

## METALLURGICAL TEST REPORT

Customer Address:  M/S -FORGE ( INDIA ) PVT . LTD #60 , SECTOR-5 , PARWANOO-H.P.	Material	Billet Route	Test Certificate No.	90513
	Process Route	EAF-LRF-VD-CCM-AMLC-EMS-RM	Date	02-02-2018
	Specification	Standard	Invoice No.	10152
	Heat No.	A05528	Weight (MT.)	13515 MT
	Grade	16MNCR5	Input/Billet Size	160X160 MM
	Supply Size	50 MMØ	Reduction Ratio	13:1
	Supply Condition	AS HOT ROLLED	No's of Pcs	NA
	Colour Code	GREEN+PINK	No's of Bundle	NA
			Multiple	NA

## TEST RESULT

### CHEMICAL ANALYSIS (ASTM E 415-14 / IS 8811-1998)

Element	C%	Mn%	Si%	S%	P%	Cr%	Ni%	Mo%	V%	Al%	Cu%	Ti%	Sn%	B%	Ca%	Co%	CE%	Cr+Ni+Mo
Spec.	Min	0.140	1.000	0.150	-	-	0.800	-	-	-	-	-	-	-	-	-	-	-
	Max	0.190	1.300	0.400	0.035	0.035	1.100	-	-	-	-	-	-	-	-	-	-	-
Achieved	0.150	1.160	0.270	0.020	0.016	1.090	0.120	0.025	0.006	0.023	0.120	-	-	-	-	-	-	-

### HARDENABILITY TEST (IS:3848, ASTM A255, SAE J406)

Distance	4/16"																	
Spec. (HRC)	Min	33																
	Max	37																
Achieved (HRC)	37.0																	

### Mechanical Properties (IS 1608 / ASTM A370)

Parameters	Test Condition: H & T				Impact Strength Charpy V-notch (Joules)	D.I. Value ASTM A255		Surface Hardness As Rolled (BHN)
	Tensile Strength (Kg/mm <sup>2</sup> )	Yield Strength (Kg/mm <sup>2</sup> )	Elongation (%)	Reduction Area (%)		(Inch)	(mm)	
Spec.	Min	-	-	-	-	-	-	-
	Max	-	-	-	-	-	-	-
Achieved	-	-	-	-	-	-	-	156/163

### Metallographic Properties

Parameters		Inclusion Rating (IS : 4163 / ASTM : E45A / JK Chart)									Grain Size IS 4748 / ASTM E112 (No.)	Depth of Decarburization		Micro Structure		
		WROST FIELD RATING										Complete	Partial	Uniform	Banding	Structure
		Type	A		B		C		D							
	Series	Thin	Thick	Thin	Thick	Thin	Thick	Thin	Thick							
Spec.	Min	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Max	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Achieved		1.0	0.0	0.5	0.0	0.0	0.0	1.0	0.0	-	6.0 to 6.5	-	-	-	15 micron max	Pearlite & Ferrite

### Physical Properties, Non Destructive Test & Other Test

Parameters	Internal Soundness ASTM E381	Step Down Test IS 4075	Surface Inspection IS 13352	Magnetic Particle Inspection IS 10138	Ultrasonic Test ASTM A388 / IS 2417	Upsetting Test IS 11169
Spec.	-	-	-	-	-	-
Achieved	Better than C2,R1,S1	Satisfactory	Satisfactory	OK	100%	-

Parameters	Dimensional Tolerance IS 3739	Spark Test	X-RF	Gas Analysis Report Test method-Leco		
				O <sub>2</sub> (ppm)	N <sub>2</sub> (ppm)	H <sub>2</sub> (ppm)
Spec.	-	-	-	-	-	-
Achieved	As per IS 3739 Grade 1	100%	100%	11.0	89.70	0.80

Remarks :

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Approved By: