ATO Lab Stainless Steel 316L

Powder Analysis

Report ID: RD/RM/1004 Rev.1

Material: Steel 316L

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Introduction

The goal of this report is a short summary of Steel 316L atomization status for marketing purposes.

There were multiple test performed on Steel 316L. The atomized material was in the form of a wire ⌀ 1,2 mm.

Report contains microscopic analysis of the distribution, circularity, oxygen/nitrogen level, flowability, chemical composition and photos of the particles.

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
Min	2,2	0,39

Figure 1 Photo of the material x100 (unscreened)

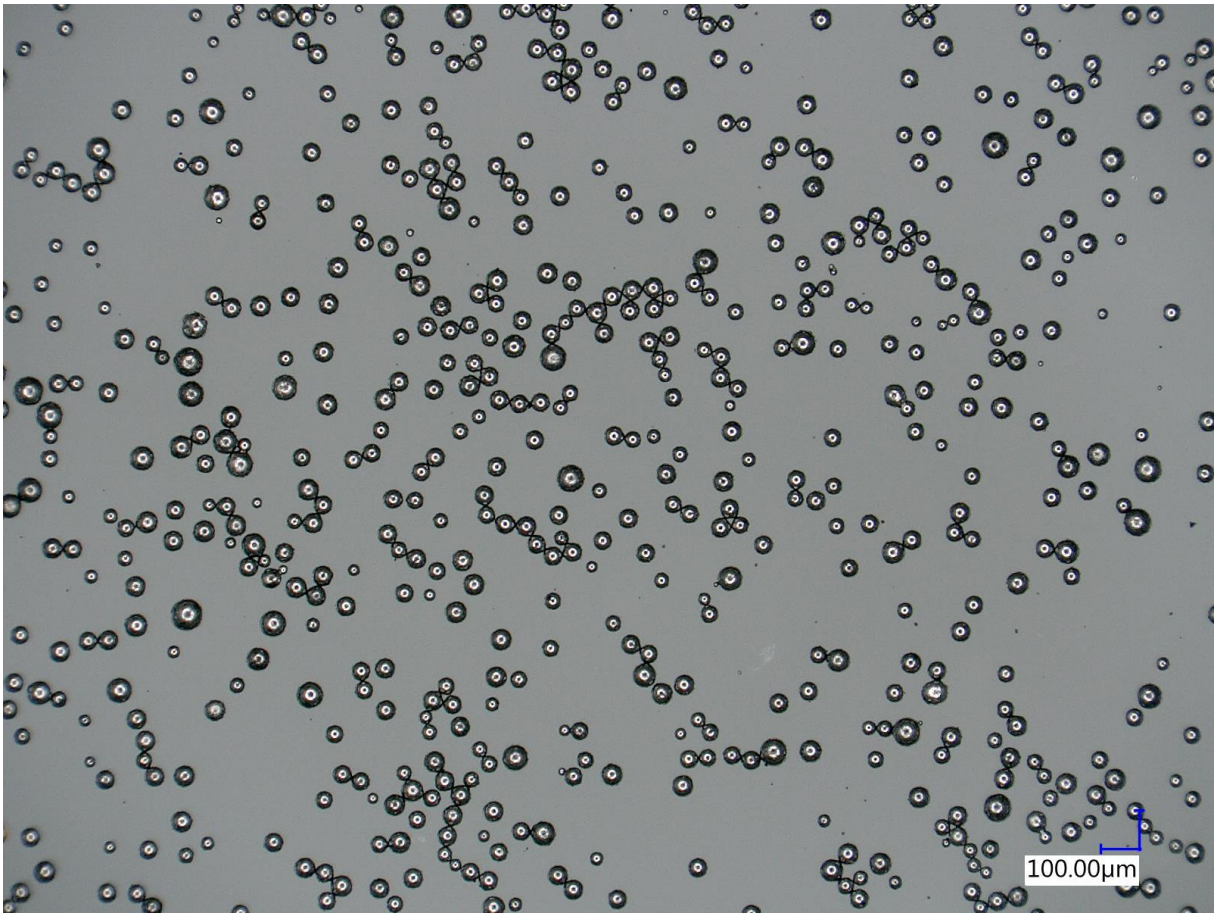


Figure 2 Histogram of the particle size distribution

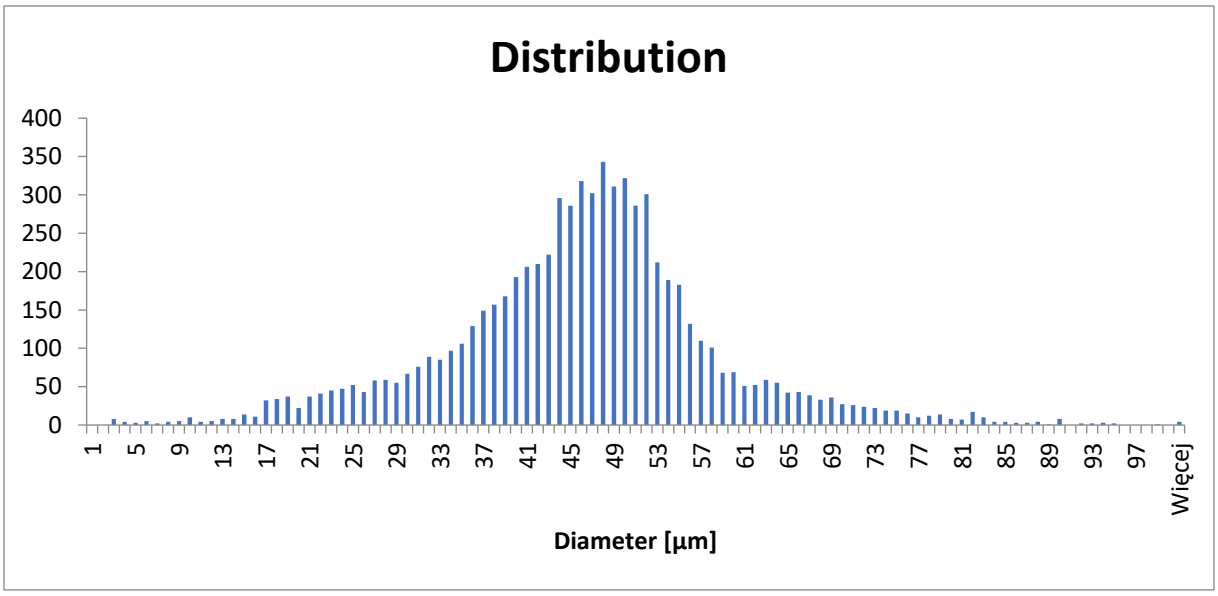


Figure 3 Histogram of distribution according to the sphericity of particles

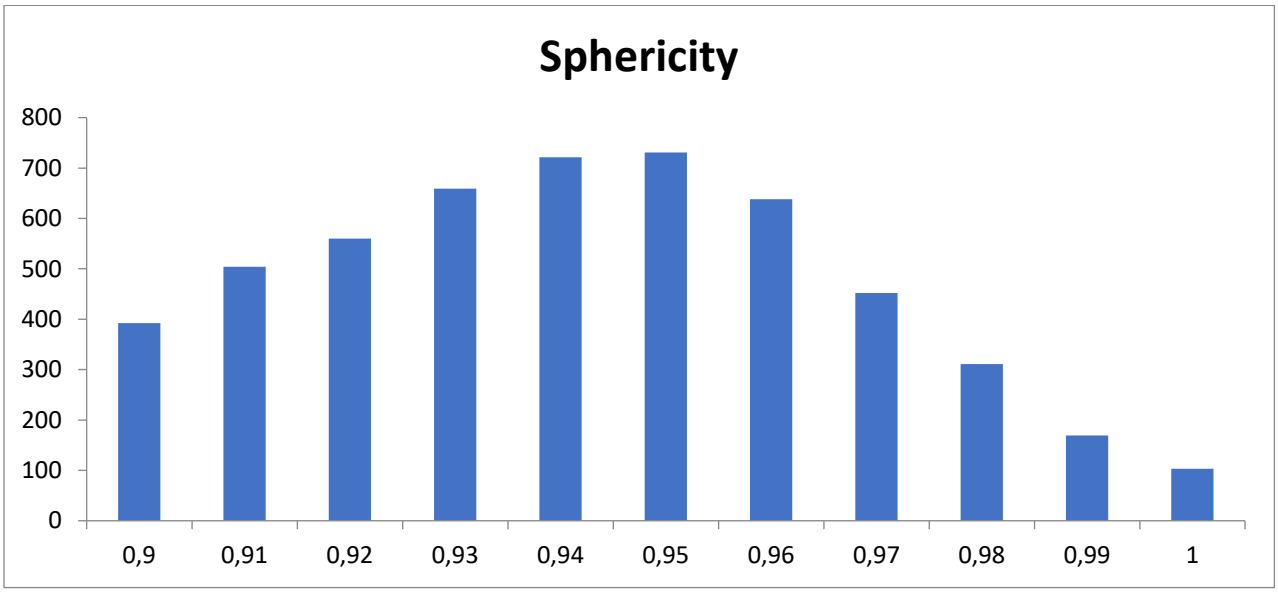


Table 2 Particles size distribution D10, D50, D90

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

Oxygen level

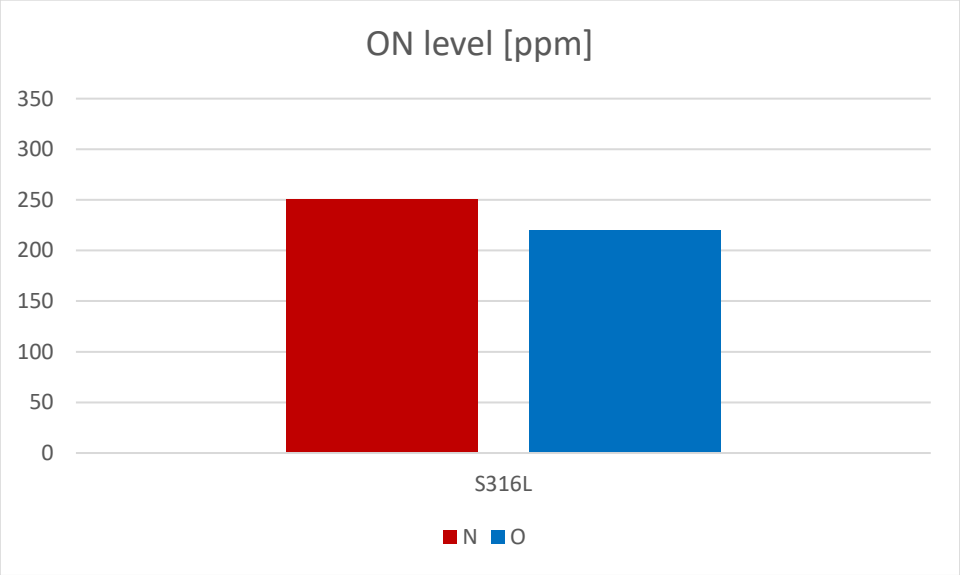
Oxygen and nitrogen levels have been tested in a certified laboratory. The results are shown below.

Table 3 Oxygen and nitrogen level in the sample

Element	**S316L**	U_B (1)	Test methods
	Test results [%]		
N	0.025	0.003	PN-EN ISO 10720:2009
O	0.022	0.002	*LECO methodology*

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

Figure 4 Oxygen and nitrogen level in the sample



Chemical composition

The chemical composition was checked using the OES-ICP method. The measurement was made in certified laboratory.

Table 4 Chemical composition of the sample

Requirements for 316 grade [%]		Steel powder	U_B (1)	Steel wire	U_B (1)	Test methods
		Test results [%]				
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 10720:2009
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

Figure 5 Sem photo of particles (x250)

