Laboratory	**Subodh Technologists, R-968, M.I.D.C. Rabale, Navi Mumbai, Maharashtra**
Accreditation Standard	**ISO/IEC 17025: 2017**
Certificate Number	**TC-8225** ***(in lieu of T-0630 & T-0629)*** **Page 1 of 10**
Validity	**05.02.2019 to 04.02.2021** **Last Amended on --**

Sl.	Product / Material of Test	Specific Test Performed	Test Method Specification against which tests are performed	Range of Testing / Limits of Detection

CHEMICAL TESTING

I.	**METALS & ALLOYS**			
1.	**Carbon Steel (Low Carbon, Medium Carbon & High Carbon Steel)**	**Optical Emission Spectrometric Analysis**		
		Carbon	ASTM E 415-2017 IS 8811:2006	0.010 % to 1.15 %
		Manganese		0.050 % to 2.0 %
		Silicon		0.050 % to 1.50 %
		Sulphur		0.005 % to 0.10 %
		Phosphorus		0.005 % to 0 .10 %
		Chromium		0.030 % to 3.50 %
		Nickel		0.020 % to 3.85 %
		Molybdenum		0.010 % to 1.50 %
		Copper		0.010 % to 0.50 %
		Vanadium		0.010 % to 0.50 %
		Titanium		0.004 % to 0.10 %
		Niobium		0.008 % to 0.55 %
		Lead		0.002 % to 0.020 %
		Aluminium		0.005 % to 0.50 %
		Boron		0.002 % to 0.015 %
		Calcium		0.0001 % to 0.010 %
		Nitrogen	ASTM E 415-2017 IS 228 (Part 23): 2008	0.002 % to 0.035 %
2.	**Stainless Steel**	**Optical Emission Spectrometric Analysis**		
		Carbon	ASTM E 1086:2014 IS 9879:1998	0.01 % to 0.30 %
		Manganese		0.40 % to 2.00 %
		Silicon		0.10 % to 0.50 %
		Sulphur		0.005 % to 0.050 %
		Phosphorus		0.005 % to 0.050 %
		Chromium		5.00 % to 27.00 %
		Nickel		0.10 % to 34.00 %
		Molybdenum		0.010 % to 4.00 %
		Copper		0.010 % to 2.00 %
		Titanium		0.05 % to 1.00 %

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		Nitrogen	IS 228 (Part 23): 2008	0.005 % to 0.25 %
3.	**Aluminium & its Alloys**	**Optical Emission Spectrometric Analysis**		
		Copper	ASTM E1251:2017a	0.010 % to 10.00 %
		Silicon		0.070 % to 14.00 %
		Magnesium		0.010 % to 6.00 %
		Zinc		0.010 % to 6.00 %
		Nickel		0.010 % to 0.70 %
		Manganese		0.010 % to 0.70 %
		Tin		0.010 % to 0.25 %
		Iron		0.070 % to 1.00 %
		Chromium		0.010 % to 0.50 %
		Lead		0.010 % to 0.90 %
		Titanium		0.010 % to 0.30 %
4.	**Copper & its Alloys**	**Optical Emission Spectrometric Analysis**		
		Tin	BS EN15079:2015	0.005 % to 8.00 %
		Zinc		0.005 % to 50.00 %
		Lead		0.050 % to 13.00 %
		Iron		0.050 % to 4.50 %
		Nickel		0.020 % to 32.00 %
		Aluminium		0.020 % to 12.00 %
		Phosphorus		0.005 % to 1.00 %
		Silicon		0.050 % to 4.50 %
		Manganese		0.010 % to 7.00 %
		Silver		0.020 % to 3.70 %
5.	**Nickel & its Alloys**	**Optical Emission Spectrometric Analysis**		
		Carbon	ASTM E 3047:2016	0.005 % to 0.15 %
		Manganese	ST-VAL-09:2005	0.010 % to 2.00 %
		Silicon		0.020 % to 1.00 %
		Copper		0.020 % to 35.0 %
		Chromium		0.10 % to 27.0 %
		Molybdenum		0.10 % to 28.00 %
		Cobalt		0.020 % to 32.00 %
		Iron		0.30 % to 42.0 %
		Aluminium		0.002 % to 1.40 %
		Titanium		0.010 % to 4.00 %

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		Tungsten		0.050 % to 14.0 %
		Vanadium		0.050 % to 0.10 %
		Sulphur		0.0003 % to 0.003 %
		Phosphorus		0.002 % to 0.020 %
		Niobium		0.010 % to 6.00 %
6.	**Titanium & Titanium Alloys**	**Optical Emission Spectrometric Analysis**		
		Aluminium	ASTM E2994:2016 ST-VAL-11:2015 Issue No. 01 Issue Date: 05.08.2015	4.00 % to 7.00 %
		Tin		0.005 % to 2.20 %
		Vanadium		0.005 % to 4.50 %
		Carbon		0.005 % to 0.10 %
		Iron		0.010 % to 0.30 %
		Nitrogen		0.005 % to 0.030 %
7.	**Others / Alloy Steels, Stainless Steels, Nickel Base Alloys**	**Positive Material Identatification (Metals Identification, Grade Verification& not for Quantitative Analysis)**		
		Chromium	ASTM E 1476:2004 (RA 2014) (XRF)	Qualitative
		Nickel		Qualitative
		Molybdenum		Qualitative
		Manganese		Qualitative
		Vanadium		Qualitative
		Tungsten		Qualitative
		Cobalt		Qualitative
		Titanium		Qualitative
		Niobium		Qualitative
		Copper		Qualitative
8.	**Others / Iron, Steel, Special Steel, Stainless Steel, Nickel and its Alloys**	**Wet Chemical Analysis**		
		Carbon	IS 228 (Part 1): 2002	0.01 % to 4.50 %
		Manganese	IS 228 (Part 2): 2002	1.00 % to 3.00 %
		Silicon	IS 228 (Part 8): 2004	0.05 % to 3.00 %
		Sulphur	IS 228 (Part 9): 1989 (RA 2014)	0.010 % to 0.25 %
		Phosphorus	IS 228 (Part 3): 2002	0.01 % to 0.040 %
		Chromium	ST-VAL-01-2003 IS 228 (Part 6): 2002	0.10 % to 25.00 %
		Nickel	IS 228 (Part 5): 2002	0.10 % to 36.00 %

Sl.	Product / Material of Test	Specific Test Performed	Test Method Specification against which tests are performed	Range of Testing / Limits of Detection
		Molybdenum	IS 228 (Part 7): 1990 (RA 2018)	0.10 % to 4.00 %
		Copper	IS 228 (Part 15): 2004	0.05 % to 1.00 %
		Nitrogen	IS 5194:2002	0.005 % to 0.20 %
		Vanadium	ASTM E 30:1997	0.10 % to 2.00 %
9.	**Copper & its Alloys**	Copper	IS 440:2000	0.10 % to 99.90 %
		Lead	IS 4027 (Part 1): 2006	0.05 % to 5.00 %
		Nickel	IS 440:2000	0.10 % to 50.00 %
		Phosphorus	IS 440:2000	0.01 % to 1.00 %
10.	**Titanium & Titanium Alloys**	**ONH Analysis**		
		Oxygen	ASTM E 1409:2013	0.05 % to 0.38 %
		Nitrogen	ASTM E 1409:2013	0.0030 % to 0.0500 %
		Hydrogen	ASTM E 1447: 2016	0.0010 % to 0.0200 %
11.	**Others / Steel, Iron, Nickel alloys**	Oxygen	ASTM E 1019:2011	0.0040 % to 0.0300 %
		Nitrogen	ASTM E 1019:2011	0.0005 % to 0.50 %
		Hydrogen	ASTM E 1019:2011 ISO3690:2012	0.0001 % to 0.0030 %
12.	**Copper & Copper Alloys**	Oxygen	ASTM E 2575:2008	0.0050 % to 0.0400 %
II.	**METALLIC COATING AND TREATMENT SOLUTIONS**			
1.	**Other / Zinc Plated Steel Articles**	Mass of Zinc Coating	IS 6745:2010 (Clause No. 5); EN ISO 1461:1999	50 gms/m^2 to 1200 gms/m^2
		Uniformity of Coating	IS 2633:2010	Qualitative
		Adhesion Test	IS 2629-94	Qualitative
2.	**Other / Copper & Copper Alloys**	Mercurous Nitrate Test	IS 2305:1988 ASTM B 154:2016	Qualitative

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Accreditation Standard	**ISO/IEC 17025: 2017**	
Certificate Number	**TC-8225** ***(in lieu of T-0630 & T-0629)***	**Page 5 of 10**
Validity	**05.02.2019 to 04.02.2021**	**Last Amended on --**

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MECHANICAL TESTING

I.	**MECHANICAL PROPERTIES OF METALS**			
1.	**Metals and alloys Ferrous and Nonferrous**	Tensile Test,	IS1608:2005(RA2017) ASTME8M:2016a. ISO 6892-1:2016, IS 1786:08(RA2013) ASTM A370:2017a	(0.50kN to 50kN)
		Y.S.(MPa)		10 to 1400Mpa
		U.T.S.,(MPa)		10 to 1800Mpa
		%Elongation		2 to 90%
		%Reduction Area,		5 to 90%
		Proof Stress(Mpa)		10 to 1400Mpa
		Tensile Test,	IS1608:2005(RA2017) ASTME8M:2016a. ISO 6892-1:2016 IS 1786:08(RA2013) ASTM A370:2017a	(4kN to 400kN)
		Y.S.(MPa)		10 to 1400Mpa
		U.T.S.,(MPa)		10 to 1800Mpa
		%Elongation		2 to 90%
		%Reduction Area,		5 to 90%
		Proof Stress(Mpa)		10 to 1400Mpa
		Tensile Test,	IS1608:2005(RA2017) ASTM E8M2016a. ISO 6892-1:2016, IS 1786:08(RA2013) ASTM A370:2017a	(6kN to 600kN)
		Y.S.(MPa)		10 to 1800Mpa
		U.T.S.(MPa)		10 to 2200Mpa
		%Elongation		2 to 90%
		%Reduction Area,		5 to 90%
		Proof Stress(Mpa)		10 to 1800Mpa
2.	**Metals and alloys Ferrous and Nonferrous**	Tensile Test at elevated temp. Y.S. ,(MPa) U.T.S.,(MPa) % Elongation Proof Stress(Mpa)	ASTM E 21:2017 ISO 6892-2:2018	(2kN to 50 kN, 35˚C to 1000˚C) 2kN to 50 kN 2kN to 50 kN 5 to 90% 2kN to 50 kN
3.	**Steel Plates**	Through-Thickness tension testing	ASTM A 770:2003 (RA 2018) BS EN 10164:2008	Reduction Area: 5 – 80%
4.	**Ferrous and Non Ferrous Metals and**	1) Tensile Test U.T.S. (Mpa) (Transverse, All weld)	ASME Sec IX 2017 IS 2825:1969(RA2012) BSEN ISO 15614-1:2017	(2kN to 600 kN) 10 to 2200Mpa

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Accreditation Standard	**ISO/IEC 17025: 2017**
Certificate Number	**TC-8225** ***(in lieu of T-0630 & T-0629)*** **Page 6 of 10**
Validity	**05.02.2019 to 04.02.2021** **Last Amended on --**

