

METALLURGICAL TEST REPORT

Customer Address: M/S -FORGE (INDIA) PVT . LTD #60 , SECTOR-5 , PARWANOO-H.P.	Material	Billet Route	Test Certificate No.	93172
	Process Route	EAF-LRF-VD-CCM-AMLC-EMS-RM	Date	03-06-2018
	Specification	Graziano Spec. Q.F. 1001 - R1, Dated-01.04.2015	Invoice No.	2051
	Heat No.	A06904	Weight (MT.)	11.390
	Grade	20MNCR5	Input/Billet Size	200X200 MM
	Supply Size	75 MM RCS	Reduction Ratio	7.1:1 (Spec-7:1 min)
	Supply Condition	AS HOT ROLLED	No's of Pcs	NA
	Colour Code	BLUE+YELLOW	Multiple	NA
			Length Size	4.0 to 6.0 meter

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%	Al/N2 Ratio
Spec.	Min	0.150	1.000	0.150	0.015		1.000			0.020	-	-	-	-	-	-	-	2.10
	Max	0.200	1.300	0.400	0.030	0.020	1.300	0.300	0.100	0.050	0.300	-	-	0.0005	0.0010	-	-	-
Achieved		0.170	1.240	0.205	0.025	0.018	1.230	0.080	0.020	0.003	0.031	0.135	-	0.0004	0.0005	-	-	3.60

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

Distance (mm)	1.5	5	10	15	20	25	30											
Spec.	Min	41	38	32	29	27	25.5	24.5										
	Max	46	44	38.5	35.5	33.5	32	31										
Achieved (HRC)		44.5	42.5	36.0	30.0	28.5	27.0	26.0										

Mechanical Properties (IS 1608 / ASTM A370)

Parameters	Test Condition: H & T				Impact Strength Charpy V-notch (Joules)		D.I. Value ASTM A255 (Inch) (mm)		Surface Hardness As Rolled (BHN)
	Tensile Strength (Mpa)	Yield Strength (Mpa)	Elongation (%)	Reduction Area (%)					
Spec.	Min	1230	930	7	-	25 KCU min(J)	-	-	-
	Max	1570			-		-	-	260
Achieved	1370	1066	10	-	33 J		-	-	170/174

Metallurgical Results

Parameters		Inclusion Rating (IS : 4163 / ASTM : E45A / JK Chart)										Grain Size IS 4748 / ASTM E112 (No.)	Depth of Decarburization IS 6396/ASTM E1077		Micro Structure
		WROST FIELD RATING											Complete	Partial	
		Type	A		B		C		D		DS				
Series	Thin	Thick	Thin	Thick	Thin	Thick	Thin	Thick	Thin	Thick					
Spec.	Min	-	-	-	-	-	-	-	-	-	5-8	Not Allowed	0.6% of the nominal diameter with maximum of 0.6 mm	Banding OK as per UNI 8449 (A max of GR-4 is acceptable)	
	Max	2.0	1.5	2.0	1.0	0.5	0.5	1.0	1.0	-					
Achieved		1.5	0.5	0.5	0.0	0.0	0.0	1.0	0.0	-	6.5 to 7.0	NIL	0.14 mm		

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.	S3, C2, R3 MAX-	Free From Streaks	Free from surface defects	Free From Crack	Defect Echo max 20% of back wall Echo	-
Achieved	Better than S1,C1,R1	ok	Satisfactory	100% Done OK	100% Done OK	-

Parameters	Dimensional Tolerance IS 3739	Spark Test	X-RF	Gas Analysis Report Test method-Leco		
				O ₂ (ppm)	N ₂ (ppm)	H ₂ (ppm)
Spec.	As per IS 3739 Grade 1	-	-	20 max	60-120	2.5 max
Achieved	As per IS 3739 Grade 1	100% Done OK	100% Done OK	12.00	86.0	1.12

Remarks :

Tested for Radioactive Contamination - OK

Material conforms to Graziano Spec. Q.F. 1001 - R1, Dated-01.04.2015

Prepared By:

Approved By: