

Laboratory TCR Engineering Services Pvt. Ltd., VKB House, Plot No. EL-182, MIDC, TTC, Industrial Area, Electronic Zone, Mahape, Navi Mumbai, Maharashtra

Accreditation Standard ISO/IEC 17025: 2005

Certificate Number TC-6905 (in lieu of T-0367, T-0368 & T-3304) **Page 1 of 22**

Validity 27.02.2018 to 26.02.2020 **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
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CHEMICAL TESTING

AT LAB				
I.	METALS & ALLOYS			
1.	Ferrous Base			
a.	Stainless Steel	Carbon	ASTM E1086 -2014 OES IS 9879-98 Ra 2015 OES	0.01 % -1.5%
		Sulphur	ASTM E1086 -2014 OES IS 9879-98 Ra 2015 OES	0.001 % - 0.3%
		Phosphorus	ASTM E1086 -2014 OES IS 9879-98 Ra 2015 OES	0.005 % -0.25%
		Manganese	ASTM E1086 -2014 OES IS 9879-98 Ra 2015 OES	0.10 % -16.5%
		Silicon	ASTM E1086 -2014 OES IS 9879-98 OES	0.10 % -2.0%
		Chromium	ASTM E1086 -2014 OES IS 9879-98 Ra 2015 OES	5.0 % -30.0%
		Nickel	ASTM E1086 -2014 OES IS 9879-98 Ra 2015 OES	0.2 % - 20.0%
		Molybdenum	ASTM E1086 -2014 OES IS 9879-98 Ra 2015 OES	0.01 % -4.0%
		Titanium	TCR/TM-03(2013) OES Issue.No.2/Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.005 % -0.50%
		Niobium	ASTM E1086 -2014 OES Issue.No.2 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001 % -1.5%

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		Zirconium	TCR/TM-03(2013) OES Issue.No.2 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.003 % -0.8%
		Vanadium	TCR/TM-03(2013) OES Issue.No.2 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001 % -2.0%
		Copper	ASTM E1086 -2014 OES IS 9879-98 Ra 2015 OES	0.001 % -5%
		Aluminum	TCR/TM-03(2013) OES Issue.No.2 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001 % -1.5%
		Tungsten	TCR/TM-03(2013) OES Issue.No.2 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001 % -21%
		Cobalt	TCR/TM-03(2013) OES Issue.No.2 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001 % -1.0%
		Tin	TCR/TM-03(2013) OES Issue.No.2 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001 % -0.1%
		Antimony	TCR/TM-03(2013) OES Issue.No.2/Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001 % -0.5%
		Tantalum	TCR/TM-03(2013) OES Issue.No.2 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001 % -0.01%

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		Boron	TCR/TM-03(2013) OES Issue.No.2 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001 % -0.01%
		Lead	TCR/TM-03(2013) OES Issue.No.2 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001 % -0.3%
		Nitrogen	TCR/TM-03(2013) OES Issue.No.2/Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.01 % -0.4%
b.	Carbon Steel & Low Alloy Steel	Carbon	ASTM E415-2017OES IS 8811-98 Ra 2012OES	0.0010 % -1.5%
		Sulphur	ASTM E415-2017OES IS 8811-98 Ra 2012OES	0.001 % -0.3%
		Phosphorus	ASTM E415-2014OES IS 8811-98 Ra.2012OES	0.001 % -0.3%
		Manganese	ASTM E415-2014OES IS 8811-98 Ra.2012 OES	0.01 % -4.0%
		Silicon	ASTM E415-2017OES IS 8811-98 Ra 2012OES	0.01 % -2.00%
		Chromium	ASTM E415-2017OES IS 8811-98 Ra 2012OES	0.01 % -4.00%
		Nickel	ASTM E415-2017OES IS 8811-98 Ra 2012OES	0.01 % -4.50%
		Molybdenum	ASTM E415-2014OES IS 8811-98 Ra 2012OES	0.010 % -4.00%
		Titanium	ASTM E415-2017OES IS 8811-98 Ra 2012OES	0.010 % -0.5%
		Niobium	ASTM E415-2017OES IS 8811-98 Ra 2012OES	0.01 % -1.5%
		Zirconium	ASTM E415-2017OES IS 8811-98 Ra 2012OES	0.001 % -0.8%

