AMT India -Thiruvallur

Document Number: WK00030335
Part Number: C42017
Part Description: 100 RCS BAR
Material Spec: 1E1120A SAE4120M
Product Category: Steel
Heat Code: C42017
Material Type: Rough

Lab Code: Product Audit - Product Group
Submitter: Nithya N M
Sample Quantity: 1
Submit Date: 01 23 2018
Due Date: 02 16 2018
Complete Date: 02 02 2018
LotQty: 1
DestroyQty: 1
ReturnQty: 0

Disposition :Accepted by Nithya N M on 02 02 2018

Submitted RCS Bar (H.No:C42017) meets the requirements of 1E1120 specification.

Lab Paper Comments:

100mm RCS Bar (H.No:C42017) submitted for raw material validation.
Steel was procured from USHA MARTIN.

General Comments and Results for Basic Spectro

Chemsitry sample tested in optical emission spectroscopy according to the standard ASTM E415.All elements were meeting the requirements of 1E1120 specification.

Sam-01 ----- Spec Number : 1E1120 (Basic Spectro)

Test	Location	Results	Spec	Out Spec
Carbon - C	Loc 1	0.21 %	[0.19 % , 0.23 %]	
Manganese - Mn	Loc 1	1.06 %	[0.80 % , 1.10 %]	
Phosphorous - P	Loc 1	0.011 %	<= 0.020 %	
Sulfur - S	Loc 1	0.018 %	[0.015 % , 0.025 %]	
Silicon - Si	Loc 1	0.14 %	<= 0.18 %	
Nickel - Ni	Loc 1	0.019 %		
Chromium - Cr	Loc 1	0.55 %	[0.45 % , 0.70 %]	
Molybdenum - Mo		0.18 %	[0.08 % , 0.25 %]	
Aluminum - Al	Loc 1	0.021 %	>= 0.02 %	
Copper - Cu	Loc 1	0.011 %		
Vanadium - V	Loc 1	0.0046 %		
Boron - B	Loc 1	0.0002 %		
Titanium - Ti	Loc 1	0.0072 %		
Zirconium - Zr	Loc 1	0.0030 %		
Lead - Pb	Loc 1	0.001 %		
Tin - Sn	Loc 1	0.0034 %		
Antimony - Sb	Loc 1	0.011 %		
Zinc - Zn	Loc 1	0.0027 %		
DI Calculation	Loc 1	48.91 mm	[43.2 mm , 61 mm]	
Tungsten - W	Loc 1	0.0070 %		
Bismuth - Bi	Loc 1	0.0015 %		

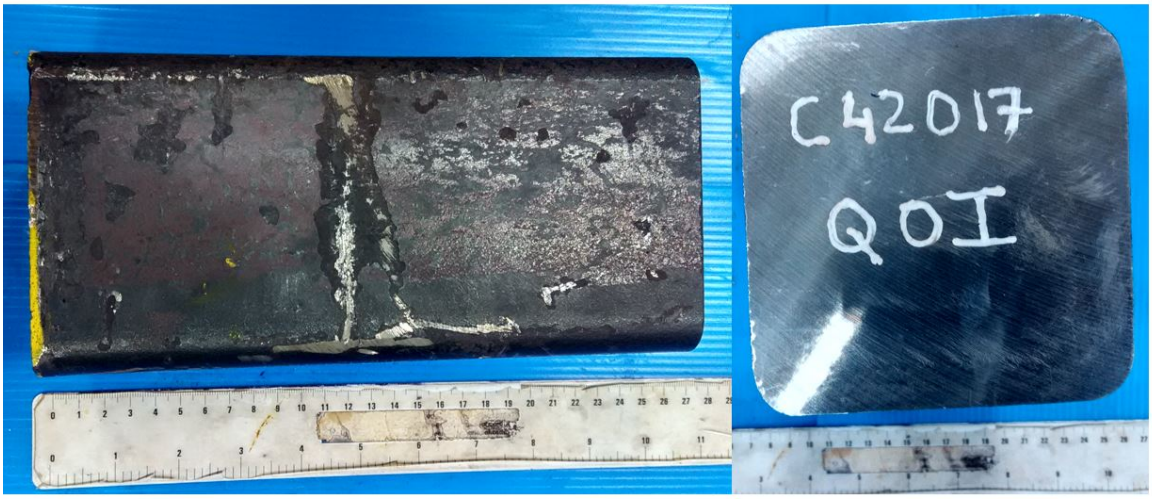


Fig.1 100RCS Bar(H.No:C42017)submitted for raw material validation.

