

Laboratory **Material Testing Laboratory, Ordnance Factory, Ambajhari, Nagpur, Maharashtra**

Accreditation Standard **ISO/IEC 170252005**

Certificate Number **TC-7029** (in lieu of T-0030, T-0031 & T-0053) **Page 1 of 7**

Validity **13.03.2018 to 12.03.2020** **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**

I.	METALS AND ALLOYS			
1.	Iron Base Alloys	Silicon	IS 228 Part 8: 1989 (RA 2009)	0.10% to 2.0%
		Chromium	IS 228 Part 6: 1987 (RA 2002)	0.10% to 25.00%
		Nickel	IS 228 Part 5: 1987 (RA 2002)	0.10% to 20.00%
		Manganese	IS 228 Part 2: 1987 (RA 2008)	0.10% to 2.00%
2.	Ferrous materials, alloys and products	Carbon	ASTM E 1019 -2011	0.01% to 3.5%
3.	Copper & Copper Base Alloys	Copper	IS 3685: 1966 (RA 2006)	50.00% to 75.00%
		Lead	IS 3685:1966 (RA 2006)	0.05% to 10.00%
4.	Aluminum Base Alloys	Silicon	ASTM E 1251- 2011	0.05% to 13.0%
		Iron		0.05% to 1.40%
		Copper		0.05% to 9.00%
		Manganese		0.03% to 1.50%
		Magnesium		0.05% to 3.50%
		Chromium		0.01% to 0.35%
		Zinc		0.05% to 8.00%
		Titanium		0.001% to 0.35%
		Nickel		0.01% to 1.50%
		Lead		0.01% to 0.30%
		Tin		0.01% to 0.30%
5.	Plain Carbon and Low Alloy Steels	Carbon	ASTM E 415: 2015	0.019% to 1.50%
		Silicon		0.033% to 1.90%

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		Manganese		0.13% to 1.75%
		Phosphorus		0.005% to 0.075%
		Sulphur		0.005% to 0.075%
		Chromium		0.050% to 3.5%
		Molybdenum		0.05% to 1.25%
		Nickel		0.015% to 5.00%
		Copper		0.010% to 0.75%
		Vanadium		0.01% to 0.60%
		Aluminium		0.005% to 0.10%
6.	Stainless Steels	Carbon	ASTM E 1086: 2014	0.050% to 0.30%
		Silicon		0.10% to 1.50%
		Manganese		0.10% to 2.00%
		Phosphorus		0.005% to 0.050%
		Sulphur		0.005% to 0.30%
		Chromium		8.00% to 25.50%
		Molybdenum		0.10% to 2.50%
		Nickel		0.10% to 25.00%
7.	Tool Steels	Carbon	WS/MTL/C/29	0.30% to 1.20%
		Silicon	Issue No. 04	0.10% to 1.00%
		Manganese	Date - 20-02-2014	0.10% to 1.00%
		Phosphorus		0.005% to 0.05%
		Sulphur		0.005% to 0.05%
		Chromium		1.25% to 5.50%
		Molybdenum		0.05% to 5.50%
		Vanadium		0.10% to 2.00%
		Copper		0.05% to 12.0%
		Tungsten		0.01% to 25.0%
8.	Copper Base Alloys	Zinc	BSEN 15079 : 2015	0.008% to 35.0%
		Lead		0.010% to 10.0%
		Tin		0.016% to 11.0%
		Phosphorus		0.004% to 1.00%
		Manganese		0.004% to 1.8%
		Iron		0.01% to 1.75%
		Nickel		0.01% to 35.0%

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		Silicon		0.01% to 0.50%
		Antimony		0.01% to 0.50%
		Bismuth		0.020% to 0.15%
		Aluminium		0.002% to 8.00%
		Arsenic		0.003% to 0.5%
9.	Carbon and Alloy Steel	Manganese	WS/MTL/C-11 Issue No. 03 Date - 26-02-2007	0.01% to 2%
		Nickel	WS/MTL/C-12 Issue No. 03 Date - 26-02-2007	0.02% to 3%
		Cobalt	WS/MTL/C-15 Issue No. 03 Date - 26-02-2007	0.05% to 3%
		Molybdenum	WS/MTL/C-14 Issue No. 03 Date - 26-02-2007	0.08% to 2%
		Chromium	WS/MTL/C-13 Issue No. - 03 Date - 26-02-2007	0.05% to 2%
		Vanadium	WS/MTL/C-29 Issue No. 03 Date - 26-02-2008	0.14% to 2.5%
10.	Aluminum Alloys	Iron	WS/MTL/C-16 Issue No. 03 Date - 26-02-2007	0.05% to 1%
		Copper	WS/MTL/C-17 Issue No.03 Date - 26-02-2007	0.05% to 6%
		Manganese	WS/MTL/C-18 Issue No. - 03 Date - 26-02-2007	0.05% to 1%