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		Vanadium	ASTM E415-2017OES IS 8811-98 Ra 2012OES	0.001 % -2%
		Copper	ASTM E415-2017OES IS 8811-98 Ra 2012OES	0.01 % -5%
		Aluminum	ASTM E415-2017OES IS 8811-98 Ra 2012OES	0.001 % -1.5%
		Tungsten	TCR/TM-03(2013) OES Issue.No.2 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.01 % -2.0%
		Cobalt	ASTM E415-2017OES IS 8811-98 Ra 2012OES	0.005 % -1.0%
		Tin	ASTM E415-2017OES IS 8811-98 Ra 2012OES	0.005 % -0.1%
		Antimony	ASTM E415-2017OES IS 8811-98 Ra 2012OES	0.001 % -0.5%
		Tantalum	TCR/TM-03(2013) OES Issue.No.2 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001 % -0.1%
		Boron	ASTM E415-2017OES IS 8811-98 Ra 2012OES	0.001 % -0.01%
		Lead	TCR/TM-03(2013) OES Issue.No.2 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001 % -0.3%
		Nitrogen	ASTM E415-2017OES IS 8811-98 Ra 2012OES	0.01 % -0.4%
c.	Tool steel	Carbon	TCR/TM-03(2013) OES	0.20 % -3.00%
		Sulphur	Issue.No.2 Date 28.12.2013	0.005 % -0.05%
		Phosphorus	Amd.No.1 Date 02.01.2018	0.001 % -0.3%
		Manganese		0.10 % -0.1.0%
		Silicon		0.10 % -1.50%

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		Chromium		2.0 % -16.0%
		Nickel		0.01 % -4.50%
		Molybdenum		0.20 % -10.0%
		Titanium		0.001 % -0.5%
		Copper		0.001 % -2.0%
		Cobalt		0.01 % -10.00%
		Vanadium		0.001 % -2.0%
		Tungsten		0.001 % -14.00%
d.	Cast Iron	Carbon	ASTM E 1999-2011 OES	1.00 % -4.00%
		Sulphur	ASTM E 1999-2011 OES	0.01 % -0.30%
		Phosphorus	ASTM E 1999-2011 OES	0.01 % -0.20%
		Manganese	ASTM E 1999-2011 OES	0.05 % -2.50%
		Silicon	ASTM E 1999-2011 OES	1.00 % -2.0%
		Chromium	ASTM E 1999-2011 OES	0.5 % -1.00%
		Nickel	ASTM E 1999-2011 OES	0.1 % -3.00%
		Molybdenum	ASTM E 1999-2011 OES	0.05 % -0.50%
		Titanium	ASTM E 1999-2011 OES	0.001 % -0.5%
		Copper	ASTM E 1999-2011 OES	1.00 % -4.00%
		Aluminum	TCR/TM-03(2013) Issue.No.2 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.010 % -0.50%
		Tin	ASTM E 1999-2011 OES	0.010 % -0.10%
		Lead	TCR/TM-03(2013) OES Issue.No.2 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001 % -0.10%
2.	Non Ferrous Base			
a.	Copper and Its Alloys	Tin	TCR/TM-03(2013) Issue.No.2 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001 % -7.5%
		Zinc		0.001 % -40.0%
		Lead		0.001 % -7.0%
		Iron		0.001 % -6.0%
		Nickel		0.001 % -6.0%

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		Aluminum		0.001 % -12.0%
		Manganese		0.001 % -7.0%
		Sulphur		0.001 %-0.01%
		Arsenic		0.001 %-0.2%
		Cobalt		0.01 %-0.5%
		Antimony		0.001 %-2.0%
		Silver		0.001 %-1.0%
		Cadmium		0.0005 % -0.15%
		Beryllium		0.01 % -3.0%
		Bismuth		0.001 %-0.1%
		Silicon		0.001 % -5.5%
		Chromium		0.0005 % -1.0%
		Phosphorus		0.001 %-1.0%
b.	Aluminum and Its Alloys	Copper	ASTM E 1251-2017 OES ASTM E 227-1996	0.001 %-9.0%
		Tin	ASTM E 1251-2017 OES	0.001 %-2.0%
		Zinc	ASTM E 1251-2017 OES	0.001 %-9.0%
		Lead	ASTM E 1251-2017 OES	0.001 %-0.50%
		Iron	ASTM E 1251-2017 OES	0.001 %-1.5%
		Nickel	ASTM E 1251-2017 OES	0.001 %-2.0%
		Manganese	ASTM E 1251-2017 OES	0.01 %-1.5%
		Titanium	ASTM E 1251-2017 OES	0.01 %-0.50%
		Chromium	ASTM E 1251-2017 OES	0.001 %-0.50%
		Silicon	ASTM E 1251-2017 OES	0.01 %-15.0%
		Magnesium	ASTM E 1251-2017 OES	0.001 %-9.0%
		Zirconium	ASTM E 1251-2017 OES	0.01 %-0.1%
		Vanadium	ASTM E 1251-2017 OES	0.001 %-0.1%
		Cadmium	TCR/TM-03(2013) Issue.No.2 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001 %-0.1%
		Antimony	ASTM E 1251-(2017) OES	0.001 %-0.50%

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c.	Nickel and Its Alloys	Carbon	TCR/TM-03(2013)	0.001 %-0.5%
		Sulphur	Issue.No.2 Date 28.12.2013	0.001 %-0.1%
		Phosphorus	Amd.No.1 Date 02.01.2018	0.001 % to 0.1%
		Manganese		0.001 % -2.0%
		Silicon		0.005 %-5.0%
		Chromium		0.001 %-32.0%
		Molybdenum		0.001 %-30.0%
		Copper		0.001%-34.0%
		Tungsten		0.001%-5.0%
		Iron		0.001%-20.0%
		Aluminum		0.001%-5.0%
		Titanium		0.001%-1.5%
		Vanadium		0.001%-0.5%
		Niobium		0.001%-5.0%
		Cobalt		0.001%-2.0%
		Tantalum		0.001% to 0.1%
		Boron		0.001%-0.10%
		Lead		0.001%-0.1%
3.	Metal Alloys - Wet Chemical Analysis			
a.	Iron Base and Its Alloys	Manganese	TCR/TM-AAS-01-06(2013)	0.001%-16.0%
		Chromium	Issue.No.1/Date 28.12.2013	0.001%-28.0%
		Nickel	Amd.No.1 Date 02.01.2018	0.001%-11.0%
		Molybdenum	TCR/TM- ICP-01-06(2013)	0.001%-32.0%
		Titanium	Issue.No.1/Date 28.12.2013	0.001%-1.0%
			Amd.No.1 Date 02.01.2018	
		Niobium	TCR/TM- ICP-01-06(2013)	0.001%-3.5%
		Zirconium	Issue.No.1 Date 28.12.2013	0.001%-0.01%
		Vanadium	Amd.No.1 Date 02.01.2018	0.001%-2.0%

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		Copper	TCR/TM-AAS-01-06(2013)	0.001%-3.25%
		Aluminum	Issue.No.1 Date 28.12.2013 Amd.No.1 Date 02.01.2018 TCR/TM- ICP-01-06(2013) Issue.No.1 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001%-2.0%
		Tungsten	TCR/TM- ICP-01-06(2013) Issue.No.1 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001%-7.0%
		Cobalt	TCR/TM-AAS-01-06(2013)	0.001%-8.0%
		Tin	Issue.No.1 Date 28.12.2013 Amd.No.1 Date 02.01.2018 TCR/TM- ICP-01-06(2013) Issue.No.1 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001%-0.15%
		Tantalum	TCR/TM- ICP-01-06(2013)	0.001 %-0.03%
		Boron	Issue.No.1 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001%-0.05%
		Lead	TCR/TM-AAS-01-06(2013)	0.0001%-0.50%
		Magnesium	Issue.No.1 Date 28.12.2013	0.001%-0.30%
		Arsenic	Amd.No.1 Date 02.01.2018 TCR/TM- ICP-01-06(2013) Issue.No.1 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001%-0.60%

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b.	Copper Base and Its Alloys	Tin	TCR/TM-AAS-02-06(2013)	0.001% – 8.0%
		Zinc	Issue.No.1 Date 28.12.2013	0.001 % – 5.0%
		Lead		0.0001% – 4.50%
		Iron	Amd.No.1 Date 02.01.2018	0.001 %– 5.50%
		Nickel	TCR/TM- ICP-02-06(2013)	0.001% – 5.0%
		Aluminum	Issue.No.1 Date 28.12.2013	0.001% – 10.0%
		Arsenic		0.0001% – 0.050%
		Cobalt	Amd.No.1 Date 02.01.2018	0.001 % – 0.20%
		Antimony		0.001 %– 0.30%
		Silver		0.001 % – 0.10%
		Cadmium		0.0001 % – 0.20%
		Beryllium		0.001 % – 2.0%
		Bismuth		0.001 % – 0.20%
		Chromium		0.01% – 1.50%
		Tellurium		0.01% – 0.10%
		Selenium		0.01% – 0.10%
		Mercury	TCR/TM- ICP-02-06(2013)	0.001% – 0.10%
c.	Aluminum Base and Its Alloys	Tin	TCR/TM-AAS-03-06(2013)	0.001% – 0.30%
		Zinc	Issue.No.1 Date 28.12.2013	0.001% – 8.0%
		Lead		0.001% – 1.50%
		Iron	Amd.No.1 Date 02.01.2018	0.001% – 1.50%
		Nickel	TCR/TM- ICP-03-06(2013)	0.001% – 2.50%
		Manganese	Issue.No.1 Date 28.12.2013	0.001% – 1.50%
		Titanium		0.001% – 0.30%
		Chromium	Amd.No.1 Date 02.01.2018	0.001% – 0.20%
		Magnesium		0.001% – 2.50%
		Boron		0.0010% – 0.01%
		Zirconium		0.001% – 0.20%
		Vanadium		0.001% – 0.20%