Sl.	Product / Material of Test	Specific Test Performed	Test Method Specification against which tests are performed	Range of Testing / Limits of Detection
	Alloys/ steel products / weld in metal	2) Transverse Root , Face, Side Bend Test	ASTM E190:2014 API 1104:2013 AWS D1.1:2015	Qualitative
		3) Nick break test & fillet weld fracture test	IBR Rule:1950	Qualitative
		4) Macro & Micro Examination	ASME Sec. VIII DIV1:2017	Qualitative
		5) Leak path	ASTM E 23:2016b EN ISO 148-1:2016	Qualitative
		6) Pull out Test		12.5 to 240 Joules
		7) Charpy Impact Test (V- Notch on metallic material)		2 to 240 Joules
5.	**Welding Electrode**	1) All weld tensile	IS 814:2004 SFA 5.1M:2015	(2kN to 600 kN) 10 to 2200Mpa
		2) Transverse Root, Face, Side bend		Qualitative
		3) Concentricity of flux coating		
		4) Charpy Impact Test (V- Notch on metallic material)	ASTM E 23:2016b EN ISO 148-1:2016	12.5 to 240 Joules 2 to 240 Joules
6.	**Metals and alloys Ferrous and Nonferrous**	Rockwell Hardness	IS 1586 (Part 1): 2018	20 to 100 HRBW
			ASTM E 18:2018, ASTM A370:2017a	20 to 70 HRC
		Brinell Hardness Test	IS 1500Pt.1:2013 ASTM E 10:2018, ASTM A370:2017a	HBW 2.5/187.5, 88 to 500 HBW 5/250 218 to 323
		Vickers Hardness Test	IS1501Pt.1:2013 / ASTM E 384:2017 ASTM A370:2017a	HV5 31 to 700
				HV10 50 to 700
				HV30 128 to 700

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7.	**Ferrous Material**	End quench test for Hardenability of steel.	IS3848:2014 ASTM A255:2010	20 to 70 HRC
8.	**TMT Bar**	Bend Test /Rebend Test Elongation Proof Stress UTS	IS1786:2008 ASTM E290:2014 IS 1599: 2012	Qualitative (Mandrel Size 80mm Max.) (2,4,8,10,16,20, 32,40,50,56,80mm) 2% to 60% 2kN load to 600kN load 2kN load to 600kN load
9.	**Metals and alloys Ferrous and Nonferrous**	Shear Strength Test for Cladded Material	ASTM A265:2012 ASTM A264:2012 ASTM A263:2012	4KN to 400KN
10.	**Metallic Tubes**	Flattening Test	IS2328:2018 ASTM A370:2017a	Qualitative (Upto 400 mm NB)
11.	**Metallic Tubes Steel Tubes**	Drift Expansion/Flaring	IS2335:2005 RA 2017 ASTM A370:2017a	Qualitative (Upto 60 Deg.)
12.	**Ferrous Materials & Products, Stainless Steel Nickel Alloys**	Charpy Impact Test (V- Notch on metallic material)	ASTM E 23:2016b EN ISO 148-1:2016	12.5 to 240 Joules 2 to 240 Joules Ambient to –(minus)196Deg.C.
13.	**Nut for high pressure and high temperature service / Steel Bolt and Screw / Steel Bolt and Screw (M8 to M24 Course thread) / Steel Nut (M8 to M24 coarse thread)**	Test on Fasteners (Proof Load / Tensile Test)	IS1367(Pt-3):2018 / ISO 898-1:2016 IS1367(Pt6):1994/ ISO 898-2:2012 ASTM A 194:2017	(6kN to 600 kN)

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14.	**Ferrous and Nonferrous Material**	Creep, stress rupture Test	ASTM E139:2011	Temp upto 1000 Deg. C Weight upto 500 kg (Ratio 1:20)
15.	**Austenitic Stainless Steels**	Oxalic Acid etch Test Practice 'A'		
		Ferric Sulphate Sulphuric acid Test Practice 'B'	ASTM A262:2015	200X/250X/500X Qualitative
		Boiling Nitric acid Test Practice 'C' (Huey Test)	ASTM A262:2015	2.00 to 100 Mils per year
		Practice E {Strauss Test}	ASTM A262:2015	2.00 to 100 Mils per year
			ISO 3651pt-1:1998	IGC Practice 'E' Former Dia.1Thk.
			ASTM A262:2015 EN ISO 3651 (Part 2): 1998	
16.	**Nickel Rich Chromium Bearing Alloys**	IGC Method A	ASTM G 28:2002 (RA 2015)	2.00 to 100 Mils per year
17.	**Stainless Steel Nickel-Base Alloys**	Chloride Stress Corrosion Cracking Test (Magnesium chloride & calcium chloride)	ASTM G 36 :1994	Qualitative
		Method A: Pitting Test		0.001 mm Min pit Depth
		Method B: Crevice Test	ASTM G 48 :2011(RA2015)	Qualitative 22 to 50Deg.C
		Method C& E: Critical Pitting Temperature Test		Qualitative 10 to 85Deg.C
18.	**Pipeline & Pressure Vessel Steel**	Hydrogen-Induced Cracking Test (HIC)	NACE TM 0284:2016	Qualitative

