



MATERIAL REPORT

STAINLESS STEEL 316L

RD/RM/2004

INTRODUCTION

The goal of this report is a short summary of Steel 316L atomization status for marketing purposes. There were multiple tests performed on Steel 316L. The atomized material was in the form of a $\varnothing 1,2$ mm wire.

For each test, a microscopic analysis of the distribution, circularity, oxygen/nitrogen level, chemical composition, and flowability test was performed.

This report presents an overview of the findings from these tests.

AVERAGE TEST RESULTS

Table 1 Basic average values

	Diameter [μm]	Circularity
Average	45,59	0,95
Standard deviation	12,49	0,05
Max	108,45	1,00
Min	2,2	0,39

Figure 1 Photo of the material x100 (unscreened)

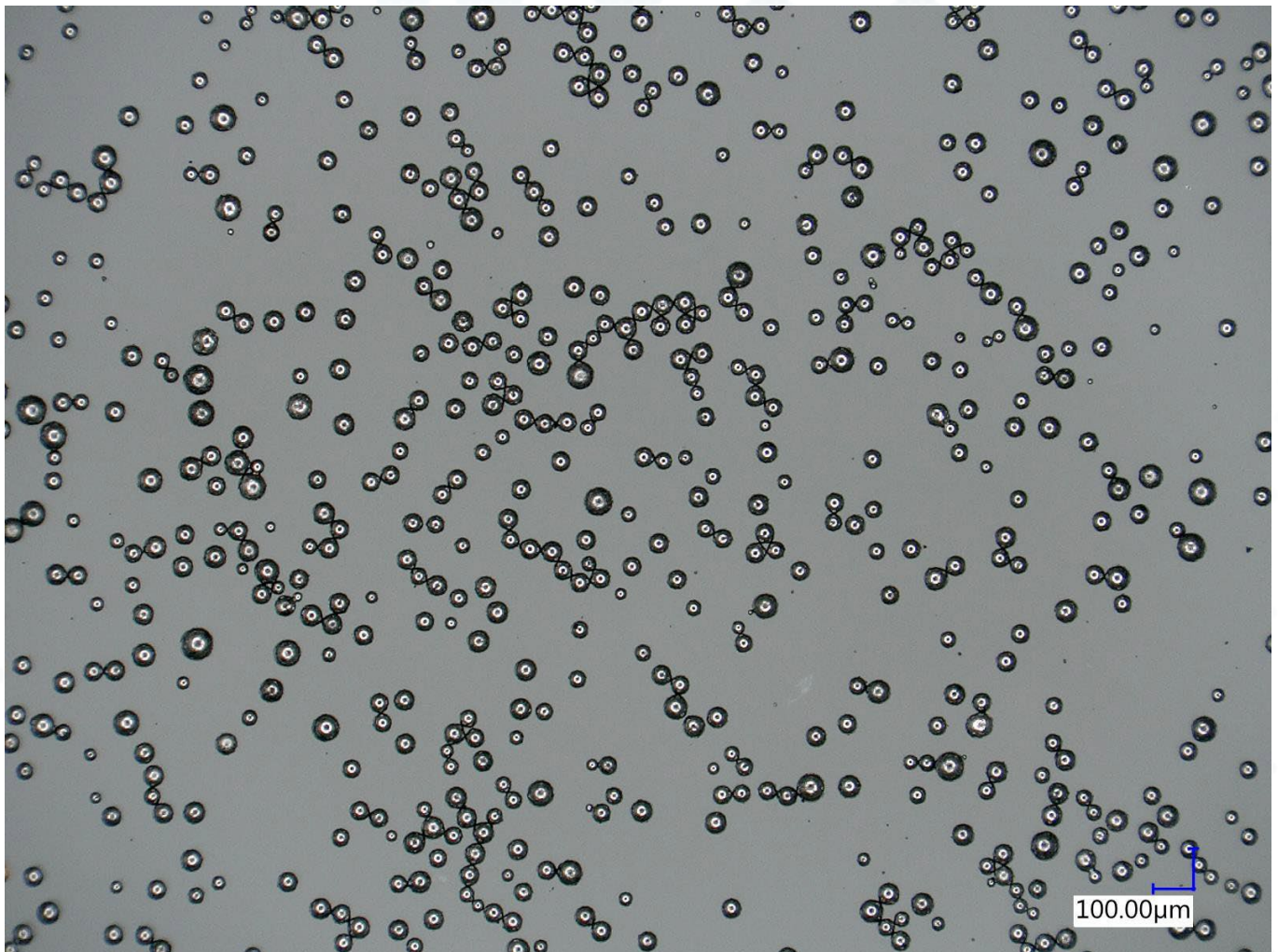


Figure 2 Histogram of the particle size distribution

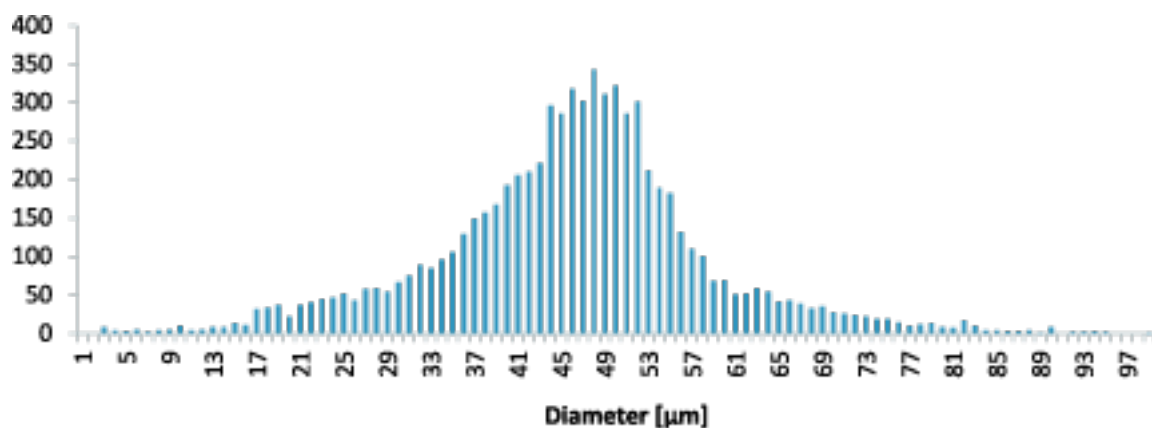


Table 2 Particles size distribution D10, D50, D90

D10	35,91	D50	48,11	D90	74,81
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OXYGEN LEVEL

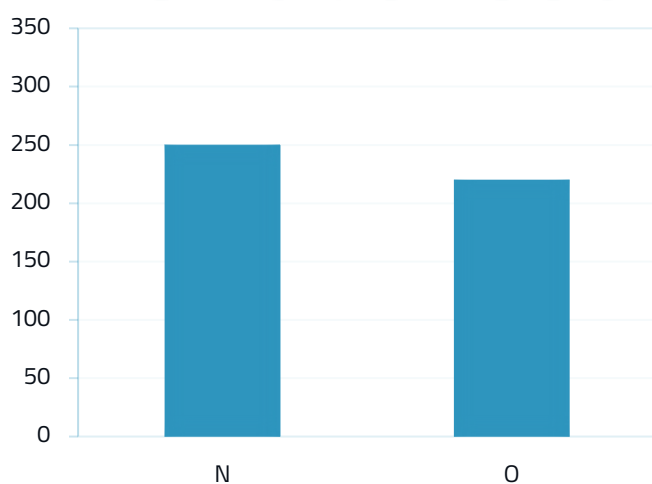
Oxygen and nitrogen levels have been tested in a certified laboratory. The results are shown below.