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		Cadmium	TCR/TM–AAS-03-06(2013) Issue.No.1 Date 28.12.2013 Amd.No.1 Date 02.01.2018 TCR/TM– ICP-03-06(2013) Issue.No.1 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001% - 0.10%
d.	Nickel Base and Its Alloys	Manganese	TCR/TM–AAS-04-06(2013) Issue.No.1 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.005% – 1.0%
		Chromium	TCR/TM– ICP-04-06(2013) Issue.No.1 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001% – 22.0%
		Molybdenum	TCR/TM– ICP-04-06(2013) Issue.No.1 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001% – 17.0%
		Copper	TCR/TM– ICP-04-06(2013) Issue.No.1 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001% – 1.0%
		Tungsten	TCR/TM– ICP-04-06(2013) Issue.No.1 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001% – 6.0%
		Iron	TCR/TM–AAS-04-06(2013) Issue.No.1 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001% – 10.0%
		Aluminum	TCR/TM– ICP-04-06(2013) Issue.No.1 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001% – 1.20%
		Titanium	TCR/TM– ICP-04-06(2013) Issue.No.1 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001% – 2.50%
		Vanadium	TCR/TM– ICP-04-06(2013) Issue.No.1 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001% – 0.60%
		Niobium	TCR/TM– ICP-04-06(2013) Issue.No.1 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001% – 4.0%
		Cobalt	TCR/TM– ICP-04-06(2013) Issue.No.1 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001% – 17.0%
		Tantalum	TCR/TM– ICP-04-06(2013) Issue.No.1 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001%-0.10%

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e.	Iron Base and Its Alloys (Stainless Steel, Carbon & Low Alloy Steel, Tool Steel, Cast Iron)	Carbon	ASTM E1019 – 11 (LECO-CS)	0.001 %-4.50%
		Sulfur	ASTM E1019 – 11 (LECO-CS)	0.0001 %-0.60%
		Phosphorus	IS 228 – Pt.3-1987-Ra-2012	0.010 %-0.50%
		Manganese	IS 228-Pt.2-1987 Ra.2012	0.10 %-10.0%
		Silicon	IS 228 – Pt.8-1987– Ra-2014	0.05% to 5.0%
		Chromium	IS 228 – Pt. 6-1987-Ra-2014 TCR/TM/06 Issue.No.1 Date 30.1.2016 Amd.No.1 Date 15.01.2018	0.10 % – 40.0%
		Nickel	IS 228-Pt -5-1987-Ra-2014	0.10 % – 50.0%
		Nitrogen	IS 228-Pt-19-19987-Ra.2016	0.001 % -0.50%
		Tungsten	IS 228 – Pt.16-1992-Ra.2014	0.10 % – 25.0%
f.	Copper Base and Its Alloys	Copper (Pure)	IS 440 – 1964 Ra-2012	90.00 % -99.99%
		Copper (Cu base alloy)	IS 3685-1966 Ra2012 IS 4027 –part 1-1987-Ra.2012	30.0 % -90.0%
		Tin	IS 4027-part 5-1987-Ra.2012 ASTM E 478-08	0.10 % to 15.0%
		Zinc	ASTM E 478-08 (2017)	0.5 % -20.0%
		Lead	IS 3685-1966-Ra.-2012 ASTM-E-478-08 (2017) IS 4027 –part 1-1987-Ra.2012	0.01 % -15.0%

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		Iron	IS 3685-1966-Ra-2012	0.01 % -1.0%
		Nickel	ASTM-E-478-08 (2017)	4.0 % - 50.0%
		Silicon	ASTM-E-478-08 (2017)	0.001 % – 5.0%
		Phosphorus	IS 4027-part 3-1987-Ra.2012 IS 3685-1966 Ra 2012	0.0001 % -1.00%
		Sulfur	ASTM E1019-2011 LECO CS	0.001 % -0.10%
		Carbon	ASTM E1019-2011 LECO CS	0.001 % -0.30%
g.	Aluminum base and Its Alloys	Silicon	IS 504-1963/IS 504 Part 1 2002 ASTM E 34-11/ ASTM E-3061-17	0.02 %-20.0%
h.	Nickel Base and Its Alloys	Aluminum	ASTM E 354- 2014	0.20 % – 18.0%
		Carbon	E1019- 11 (LECO-CS)	0.005 %– 1.0%
		Sulfur	E1019- 11 (LECO-CS)	0.002 to 0.10%
		Phosphorus	ASTM E 354- 2014	0.01%– 0.080%
		Silicon	ASTM E 354- 2014	0.01% – 5.0%
		Chromium	ASTM E 354- 2014	0.10% – 33.0%
		Molybdenum	ASTM E 354- 2014	0.1% – 30.0%
		Nitrogen	TCR/TM/04-(2006) (Wet) Issue.No.2 Date 28.12.2013 Amd.No.1 Date 02.01.2018	0.001% to 0.50%
		Copper	ASTM E 354- 2014	0.001% – 10.0%
4.	Metal Identification by Portable XRF Analyzer			
a.	PMI -Ferrous Base	Chromium	ASTM E1476-04(2014)	Qualitative
		Nickel		
		Molybdenum		
		Vanadium		
		Tungsten		
		Cobalt		