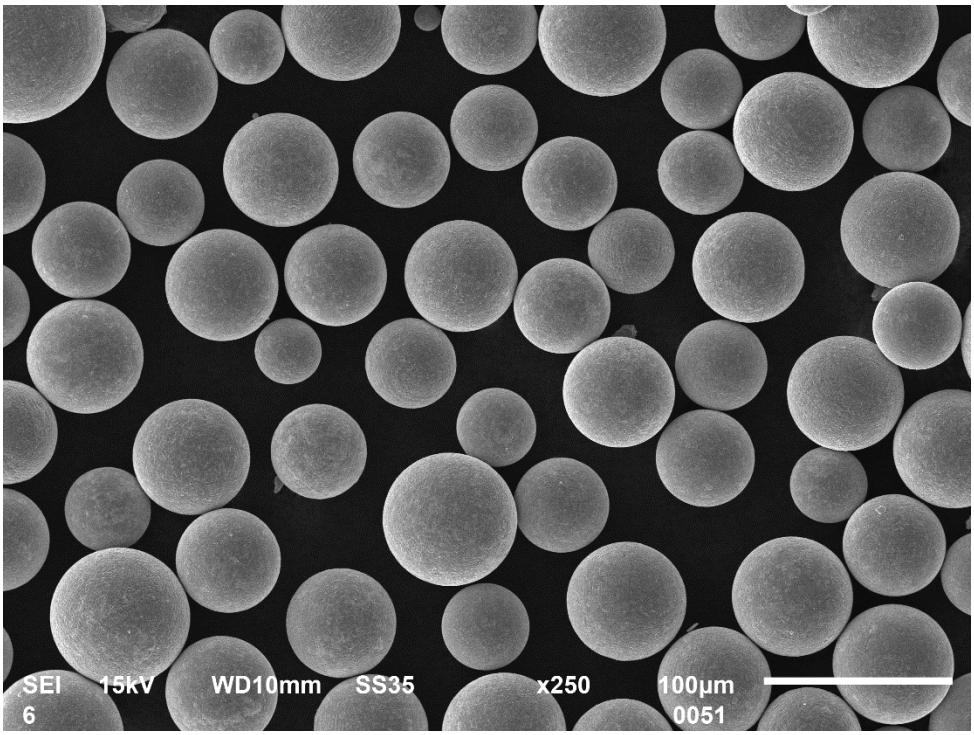
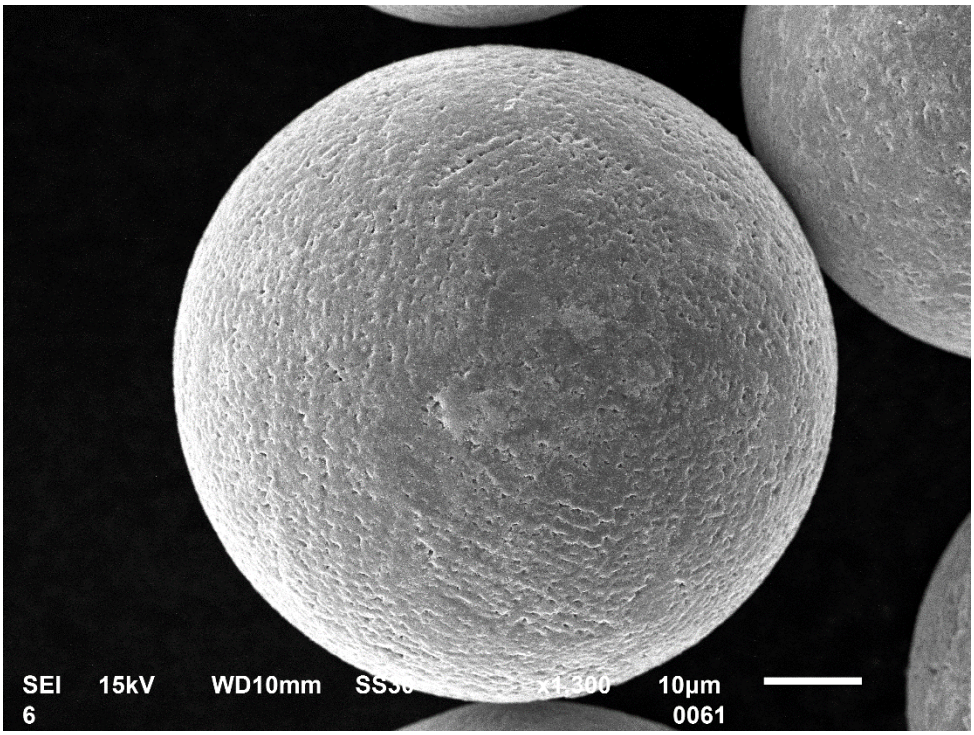


Figure 6 Sem photo of particles (x1300)



Flowability

Flowability was checked with Hall flowmeter (ISO 4490)

Table 5 Flowablity mesurment result

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

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%