General Comments and Results for Microcleanliness

Microcleanliness(Inclusion rating)was measured as per standard ASTM E45 and results found within the limits of 1E2661A specification.

Sam-01 ----- Spec Number : 1E2661A (Microcleanliness)

Test	Location	Results	Spec	Out Spec
Alumina B - Heavy	Loc 1	0.0	<= 1.0	
Alumina B - Thin	Loc 1	0.0	<= 2.0	
Globular Oxides D - Heavy	Loc 1	0.5	<= 1.0	
Globular Oxides D - Thin	Loc 1	0.5	<= 1.0	
Silicate C - Heavy	Loc 1	0.5	<= 0.5	
Silicate C - Thin	Loc 1	0.0	<= 0.5	
Sulfide A - Heavy	Loc 1	1.0	<= 1.5	
Sulfide A - Thin	Loc 1	0.5	<= 2.5	

General Comments and Results for Grain Size

Grain Size No:6-7observed as per ASTM E112.

Sam-01 (Grain Size)

Test	Location	Results	Spec	Out Spec
Ferritic Grain Size	Loc 1	6 - 7		

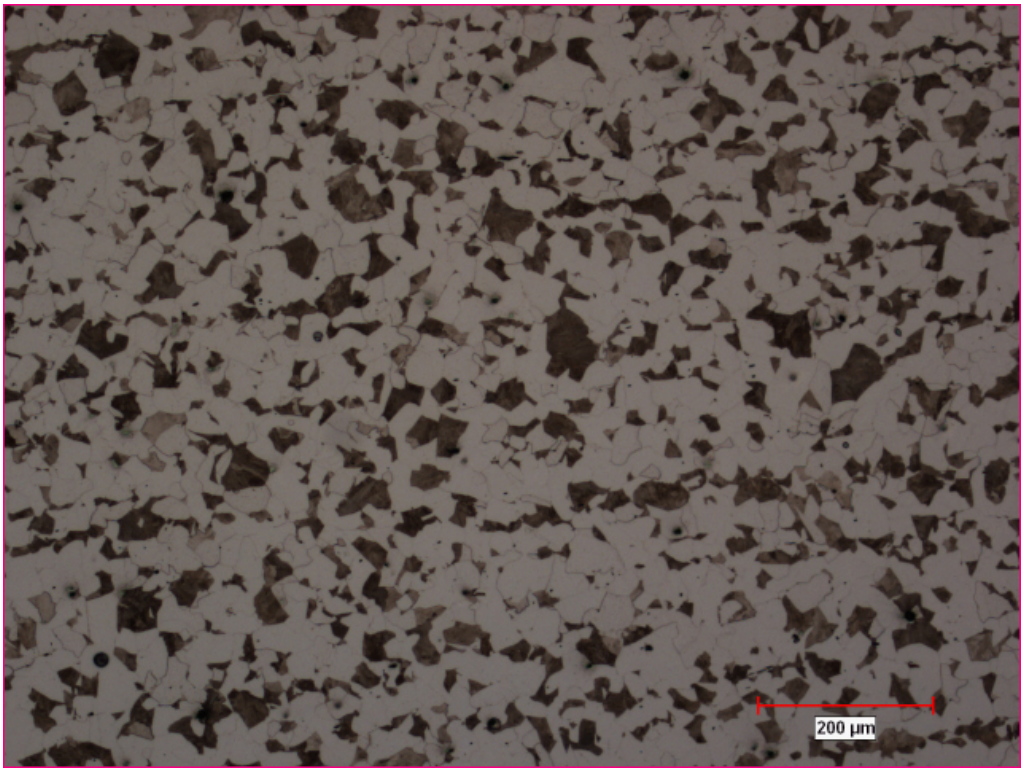


Fig.2 Ferrite and pearlite matrix.Grain size No:6-7 as per ASTM E112.

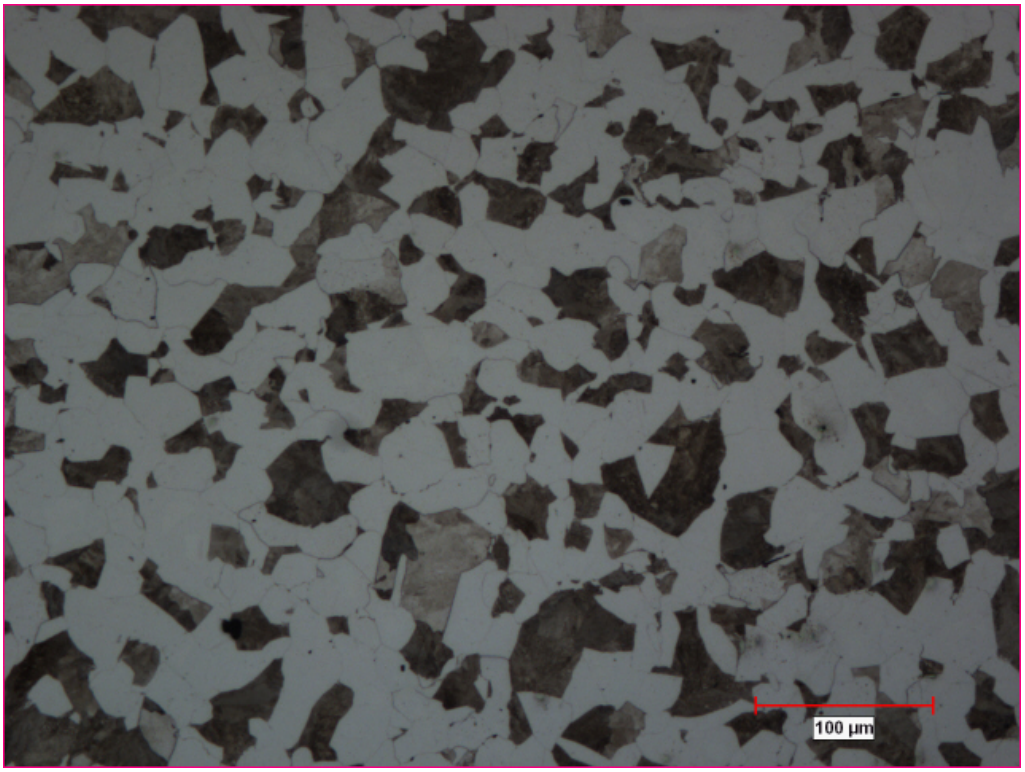


Fig.3 Ferrite and Pearlite matrix.

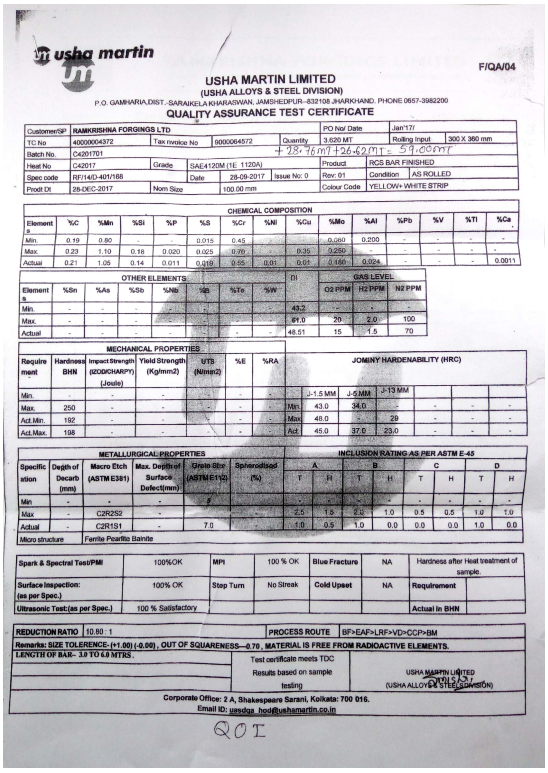
General Comments and Results for Jominy Metric Units

Jominy end quench test results found acceptable as per 1E1120 specification.