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Sl.	Product / Material of Test	Specific Test Performed	Test Method Specification against which tests are performed	Range of Testing / Limits of Detection
		Niobium		
		Titanium		
		Copper		
b.	PMI -Nickel Base	Nickel	ASTM E1476-04(2014)	Qualitative
		Chromium		
		Molybdenum		
		Tungsten		
		Cobalt		
		Iron		
		Niobium		
		Titanium		
c.	PMI -Copper Base	Copper	ASTM E1476-04(2014)	Qualitative
		Zinc	(XRF)	
		Lead		
		Tin		
		Nickel		
II.	HAZARDOUS & RESTRICTED CHEMICALS			
1.	Polymer (Products of Plastics, Resins, Paints, Rubbers Glues, Fabrics, Paper products)	Mercury	IEC 62321(Part-1-5):2013 IS 16197 (Part 1-5):2014 TCR/TM/ICP/05(ROHS)	10 mg/kg to 1000 mg/kg
		Lead	IEC 62321 (Part-1-5):2013 IS 16197 (Part 1-5):2014 TCR/TM/ICP/05(ROHS)	10 mg/kg to 1000 mg/kg
		Chromium	IEC 62321 (Part-1-5):2013 IS 16197 (Part 1-5):2014 TCR/TM/ICP/05(ROHS)	10 mg/kg to 1000 mg/kg
		Cadmium	IEC 62321 (Part-1-5):2013 IS 16197 (Part 1-5):2014 TCR/TM/ICP/05(ROHS)	10 mg/kg to 1000 mg/kg

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Sl.	Product / Material of Test	Specific Test Performed	Test Method Specification against which tests are performed	Range of Testing / Limits of Detection
2.	Metallic (Ferrous Metal & Its Alloys Like Stainless Steels, Low Alloy Steel, Carbon Steel, Tool Steel, Cast Irons) Non Ferrous Metals & Its Alloys Like Aluminum, Copper, Nickel, Lead and Tin Base	Mercury	IEC 62321 (Part-1-5):2013 IS 16197 (Part 1-5):2014 TCR/TM/ICP/05(ROHS)	10 mg/kg to 1000 mg/kg
		Lead	IEC 62321 (Part-1-5):2013 IS 16197 (Part 1-5):2014 TCR/TM/ICP/05(ROHS)	10 mg/kg to 1000 mg/kg
		Chromium/Cr(VI)	IEC 62321 (Part-1-5):2013 IS 16197 (Part 1-5):2014 TCR/TM/ICP/05(ROHS)	10 mg/kg to 1000 mg/kg
		Cadmium	IEC 62321 (Part-1-5):2013 IS 16197 (Part 1-5):2014 TCR/TM/ICP/05(ROHS)	10 mg/kg to 1000 mg/kg
3.	Electronics (Capacitors, Power Cables, Light Fixtures, Types Of Lamps Resistors, Transistors, Solders, PCB Electrical Wirings, Various Computer Parts)	Mercury	IEC 62321 (Part-1-5):2013 IS 16197 (Part 1-5):2014 TCR/TM/ICP/05(ROHS)	10 to 1000 Mg/Kg
		Lead	IEC 62321 (Part-1-5):2013 IS 16197 (Part 1-5):2014 TCR/TM/ICP/05(ROHS)	10 to 1000 Mg/Kg
		Chromium	IEC 62321-3-1:2013 IS 16197 (Part3/Sec1):2014 TCR/TM/ICP/05(ROHS) IEC 62321 Ed.1 2008-12	10 to 1000 Mg/Kg
		Cadmium	IEC 62321(Part-1-5):2013 IS 16197 (Part 1-5):2014 TCR/TM/ICP/05(ROHS)	10 to 1000 Mg/Kg
III.	CORROSION TESTS			
1.	Metals & Coated / Plated Products	Salt Spray Test	ASTM B117-2016 ISO 9227-2017 IS 6910-1985 Ra 2016	Qualitative

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CHEMICAL TESTING

AT SITE				
I.	METALS & ALLOYS			
1.	Metal Identification by Portable XRF Analyzer			
a.	PMI -Ferrous Base	Chromium	ASTM E1476-04(2014)	Qualitative
		Nickel		
		Molybdenum		
		Vanadium		
		Tungsten		
		Cobalt		
		Niobium		
		Titanium		
		Copper		
b.	PMI -Nickel Base	Nickel	ASTM E1476-04(2014)	Qualitative
		Chromium		
		Molybdenum		
		Tungsten		
		Cobalt		
		Iron		
		Niobium		
		Titanium		
c.	PMI -Copper Base	Copper	ASTM E1476-04(2014) (XRF)	Qualitative
		Zinc		
		Lead		
		Tin		
		Nickel		

