 HRA 55 HRBW to 100 HRBW 20 HRC to 70 HRC |
| | | Vickers Hardness Test | IS 1501-1 BS EN ISO 6507-1 | 50 HV 5 to 800 HV 5 50 HV 10 to 800 HV10 |
| | | Micro-Vickers Hardness | IS 1501-2 ASTM E 384 BS EN ISO 6507-1 | 50 HV 0.2 to 800 HV 0.2 50 HV1 to 800 HV1 |
| | | Portable Hardness | ASTM E 110 | 20 HRA to 88 HRA 55 HRBW to 100 HRBW 20 HRC to 70 HRC |

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| | | Hydrostatic Pressure | ASTM E 1003 | Qualitative |
| | | Izod | IS 1598 ISO 148-1 | 2 J to 168 J (At Ambient Temperature) |
| | | Charpy 'V' & 'U' NOTCH | IS 1757 (Part 1) ASTM A 370 ASTM E 23 – 16b, IBR RULE : 2016 BS EN ISO 9016 BS EN 875 ISO 148:1 | 2 J to 298 J 50 °C to (-)196 °C |
| II. | METALLOGRAPHY TEST | | | |
| 1. | Ferrous & Non-Ferrous Materials | Micro-Structural Analysis | ASM Handbook – Metallography & Microstructure - Vol.9 ASTM E3 ASTM E407 | Qualitative (50X, 100X, 200X, 400X, 500X, 1000X) |
| | | Field Metallographic Replicas | E1351-01(RA2012) | Qualitative (50X, 100X, 200X, 400X, 500X, 1000X) |
| | | Average Grain Size | IS 4748 ASTM E112 (By Comparison Method) | Qualitative (ASTM No. 1 to 10 100X) |
| 2. | Case-hardened Steel | Estimation Of Case Depth | IS 6416 (By Microscopic Method) | Qualitative 0.01/10.0mm / 100x magnification |
| | | Estimation Of Case Depth | IS 6416 (By Micro Hardness Method) | 0.01 mm to 10 mm |
| 3. | Steel | Non-Metallic Inclusion Rating by Method-A | IS 4163 ASTM E45 ISO 4967 | Qualitative (Thin & Heavy (A, B,C,D: 0.5 to 3.0) /100X) |

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| | | Determination Of Depth Decarburization By Microscopic Method | IS 6396 ASTM E1077 | 0.01 mm to 5 mm Magnification 100 X |
| 4. | Ferrous & Non-Ferrous materials | Macro Examination | IS 11371 ASTM E381 ASTM E340 BS EN ISO 17639 | Qualitative (1X to 32X) |
| 5. | Cast Iron | Size & Distribution of graphite in Gray cast Iron & S.G. Iron by Comparison Method | IS 7754 ISO 945-1 | Qualitative (100X) |
| 6. | Steel Casting Stainless | Estimating Ferrite Content by Ferrite scope Microscopic Method | ASTM A 799 ASTM A 800 | 20 % to 100 % Upto 100 nos. |
| 7. | Ferrous / Non-Ferrous Material | Determining Volume Fraction By systematic manual point count | ASTM E 562 | 10 % to 90 % |
| 8. | Austenitic Stainless Steel | IGC Practice - Method A IGC Practice - E | ASTM A 262 | Qualitative (250 X & 500X) 180°/1t & 20X, |
| 9. | Austenitic Stainless Steel Ferritic Austenite (Duplex) Stainless Steel | IGC Practice - Method B Method C Method F | ASTM A 262 ASTM G 28 – 02 EN ISO 3651-1 | 1 Mpy to 1000 Mpy 1 Mpy to 1000 Mpy 1 Mpy to 1000 Mpy |
| 10. | Austenite & Ferritic Austenite (Duplex) Stainless Steel | Method - A Method - B Method - C | EN ISO 3651-2 | Qualitative 90°/1T/ 10X |
| 11. | Ferrous materials | HIC SSCC | NACE MR 0175 NACE TM0284 NACE TM0177 ASTM G 38:01 | Qualitative |

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| | | | (Method 'A' & 'C') NACE TM0177/ASTM G 39 (Method 'B') Four Point Bend | |
| 12. | Ferritic Austenite (Duplex) Stainless Steel | Ferric Chloride Pitting (Method A,B, C & D) | ASTM G 48 | 1 g/cm ² to 1000 g/cm ² |
| 13. | Ferrous Materials | Chloride Stress Corrosion Cracking (Mgcl ₂ & Cacl ₂) | ASTM G 36-94 (2013) | Qualitative |
| 14. | Duplex Steel | Method - A Method - B Method - C | ASTM A 923 | 400X , 500X 1 to 1000 mdd 2 J to 298 J 50 °C to (-)196 °C |
| 15. | Metals and their Alloys, Metallic Coatings, Conversion Coatings, Anodic Oxide Coatings and Organic Coatings on Metallic Material | Neutral Salt Spray | ASTM B 117 ISO 9227 | Qualitative |

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