Sam-01 (Jominy Metric Units)

Test	Location	Results	Spec	Out Spec
Jominy Metric J1.5	Loc 1	43 HRC - 43 HRC	[43 HRC , 48 HRC]	
Jominy Metric J13	Loc 1	26 HRC - 27 HRC	<= 29 HRC	

Jominy Metric J5	Loc 1	36 HRC - 37 HRC	>= 34 HRC	



usha martin

F/QA/04

USHA MARTIN LIMITED
(USHA ALLOYS & STEEL DIVISION)
P.O. GAMHARIA,DIST.-SARAIKELA KHARASWAN, JAMSHEDPUR--832108 JHARKHAND, PHONE 0657-3982200

QUALITY ASSURANCE TEST CERTIFICATE

Customer/SP	RAMKRISHNA FORGINGS LTD			PO No/ Date		Jan'17/	
TC No	40000004372	Tax invoice No	9000064572	Quantity	3.620 MT	Rolling Input	300 X 360 mm
Batch No.	C4201701				+ 28.76MT+26.62MT = 54.00MT		
Heat No	C42017	Grade	SAE4120M (1E 1120A)		Product	RCS BAR FINISHED	
Spec code	RF/14/O-401/168		Date	28-09-2017	Issue No: 0	Rev. 01	Condition	AS ROLLED
Prodt Dt	26-DEC-2017	Nom Size	100.00 mm			Colour Code	YELLOW+ WHITE STRIP

CHEMICAL COMPOSITION

Element s	%C	%Mn	%Si	%P	%S	%Cr	%Ni	%Cu	%Mo	%Al	%Pb	%V	%Ti	%Ca
Min.	0.19	0.80	-	-	0.015	0.45	-	-	0.080	0.200	-	-	-	-
Max.	0.23	1.10	0.18	0.020	0.025	0.70	-	0.35	0.250	-	-	-	-	-
Actual	0.21	1.05	0.14	0.011	0.019	0.55	0.01	0.01	0.160	0.024	-	-	-	0.0011

OTHER ELEMENTS								DI	GAS LEVEL		
Element s	%Sn	%As	%Sb	%Nb	%B	%Te	%W		O2 PPM	H2 PPM	N2 PPM
Min.	-	-	-	-	-	-	-	43.2	-	-	-
Max.	-	-	-	-	-	-	-	61.0	20	2.0	100
Actual	-	-	-	-	-	-	-	48.51	15	1.5	70

MECHANICAL PROPERTIES

Require ment	Hardness BHN	Impact Strength (JZ/DIGHARPY) (Joule)	Yield Strength (Kg/mm2)	UTS (N/mm2)	%E	%RA
Min.	-	-	-	-	-	-
Max.	250	-	-	-	-	-
Act.Min.	192	-	-	-	-	-
Act.Max.	198	-	-	-	-	-

JOMINY HARDENABILITY (HRC)

	J-1.5 MM	J-5 MM	J-13 MM			
Min	43.0	34.0	-	-	-	-
Max	48.0	-	29	-	-	-
Act	45.0	37.0	23.0	-	-	-

METALLURGICAL PROPERTIES

Specific ation	Depth of Decarb (mm)	Macro Etch (ASTM E381)	Max. Depth of Surface Defect(mm)	Grain Size (ASTM E112)	Spheroidised (%)
Min	-	-	-	6	-
Max	-	C2R2S2	-	-	-
Actual	-	C2R1S1	-	7.0	-
Micro structure	Ferrite Pearlite Bainite				

INCLUSION RATING AS PER ASTM E-45

	A		B		C		D	
	T	H	T	H	T	H	T	H
Min	-	-	-	-	-	-	-	-
Max	2.5	1.5	2.5	1.0	0.5	0.5	1.0	1.0
Actual	1.0	0.5	1.0	0.0	0.0	0.0	1.0	0.0

Spark & Spectral Test/PMI	100%OK	MPI	100 % OK	Blue Fracture	NA	Hardness after Heat treatment of sample.	
Surface Inspection: (as per Spec.)	100% OK	Step Turn	No Streak	Cold Upset	NA	Requirement	
Ultrasonic Test:(as per Spec.)	100 % Satisfactory					Actual in BHN	

REDUCTION RATIO	10.80 : 1	PROCESS ROUTE	BF>EAF>LRF>VD>CCP>BM

Remarks: SIZE TOLERENCE- (+1.00) (-0.00) , OUT OF SQUARENESS---0.70 , MATERIAL IS FREE FROM RADIOACTIVE ELEMENTS.
LENGTH OF BAR- 3.0 TO 6.0 MTRS.

Test certificate meets TDC
Results based on sample testing

USHA MARTIN LIMITED
(USHA ALLOYS & STEEL DIVISION)

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Fig.4 Attached mill test certificate received from the supplier.

End of Standard Lab Report for [WK00030335]