Table 3 Oxygen and nitrogen level in the sample

Element	Test results [%]	U _B	Test methods
N	0.025	0.003	PN-EN ISO 10720:2009
O	0.022	0.002	LECO methodology

UB – total expanded uncertainty of category B (confidence level 0.95)

Figure 3 Oxygen and nitrogen level in the sample



CHEMICAL COMPOSITION

The chemical composition was checked in certified laboratory.
Test were performed by ICP-OES method. ,

Table 4 Chemical composition of Steel powder and Steel wire #

Requirements for 316L grade [%]		Steel powder	U _B ⁽¹⁾	Steel wire	U _B ⁽¹⁾	Test methods
C	≤ 0.08	0.010	0.001	0.015	0.001	PN-EN ISO 15350:2010
Si	≤ 1.00	0.76	0.02	0.77	0.02	BOSMAL/I-7-43/06
Mn	≤ 2.00	1.0	0.1	1.6	0.1	
P	≤ 0.045	0.025	0.009	0.025	0.009	
S	≤ 0.030	0.006	0.001	0.007	0.001	PN-EN ISO 15350:2010
Cr	16.0 ... 18.0	17.3	0.3	17.4	0.3	BOSMAL/I-7-43/06
Ni	10.0 ... 14.0	10.5	0.3	10.5	0.3	
Mo	2.0 ... 3.0	2.4	0.2	2.4	0.2	
N	≤ 0.10	0.040	0.004	0.095	0.010	PN-EN ISO 15350:2010
Ti	-	< 0.01	-	< 0.01	-	BOSMAL/I-7-43/06
Cu	-	0.11	0.01	0.14	0.01	
W*	-	< 0.05	-	< 0.05	-	
O*	-	0.0089	0.0010	0.0082	0.0009	LECO methodology
Fe	balance	balance	-	balance	-	BOSMAL/I-7-43/06

