



From: Clorindo Appo S.R.L

To: Federal Mogul USA

Title: Ring AR82190AV1

Report N: 020118-1

Date: 02/01/18

Authors: Fernando Ferrari

Departament: Foundry

Lot/batch: 659

Sample Quantity: 1

**Summary:**

- 1- Chemical Coposition**
- 2- Degree of Saturation**
- 3- Tensile Streghth**
- 4- Hardness**
- 5- Thermal Expansion Coefficient**
- 6- Microstructure**



**1- Chemical Coposition:** Spectrometer Chemical Analysis is attached

**2- Degree of Saturation:** Sc:1 - 1O.K. (0,80 - 0,95)

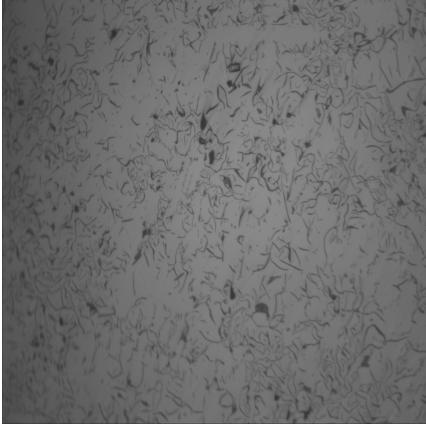
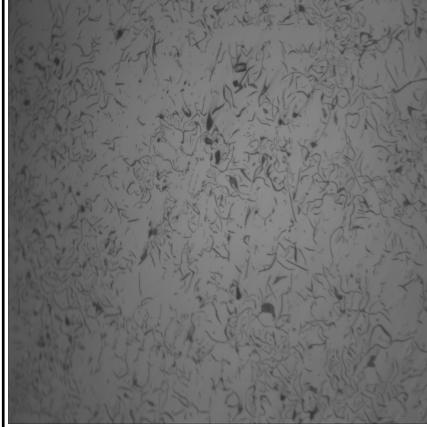
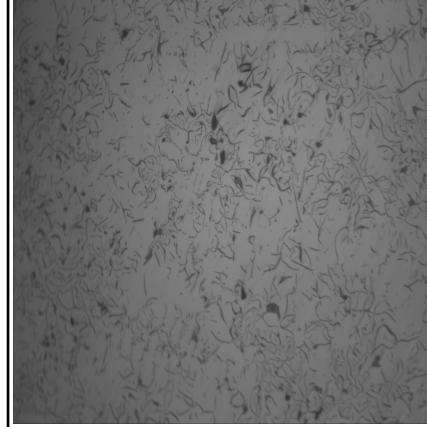
**3- Tensile Stregth:** 198Mpa (n/mm<sup>2</sup>) O.k. (160-206N/mm<sup>2</sup>)

**4- Hardness:** 125 - 137 HB (187,5 kg. - 2,5mm) 70-75RB(100kg.-1/16")  
O.K. (120-160 HB)

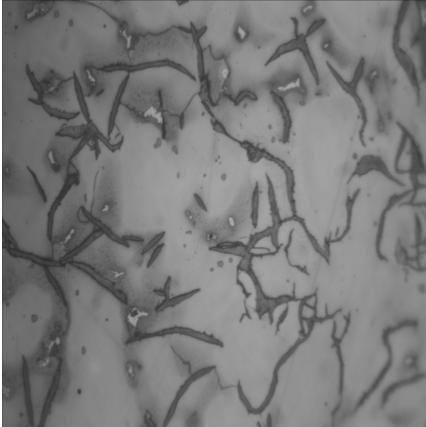
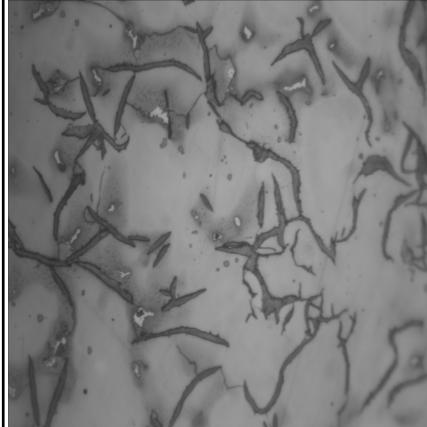
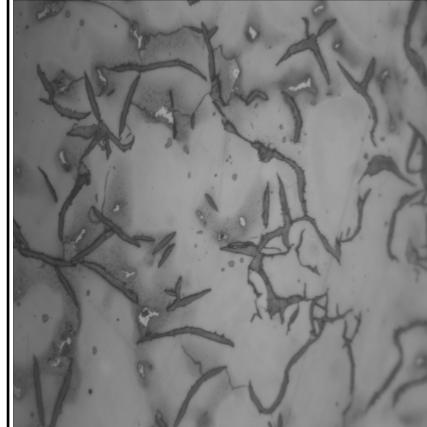
**5- Thermal Expansion Coefficient:** 19,2(1/ C x 10-6) O.K. (18,5 - 19,5, 20 to 400 C)