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MECHANICAL TESTING

I.	MECHANICAL PROPERTIES OF METALS			
1.	Ferrous & Nonferrous - Material & Products - Steel, Alloy Steel, Cast Iron, Cu- Cu Alloy, Al-Al Alloy, Ni-Ni - Alloys, Ti-Ti Alloys	Tensile Test YS/0.2% & 1% YS UTS % EL % RA	ASTM A370-17 ASTM E8-16a ASME SEC. IX - 17 BS EN 10002-1:01 ISO6892-1:16 IS 1608:05(RA2011)	25Mpa-5000Mpa 25Mpa-5000Mpa 2.0 % -80.0 % 2.0 % -90.0 % 1 kN-350.0 kN 2.0 % – 80.0 % 2.0 % - 65.0 %
		Through Thickness Tensile Test % RA	ASTM A770-03(2012)	2.0 % -75.0 %
		Elevated Temp. Tensile Test (80 °C to 800 °C) YS/0.2% & 1% YS UTS % EL % RA	ASTM E21-09 EN10002-5:1991 ISO6892-2:2011	10 kN-950.0 kN 5-45.0kN 25kN-240.0kN 2.0 % – 80.0 % 2.0 % - 65.0 %
2.	Ferrous & Non Ferrous - Material & Products - Steel, Alloy Steel, Cast Iron, Cu- Cu Alloy, Al-Al Alloy, Ni-Ni Alloys, Ti-Ti Alloys	Fatigue Test LCF/HCF a)Tension-Tension b)Tension-Compression c)Compression-Compression	ASTM E466-2015 ASTM E606-2012 IS 5074:1969(RA2010)	1kN – 45kN 2.5kN – 240.0kN (Qualitative)
3.	Reinforcement Bar/ Coupler	Fatigue Test HCF	IS 16172-2014	1kN – 45kN 2.5kN – 240.0kN (Qualitative)

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Sl.	Product / Material of Test	Specific Test Performed	Test Method Specification against which tests are performed	Range of Testing / Limits of Detection
		Static Tensile Test a)UTS b)% EL Slip Test	IS 16172-2014	25Mpa-5000Mpa 25Mpa-5000Mpa 1.0 % – 50.0 % 0.01 -5.0 mm
4.	Ferrous & Non - Ferrous - Material & Products - Steel, Alloy Steel, Cast Iron, Cu- Cu Alloy, Al-Al Alloy, Ni-Ni Alloys, Ti-Ti Alloys	Fracture Toughness 1)KIC & JIC 2)CTOD 3)FCGR	ASTM E399-13e3 ASTME1290-08e1 ASTM E1820-2017 BS 7448(Part1-4) (I-1991,II-199,III-2005, IV-1997) ASTM E647-2015e1/ ISO12108-2012 ISO15653-2010	5Mpa to 100Mpa 0.5kJ/m ² - 1000kJ/m ² 0.01mm to 5.0mm 10 ⁻⁹ da/dN – 10 ⁻² da/dN
5.	Fasteners	Proof Load Test (Bolts, studs & nuts)	IS 1367-6: 1994(RA2015) IS 1367-3: 2002(Ra.2007) ASTM A 370-2017	10 kN-980.0 kN (M3 to M39) (Qualitative)
6.	Ferrous & Nonferrous - Material & Products - Steel, Alloy Steel, Cast Iron, Cu- Cu Alloy, Al-Al Alloy, Ni-Ni Alloys, Ti-Ti Alloys	Brinell hardness	ASTM A 370-2017 IS 1500(Pt.1&2)-2013 ASTM E10-2017	2.5 mm /187.5 kgf (100-400HBW) 2.5 mm/62.5 kgf, (32– 303HBW) 2.5 mm/31.25 kgf, (16 – 125 HBW)
		Vickers' Hardness (Macro indentation)	IS1501(Pt. 1)-2013 IS1501(Pt. 2)-2013 ASTM E92-2017	HV5, (40 – 700) HV10, (80 – 600)
		Vickers' Hardness (Micro indentation)	ASTM E 384-2017	(25Hv to1100Hv) 0.1, 0.2, 0.3, 0.5, 1.0 kgf.
		Rockwell Hardness	IS 1586(Pt. 2)-2012 ASTM E 18-2017 e1	30 – 100 / HRB 20 – 70 / HRC
		Bend Test	IS1599-2012 Ra 2015 ASTM A 370-2017 ASTM E290-2014 ASTM E190-2014 ASME SEC IX-2017	Qualitative analysis (Mandrel Diameter (in mm): 10, 12, 16, 20, 24, 25, 30, 32, 36, 40, 50, 60, 75, 100, 120, 128, 160,