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19.	**Steel & Nickel Alloys**	Sulphide Stress Cracking (SSC) & Stress Corrosion Cracking (SCC) Method A, Method B. Method C	NACE TM 0177:2016 ASTM G39:2016 G38:2013	Qualitative
20.	**Ferrous & Nonferrous Material**	Salt Spray test	ASTM B117:2018/ ISO 9227:2017	Qualitative
		Moist SO2Corrosion test (Method A,B)	ASTM G87:02	Qualitative
21.	**Steel, Stainless Steel Nickel & Nickel Alloys**	Detection of Detrimental Intermetallic phase in Duplex Stainless steel.	ASTM A 923:2014 Method B Charpy Impact Test (V Notch) Method C Ferric chloride	12.5 to 240 Joules 22 to 40 Deg.C
II.	**METALLOGRAPHY TEST**			
1.	**Ferrous and Nonferrous Material/ Steel**	Avg. Grain Size by Comparison method. Grain size by Mc Quaid EHN Method	ASTM E 112 :2013/ IS 4748:2009 RA2017	ASTM No.1 to 10 (75X,100X)
2.	**Steel**	Decarb depth by Microscopic Method	IS6396:2012/ ASTM E 1077:2014	0.01mm to 1.00mm/100X
		Inclusion Rating by Microscopic Method	ASTM E 45:2018a (Method A & D) IS 4163:2010	Type of Inclusion : A,B,C,D Rating : 0.5 to 3.0 Group A,B,C,D,DS Qualitative
3.	**Case Hardened Steel**	Case Depth by Microscopic Method	IS 6416:2007	0.01mm to 1.00mm/100X
4.	**Plated Steel Component**	Coating Thickness (Microscopic Method)	IS 3203:1982(RA2016)	0.01 mm to 1.00mm/100X
5.	**Gray Cast Iron**	Microstructure of Cast Iron	IS7754:2007	Type, Size, Distribution Qualitative
6.	**Ferrous and Nonferrous Material**	Microstructure	ASM Vol.9:2004 ASTM E 407: 2015	100X,200X,500X, 1000X Qualitative

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Accreditation Standard	**ISO/IEC 17025: 2017**	
Certificate Number	**TC-8225** ***(in lieu of T-0630 & T-0629)***	**Page 10 of 10**
Validity	**05.02.2019 to 04.02.2021**	**Last Amended on --**

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7.	**S.G. Iron**	Microstructure	IS 1865:91(RA2010) / IS 7754 :75(RA2018)	100X,200X,500X, 1000X Qualitative
8.	**Ferrous and Nonferrous Material**	Macro structural examination	ASTM E381:2017 ASTM E 340 :2015	8X, 16X, 20X, 32X, Qualitative
9.	**Duplex Stainless Steel**	Detection of Detrimental Intermetallic phase in Duplex Stainless steel.	ASTM A 923:2014 Method A NaOH Etch	(500X) *Qualitative
		11) Volume fraction by Manual Point Count.	ASTM E 562:2011	1.00to 70%
10.	**Austenitic and Duplex Stainless Steel Weld**	12) Ferrite content by Ferritoscope	AWS A4.2: 2016 EN ISO 8249:2018	0.5 to 60% ferrite

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