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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
		CHEMICAL TESTING		
I.	**METALS & ALLOYS**			
1.	**Carbon & Low-Alloy Steel**	Aluminum	ASTM E 415-2017	0.001% to 1.51%
		Antimony		0.0009% to 0.0022%
		Arsenic		0.002% to 0.30%
		Boron		0.0001% to 0.0002%
		Calcium		0.0002% to 0.0012%
		Carbon		0.080% to 1.10%
		Chromium		0.070% to 3.40%
		Cobalt		0.003% to 0.41%
		Copper		0.017% to 0.85%
		Lead		0.0003% to 0.27%
		Manganese		0.200% to 1.55%
		Molybdenum		0.002% to 1.65%
		Nickel		0.020% to 1.73%
		Niobium		0.001% to 1.61%
		Nitrogen		0.003% to 0.01%
		Phosphorous		0.008% to 0.12%
		Silicon		0.010% to 1.76%
		Sulphur		0.005% to 0.12%
		Tin		0.001% to 0.23%
		Titanium		0.0004% to 0.98%
		Vanadium		0.001% to 0.12%
2.	**Stainless Steel**	Carbon	ASTM E 1086-2014	0.002% to 0.20%
		Chromium		0.020% to 19.80%
		Copper		0.008% to 3.56%
		Manganese		0.015% to 21.7%
		Molybdenum		0.43% to 2.0%
		Nickel		0.40% to 24.37%
		Phosphorous		0.005% % to 0.035%

Malancha Das
Convenor

N. Venkateswaran
Program Director

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		Silicon		0.010% to 0.90%
		Sulphur		0.001% to 0.013%
3.	Cast iron	Carbon	ASTM E 1999-2011	2.10% to 3.50%
		Chromium		1.10% to 1.50%
		Copper		0.070% to 0.25%
		Manganese		0.31% to 1.34%
		Molybdenum		0.004% to 1.24%
		Nickel		0.021% to 0.092%
		Phosphorous		0.070% to 0.30%
		Silicon		2.98% to 3.71%
		Sulphur		0.029% to 0.18%
		Tin		0.063% to 0.077%
		Titanium		0.025% to 0.031%
		Vanadium		0.16% to 0.20%
4.	High Manganese Steel	Carbon	ASTM E 2209-2013	0.70% to 0.858%
		Chromium		0.288% to 0.352%
		Manganese		11.79% to 14.41%
		Molybdenum		0.0162% to 0.0198%
		Nickel		2.835% to 3.465%
		Phosphorus		0.0459% to 0.561%
		Silicon		0.262% to 0.3212%
5.	Steel & Cast Iron (Combustion Method for C-S and Fusion Method for O2-N2)	C	ASTM E1019 – 2011	0.05% to 4.5%
		S		0.002% to 0.30%
		O2		5 mg/kg to 360 mg/kg
		N2		5 mg/kg to 550 mg/kg
II.	LUBRICANTS			
1.	Lubricating oil, Quenching Oil	Flash point	DIN ISO 2719-2016, A&B ASTM D93-2016a, A&B	40°C to 370°C

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2.	**Lubricating Grease**	- Penetration of 1. Standard cone, (worked and unworked) 2. Half cone, (worked and unworked)	DIN ISO 2137-2016	85 to 475, 1/10 mm
3.	**Grease, Lubricating oil, Quenching Oil**	Moisture content	ASTM D6304-2016, ASTM E1064-2016	0.01% to 2% mass
4.	**Lubricating Oils, Quenching Oil ,**	Kinematic Viscosity (@ 40 °C and 80 °C)	DIN 51562-1-1999	0.5 mm^2/s to 3000 mm^2/s

Malancha Das
Convenor

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MECHANICAL TESTING

I.	**MECHANICAL PROPERTIES OF METALS**			
1.	**Ferrous & Nonferrous Material**	Ultimate tensile strength 0.2% Proof Stress, %Elongation, % Reduction in Area	ASTM A370:2017, ASTME8/8M-2016, ISO 6892-1-2016, IS 1608: 2005 (RA 2017)	2 kN to 200 kN 2% to 70% 2% to 65%
		Charpy Impact Test V notch	ASTM E 23-2016 EN ISO148-1:2017, IS 1757 P1- 2014.	Upto 300 Joule (From Room Temp to - 40^{o} C
		Rockwell Hardness Test	ISO 6508-1, 2016 ASTM E -18, 2017 IS 1586- Part 1, 2012	20 HRC to 70 HRC 50 HRBW to 95 HRBW
		Vickers Hardness Test	ISO 6507-1, 2005, ASTM E- 384, 2017, IS-1501- Part-1, 2013, ASTM E92-2017	350 to 900 HV1 400 to 900 HV10 150 to 500 HV30
II.	**METALLOGRAPHY TEST**			
1.	**Ferrous Material**	Grain size Test (Comparison Method)	ISO-643, 2012, ASTM E-112, 2013	Grain Size Number 1 to 10, 100X Mag. Qualitative Method
		Depth of Decarburization Test (Microscopic Method)	IS-6396, 2000 (2012) ASTM E1077, 2014	10 µm to 1000 µm, 100X Mag.
		Macro Etch Test	ASTM E381-2017, IS 13015-1991 (2012)	Qualitative (Visual Inspection)

Malancha Das
Convenor

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		Carbide Size, Pearlite Amount, Carbide Network -4th & 5th Series, Carbide Segregation -6th & 7th Series (Microscopic Method)	SEP 1520- 1998, ISO 5949-1983.	Mag. 100X, 200X, 1000X Qualitative Test
		Case depth (Hardness Method)	IS-6416-1988 (2012) DIN ISO 4507-2007 ISO 18203-2016	Depth 0.05mm to 5 mm
		Non Metallic Inclusion Test	ISO 4967:2013, Methods A,B, ASTM E45 (2013) Method A, D & E, DIN 50602-1985, Method K & M, IS 4163-2004	Magnification 100X 10 to 1000 um
2.	**Ferrous & Nonferrous Material**	Fractography	ASM Handbook Vol. 12-Fractography	Qualitative Visual inspection Stereomicroscope : Mag. 10, 12.5, 16, 20, 25, 40, 50, 63, 80, 160X SEM : Mag. 5X to 100,000 X Mag .
		Microstructure Analysis (Microscopic Method)	ASM Metals Handbook Volume 9 (ferrous & copper base alloys), Metallography & Microstructures, ISO 945-1, 2008.	Mag. 50X, 100X, 200X, 500X, 1000X Qualitative Test
		Evaluation of elements by Energy Dispersive Analysis (EDS).	ASTM-E1508-2012	Qualitative Elements from Atomic Number 4 (Beryllium) to Atomic number 95 (Americium).

Malancha Das
Convenor

N. Venkateswaran
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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
		Measurement of Coating Thickness using Scanning electron Microscope	ASTM B 748-1990 (2010)	100 nm to 1 mm (100X-1000X)
		Measurement of Retained Austenite by X-ray Diffraction Method	ASTM E 975-2013	1% to 50%
		Measurement of residual stress by X-ray Diffraction Method	ASTM E 2860-2012 (Omega Method), DIN EN 15305-2008 (Omega Method)	(+) 1100 MPa to (–) 1100 MPa

Malancha Das
Convenor

N. Venkateswaran
Program Director