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Sl.	Product / Material of Test	Specific Test Performed	Test Method Specification against which tests are performed	Range of Testing / Limits of Detection
7.	Reinforce bar	Re-bend Test	BS-EN-910-1996 IS:1786-2008 Ra2013	200, 275, 280 Qualitative analysis (Mandrel Diameter: 10, 12, 16, 20, 24, 25, 30, 32, 36, 40, 50, 60, 75, 100, 120, 128, 160, 200, 275 mm)
8.	Ferrous & nonferrous - Material & Products – steel, alloy steel, cast iron, Cu- Cu Alloy, Al-Al alloy, Ni-Ni alloys, Ti-Ti alloys	Izod Impact Test Charpy Impact Test (+100 to -196 °C)	IS1598–1977(Ra.2015) ASTM A 370–2017 ASTM E 23–2016b BS EN875 - 1995 IS 1757 Part–1: 2014 DIN EN ISO 148-1-2011	2- 150 Joules / (2J -120J) 2-300 Joules (2-300 J) 2-450 Joules (2-450 J) (25 °C to -196 °C)
9.	Ferrous & nonferrous - Material & Products – steel, alloy steel, cast iron, Cu- Cu Alloy, Al-Al alloy, Ni-Ni alloys, Ti-Ti alloys	Flattening Test (Tubes & Pipes)	ASTM A 370–2017 ASTM B 111-2016 IS 2328–2005 Ra 2017 IS 2501-95 Ra.2016	Qualitative (OD: 6mm to 600mm)
		Flaring / Drift Test (Tubes & Pipe)	ASTM A 370–2017 ASTM B 153-11 (2017) IS 2335–2005 Ra 2017 IS 2501–1995 Ra.2016	Qualitative (OD 10mm to 168 mm)
10.	Ferrous & nonferrous - Material & Products – steel, alloy steel, cast iron, Cu- Cu Alloy, Al-Al alloy, Ni-Ni alloys, Ti-Ti alloys	Erichsen Cupping Test (Ferrous Sheet)	IS 10175-2012 ISO-8490–1986	(0.20 to 2.00mm Thickness)
		Pneumatic Pressure Test (Pipes /Tubes)	IS 2501 – 1995 Ra 2016 ASTM B 75-2011 B111 –2016	Qualitative analysis (2 – 15 Kg/cm ²) (3.18to 25.4 mm OD)
		Hydraulic Pressure Test (Tubes/Pipes/Fittings)	ASTMA 530-12 ASTM A450-15 ASTM A999 –2016 ASTM B75M –2011 ASTM B111 – 2016 ASTM E1003-2013	Qualitative analysis (2 - 70 Kg/cm ²) (5 - 250 Kg/cm ²) (20 - 600 Kg/cm ²) (20 - 1000 Kg/cm ²) (6.0 to 168.3mm OD)

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Sl.	Product / Material of Test	Specific Test Performed	Test Method Specification against which tests are performed	Range of Testing / Limits of Detection
11.	(Copper & Copper Alloys)	Mercurous Nitrate Test	IS 2305-1988 Ra 2015 ASTM B 154-2016	Qualitative analysis Pipe O/D: (6.35 -250mm) 1mm to 50mm thick plate 5mm Dia. To 150mm Dia.
12.	Zinc Coated Iron & Steel	Mass of Coating (stripping method) Pipe/Plate/sheet Wire)	IS 6745 –1972 (Ra 2016) ASTM A90-2013	10gsm – 1200gsm
II.	METALLOGRAPHY TEST			
1.	Ferrous & nonferrous - Material & Products – steel, alloy steel, cast iron, Cu- Cu Alloy, Al-Al alloy, Ni-Ni alloys, Ti-Ti alloys	Micro Examination General structure	ASM Vol. 9 ASTM E3-2011 (2017) ASTM E407–2015e1	Qualitative analysis 50X ,100X, 200X ,500X, 1000X
		Grain size (Comparison Method)	ASTM E112–13 IS 4748 -2009	At 75X & 100X Avg. Grain Dia. 0.2 to 0.005mm ASTM NO. 00 – 10.5
2.	Cast Iron	Distribution of Graphite in Cast Iron (Type, shape, size, %)	IS 7754 –1975 Ra.2012 ASTM A247 -2017	Qualitative Upto 100X
3.	Ferrous & nonferrous - Material & Products – steel, alloy steel, cast iron, Cu- Cu Alloy, Al-Al alloy, Ni-Ni alloys, Ti-Ti alloys	Decarburization (By Microscope)	IS 6396-2000 Ra 2012 ASTM E1077-2014	0.01 to 2.0 mm
		Case Depth (By Microscope)	IS 6416:1988(RA2012)	0.01 and 2mm
		Effective Case Depth (Hardness Method)		Hv 0.05 - Hv1. 0.01 – 3.0mm
		Thickness of Coating (Microscope Method)	ASTM B487-85(2013)	0.01 to 2.0mm
4.	Ferrous Metals	Inclusion Rating Test Method- A and D	ASTM E45-2013 IS 4163 -2004 Ra 2010	At 100X Thin / Heavy A,B,C & D; 0.5 to 3.0