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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
		Magnesium	WS/MTL/C-19 Issue No. 03 Date - 26-02-2007	0.05% to 1%
		Zinc	WS/MTL/C-20 Issue No. 03 Date - 26-02-2007	0.02% to 0.25%
11.	Copper alloys	Iron	WS/MTL/C-21 Issue No. 03 Date - 26-02-2007	0.01% to 0.3%
		Nickel	WS/MTL/C-22 Issue No. 03 Date - 26-02-2007	0.02% to 0.3%
		Lead	WS/MTL/C-23 Issue No. 03 Date - 26-02-2007	0.02% to 3%

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**MECHANICAL TESTING**

<b>I. MECHANICAL PROPERTIES OF METALS</b>				
1.	<b>Steel alloys, Copper and Copper Alloys, Aluminum and Aluminum Alloys</b>	Tensile Strength	IS 1608 : 2005 (RA 2011)	20 kN to 1000 kN 50 MPa to 4500 MPa
		Yield Stress (0.1%, 0.2 %)		2 kN to 100 kN 50 MPa to 4500 MPa
		Proof stress (0.1%, 0.2 %)		2 kN to 20 kN 50 MPa to 4500 MPa
		Elongation		1.0% to 60%
		Reduction of Area		5.0% to 60%
2.	<b>Ferrous and Non-ferrous Alloys</b>	Brinell Hardness	IS 1500 Part 1: 2013	100 HBW to 450 HBW (5mm/750kgf)
				100 HBW to 200 HBW (10mm/ 1000kgf)
				130 HBW to 440 HBW (10mm/ 3000kgf)
		Vickers Hardness	IS 1501 Part 1: 2013	90 to 400 (HV5) 110 to 610 (HV10) 275 to 450 (HV30)
3.	<b>Ferrous Alloys</b>	Rockwell Hardness	IS 1586 Part 1: 2012	20 HRC to 70 HRC
4.	<b>Alloy Steel, Copper and Copper Alloys, Aluminum and Aluminum Alloys</b>	Bend Test	IS 1599: 2012 (RA 2015)	Qualitative (Mandrel Diameter 8, 14, 25, 45 mm)
<b>II. METALLOGRAPHY TEST</b>				
1.	<b>Alloy Steel, Copper and Copper Alloys, Aluminum and Aluminum Alloys</b>	Macrostructure	ASTM E 340-2015 ASTM E 381- 2017 IS 12573: 2010 (RA 2016) IS 11371: 1985 (RA 2012)	Qualitative (Magnification 1X to 5X)

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		Micro structural	ASM Handbook – Metallography Vol.9 Metal Handbook Vol. 7 - 8th Edition ASTM E 3 – 2011 ASTM E 407-2007 (RA 2011)	Qualitative (Magnification 50X to 1600 X)
2.	<b>Alloy Steel, Copper and Copper Alloys, Aluminum and Aluminum Alloys</b>	Grain size (Microscopic method)	ASTM E 112-2013 IS 4748: 2009 (RA 2010)	Qualitative (Plate I – Grain Size No. 00-10, at 100 X, Plate II – Grain Size No. 1-8, at 100 X, Plate III- Grain Diameter - 0.005-0.200mm, at 75X)
3.	<b>Steel products</b>	Inclusion Rating	ASTM E 45- 2013  IS 4163: 2004 (RA 2010)	Qualitative [Types A, B, C, D; 0.5 to 3.0 (Thin / Heavy)]  Qualitative [Types A, B, C, D; 0.5 to 3.0 (Fine / Thick)]

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**NON DESTRUCTIVE TESTING**

<b>I. METAL AND ALLOYS</b>				
1.	<b>Aluminium Alloys: Cast Billets, Extruded Rods, Flats, Tubes and Profiles</b>	Ultrasonic Testing	AMS 2630 B: 1990 (Rev 1995) HAL Spec. LUT 7 ISSUE "A" - 1988 ISSUE "B" - 1996 IS 3664: 1981 (RA 2003)	Qualitative (Cast Billet : 350 to 600 mm Dia. Extruded Rods : 25 to 290 mm Dia. Extruded Flat : 10 to 150 mm Thick Extruded Tube & Profiles: 5 to 50 mm Thick. Limit of Detection ≥ 2 mm FBH)
2.	<b>Aluminium Alloys: Welds and Castings</b>	X-Ray Radiography (260 KV max)	IS 2595: 2008 ASTM E 505 -2015	Qualitative (5 to 25 mm of equivalent Steel thickness)
3.	<b>Aluminium Alloys: Welds and Forgings</b>	Liquid Penetrant	IS 3658: 1999 (RA 2010)	Qualitative (Flaws open to surface)