⁽¹⁾ U_B – total expanded uncertainty of category B (confidence level 0.95)

* determination not covered by the scope of accreditation

FLOWABILITY

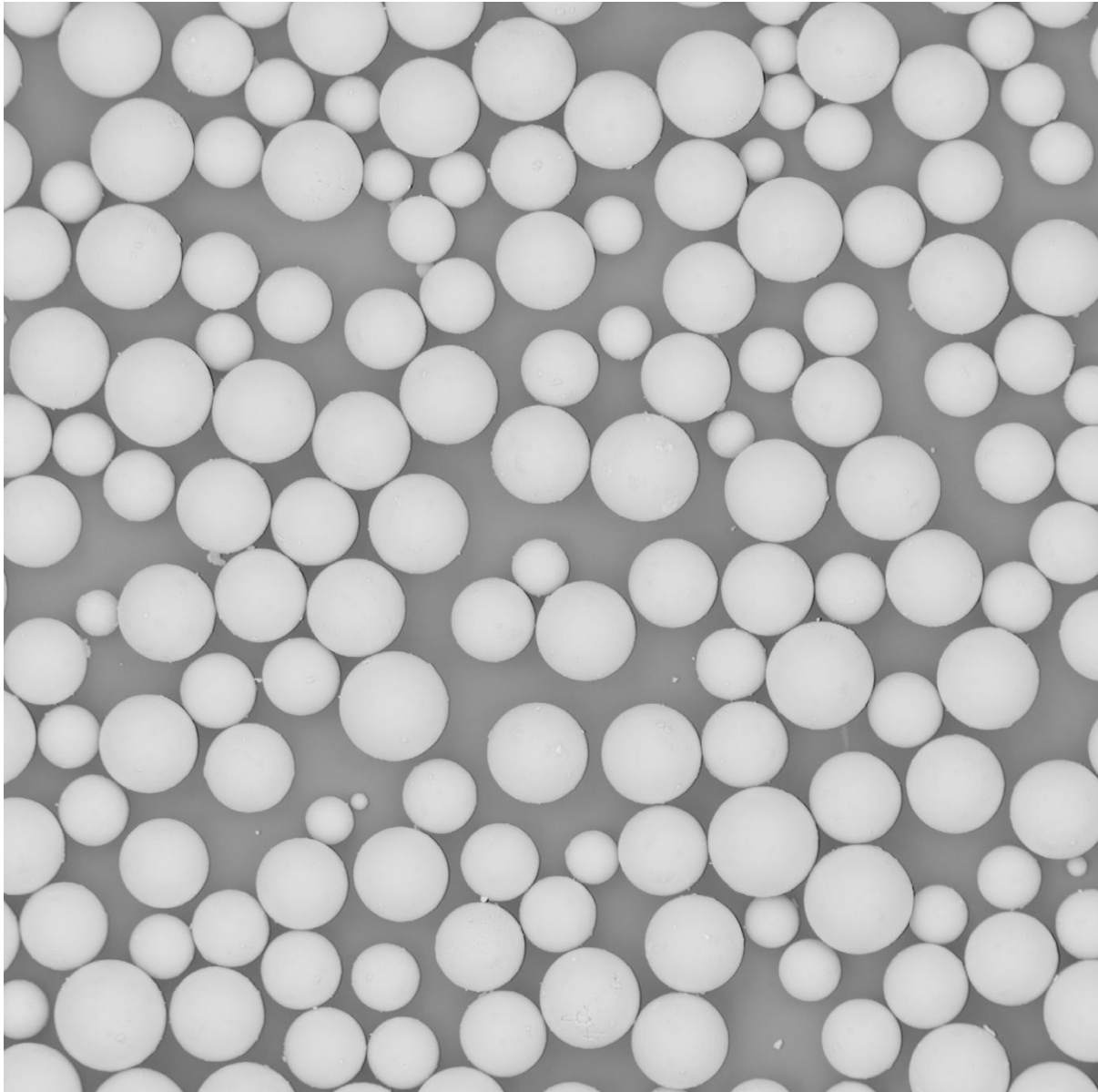
Flowability was checked with a Hall flowmeter (ISO 4490)

Table 5 Flowability measurement result

No	Sample	Flow time [s]
1	Steel 316L	18,08

SEM

Figure 4 SEM photo of Steel 316L



OVERALL CONCLUSION

For Steel 316L average measure diameter is 45,59 μm . Particles have good sphericity without any defects. No contaminations were observed among powder particles. Light oxidation was observed on some particles. Average oxygen level was measured at 220ppm and for nitrogen at 250ppm. OES-ICP examination shows that there is no contamination in chemical composition. Process of atomization of the Steel 316L was very stable and predictable. Process efficiency oscillated around 96%