**6- Microstructure:**

**X 100**

		
<p><b>O.D. Zone:</b>  <b>Graphite type A 70%+B 20%+E 10%, size 6 ASTM. O.K.</b></p>	<p><b>Middle Zone:</b>  <b>Graphite type A 80% + B 10%+E 10%, size 5-6 ASTM. O.K.</b></p>	<p><b>L.D. Zone:</b>  <b>Graphite type A 85%+B 10 +E 5%, size 5-6 ASTM. O.K.</b></p>

**X 500 Marble Etched**

		
<p><b>O.D. Zone:</b>  <b>Carbides Level: 2 to 3 % O.K.</b></p>	<p><b>Middle Zone:</b>  <b>Carbides Level: 2 to 3 % O.K.</b></p>	<p><b>L.D. Zone:</b>  <b>Carbides Level: 2 to 3 % O.K.</b></p>

**Controlled:**



Sample Result Name	Type	Measure Date Time	Recalculation Date Time	Origin	Method Name	Method Version	Operator Name	Correction Type	Type Corr Sample Name
FU 245	Unknown	13/12/2017 12:32:17	13/12/2017 12:33:41	Measured	Fe-65-All		Operator	None	
Check Type	Check Status		Grade Verification Name		Grade Verification Similarity	Grade Search Name		Grade Search Similarity	
Grade Warning	Failed		NIR1 Federal Mogul Export		0 %			100 %	
Horno	Colada	Codigo FU-232	Codigo FU-305	Codigo FU-300	Codigo FU-356	Codigo FU-301			
FU 245	325	4803.5	4804.5		4803.5	2761			

**Elements**
**Type Conc**

Meas.	C	Si	Mn	Cr	Ni	Cu	P
%	%	%	%	%	%	%	%
Conc							
1	2.73006	1.85090	1.07854	1.07128	13.7027	5.82509	0.055548
2	2.65947	1.85016	1.07656	1.08214	13.7157	5.80853	0.056486
3	2.69751	1.79496	1.08159	1.07497	13.7502	5.84411	0.054578
Min Warn	2.60000	1.65000	1.05000	1.05000	13.6000	5.70000	0.000000
Min Acc					13.5000	5.50000	
Rep	>2.69568	>1.83201	1.07890	1.07613	13.7228	>5.82591	0.055537
Max Acc					17.0000	7.00000	
Max Warn	2.68000	1.80000	1.12000	1.15000	13.8000	5.80000	0.080000
Mean	>2.69568	>1.83201	1.07890	1.07613	13.7228	>5.82591	0.055537
SD	0.035331	0.032086	0.002533	0.005524	0.024526	0.017805	0.000954
RSD	1.31066	1.75142	0.234811	0.513285	0.178724	0.305614	1.71759

Meas.	S	Sn	Zn	Al	Pb	Ti	Nb
%	%	%	%	%	%	%	%
Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc
1	0.076867	0.006132	0.010384	0.006344	0.005812	0.018032	<0.003000
2	0.079432	0.006627	0.010664	0.006228	<0.005000	0.016916	0.003775
3	0.078208	0.006812	0.010335	0.006591	0.005576	0.017429	<0.003000
Min Warn	0.060000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Rep	0.078169	0.006523	0.010461	0.006387	0.005463	0.017459	0.003258
Max Warn	0.080000	0.020000	0.030000	0.008000	0.007000	0.030000	0.030000
Mean	0.078169	0.006523	0.010461	0.006387	0.005463	0.017459	0.003258
SD	0.001283	0.000351	0.000177	0.000185	0.000418	0.000559	0.000447
RSD	1.64092	5.38670	1.69396	2.90407	7.64474	3.19950	13.7269

Meas.	Mo	W	V	Co	Ca	Mg	Ce
%	%	%	%	%	%	%	%
Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc
1	0.053857	<0.012000	0.024632	0.061111	0.000221	<0.000500	<0.003000
2	0.054857	<0.012000	0.026012	0.061381	0.000187	<0.000500	<0.003000
3	0.054560	<0.012000	0.025437	0.060843	0.000204	<0.000500	<0.003000
Min Warn	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Rep	0.054425	<0.012000	>0.025360	0.061112	0.000204	<0.000500	<0.003000
Max Warn	0.070000	0.030000	0.025000	0.200000	0.010000	0.010000	0.010000
Mean	0.054425	<0.012000	>0.025360	0.061112	0.000204	<0.000500	<0.003000
SD	0.000513	0.000000	0.000693	0.000269	0.000017	0.000000	0.000000
RSD	0.943259	0.000000	2.73261	0.440148	8.46402	0.000000	0.000000

Meas.	As	Bi	La	B	Zr	Fe	
%	%	%	%	%	%	%	
Conc	Conc	Conc	Conc	Conc	Conc	Conc	
1	0.007589	0.011778	0.001137	0.008412	<0.001000	73.3741	
2	0.007635	0.013750	0.001347	0.008561	<0.001000	73.4321	
3	0.007552	0.011806	0.001151	0.008314	<0.001000	73.3878	
Min Warn	0.000000	0.000000	0.000000	0.000000	0.000000		
Rep	0.007592	0.012445	0.001211	0.008429	<0.001000	73.3980	