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5.	Ferrous & nonferrous - Material & Products - steel, alloy steel, cast iron, Cu- Cu Alloy, Al-Al alloy, Ni-Ni alloys, Ti-Ti alloys	Macro etch Test	ASTM E340-2015 ASTM E381-2017 DIN BS EN 1321- 1996 BS EN ISO 17639-2013	Qualitative 10X,15X,20X,30X, 40X
6.	Stainless Steel	Ferrite Content Test (By Microscopic method)	ASTM E562-2011	2 %– 70%
		Ferrite Content Test (By Ferrite-scope)	ASTM A799-2010(RA2015) ASTM A800-2014	0.5%– 70%
7.	Austenitic Stainless Steel	IGC Practice A	ASTM A262 – 2015	250X-500X
		IGC Practice B		0.001mpy -100mpy
		IGC Practice C		0.001mpy -100mpy
		IGC Practice E		Qualitative analysis (former dia. 1t, 2t, 4t)
		IGC Practice F		Qualitative analysis
8.	Duplex stainless	IGC Method-A	DIN-EN-ISO 3651-2 1998	Qualitative analysis
		IGC Method-B		
		IGC Method-C		
9.	Ferritic Stainless Steel	IGC Test Practice W, X, Y & Z	ASTM A763-2015	Pr. W, Z; 250X, 500X Pr. X,Y 0.001 mpy to 100 mpy
10.	Nickel based Alloys	IGC Method-A	ASTM G28-02(2015)	0.001 mpy to 100 mpy
		IGC Method-B		0.001 mpy to 100 mpy
11.	Ferrous & nonferrous - Material & Products – steel, alloy steel, cast iron, Cu- Cu Alloy,	HIC Test	NACE TM 0284-2016	Qualitative
		SSCC Test	NACE TM 0177-2016, ASTM G39-99(2016) ISO 11439 (2013) IS 15490 (2017) ASTM B858-2006(2012)	Qualitative

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Sl.	Product / Material of Test	Specific Test Performed	Test Method Specification against which tests are performed	Range of Testing / Limits of Detection
	Al-Al alloy, Ni-Ni alloys, Ti-Ti alloys	MgCl ₂ CaCl ₂	ASTM G36-94 (2013)	Qualitative
12.	Stainless Steel	Pitting Corrosion (Method A,C,E)	ASTM G48-2015	0.0001 g/cm ² to 100 g/cm ²
		Crevice Corrosion (Method B,D,F)		
		Detection of Detrimental intermetallic Phases	ASTM A923-2014	Method A At 400X, 500X
		Method A, B & C		Method B 2J to 400J
				Method C Quantitative analysis 0.01 to 10 mdd

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NON - DESTRUCTIVE TESTING

AT LABORATORY & SITE				
I.	METALS & ALLOYS			
1.	Ferrous & Non Ferrous Metals & Alloys Welds Castings	Radiography Testing X-Rays (Kv-250) Gamma Rays (Ir-192)	ASME Sec. V Article 2 & 22 Edition 2017 (SE-94) ASTM E-446-2015 ASTM E-155-2015 ASTM E-192-2015	2 mm to 40 mm - X-ray & 8 mm to 50 mm gamma ray with 2 % sensitivity Qualitative
2.	Ferrous & Non Ferrous Metals & Alloys	Ultrasonic Testing		
a.	Welds		ASME Sec. V Article 4,5 & 23 Edition 2017 ASMESA-388-2017	Thickness: 5 mm to 50 mm
b.	Forging			Diameter: 20 mm to 500 mm
c.	Plates		ASME SA-435-2017 ASME SA-577 -2017 ASME SA -578-2017	Thickness: 6 mm to 300 mm
d.	Castings		ASME SA -609-2017	Thickness: 10 mm to 200 mm
e.	Pipes & Tubing		ASME SE -213-2017 ASMESE-273-2017 ASME Sec II 2017	25 mm to 1000 mm Thickness Range 5 mm to 100 mm Qualitative
3.	Ferromagnetic Materials	Magnetic Particle Testing (Yoke & Prod) Visible & Fluorescent	ASME Sec. V Article 7 Edition 2017 SE-709-2017	Surface & Sub Surface Flaws (Depth: 3 mm max) Qualitative
4.	Ferrous & Non Ferrous Metals & Alloys	Liquid Penetrant Testing (Visible Penetrant)	ASME Sec. V Article 6 Edition 2017 SE 165-2017	Flaws open to surface Qualitative