

SUPER PURE OXYGEN-FREE COPPER GRADE BASIC

Trace Impurities (basic quality)

Impurity values are listed for Basic-Pure Lot (was received at basic process to achieve Cu OF 5N5) according to ASTM B170 and to analysis methods:

GRADE BASIC		LMS *, AES * (ppm)		LMS + AES + SSMS * + GDMS * (ppm)			
TC # 2018-04B		min	max	~ min	~ med	~ avg	max *
1	P	< 0.1 AES	< 0.1 AES	< 0.005	< 0.02	< 0.02	< 0.04
2	Mn	< 0.1	< 0.1	< 0.005	< 0.01	< 0.01	< 0.02
3	Fe	< 0.1	1	< 0.05	≤ 0.3	≤ 0.4	1
4	Ni	< 0.1	< 0.1	< 0.005	< 0.01	< 0.02	< 0.04
5	Zn	< 0.1 AES	< 0.1 AES	< 0.005	< 0.01	< 0.02	< 0.04
6	As	< 0.1	< 0.1	< 0.005	< 0.01	< 0.02	< 0.04
7	Se	< 0.1	< 0.2	< 0.005	< 0.01	< 0.04	< 0.1
8	Ag	< 0.1	2,7	< 0.05	≤ 0.6	≤ 0.8	2,7
9	Cd	< 0.2	< 0.2	< 0.005	< 0.01	< 0.02	< 0.04
10	Sn	< 0.2	< 0.2	< 0.005	< 0.02	< 0.02	< 0.04
11	Sb	< 0.2	< 0.2	< 0.005	< 0.02	< 0.02	< 0.04
12	Te	< 0.2	< 0.2	< 0.005	< 0.02	< 0.02	< 0.04
13	Pb	< 0.2	< 0.2	< 0.005	< 0.01	< 0.01	< 0.02
14	Bi	< 0.2	< 0.2	< 0.005	< 0.01	< 0.01	< 0.02
	Fe + Ag	≥ 0,3	≤ 2,7	≥ 0,3			≤ 2,7
Cu (1 - 14) :		5N8	5N5	6N5	6N	6N	5N7
15	S	< 3	< 3	< 0.01	≤ 0.1	< 0.2	< 0.4
Cu (1 - 15) :		5N5	5N2	6N4	6N	5N8	5N6
16	O LMS	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2
CU OXY-FRE :		5N3	5N	5N7	5N7	5N6	5N5

Oxygen is measured and counted "≤ 2 ppm" as LMS Detection Limit of the current equipment. In reality, oxygen can be <0.05 - <0.1 - <1ppm. Our technology is able to make it. It is necessary to find and use the equipment capable of such measuring. Needed Detection Limit is <0.01ppm. In this case Cu OF (can be now or it can be made) :

O < 1 ppm	5N4	5N1	5N8	5N8	5N7	5N6
O < 0.5 ppm	5N4	5N2	6N	5N8	5N8	5N6
O < 0.1 ppm	5N5	5N2	6N3	6N	5N8	5N6
O < 0.05 ppm	5N5	5N2	6N4	6N	5N8	5N6
+ also according to Metals basis (all metals : > 60)						
Cu	5N2	5N	6N2-3	6N	5N8	5N7
Cu + Ag	5N2	5N2	6N5-6	6N3	6N2	5N8

* For LMS and AES excluding Fe and Ag, impurities are always is Detection Limit of methods and the equipment, including metals and metalloids not entering into ASTM B170 (limits are <0.08 - <0.2 depending on an element).

Max-impurities by SSMS+GDMS are not for the best tests, some possible inaccuracies and small possible mistakes were taken into account and added, but still they are for the sufficiently qualified measurement. **Avg-impurities** are for more exact measurement. For **med** and **min** of impurities there is need for the highest level of testing, also possibly by other methods appropriate to this level. Limits " <x - <0.00x " were considered (were subtracted from 100 %) at calculation of purity as **corresponding quantity of impurities**.

Analysis

Material was tested at various leading laboratories (in Russia, the USA, China) by methods of LMS, AES, SSMS and GDMS. Not all methods, the equipment and qualification allow to measure chemical purity of copper equally. Especially it concerns purity of 5N+ and above. Some methods and laboratories cannot measure certain elements or test exactly, like they are real. Analysis of our Copper requires very good preparation of equipment appropriate to this level of purity, in super-quality and super-pure materials and instruments (chemical substances, cutters and other work tools) for preparation of the copper sample for analysis and the highest qualification level of the laboratory personnel.

Production Process

We have developed our own technology allowing us to predict, produce and supervise a chemical compound. The basic necessary equipment for our technology was designed and made by ourselves.

Some Characteristics

Confirmation of quality of our product is the electrical conductivity which is independent of methods of the chemical analysis. Conductivity of our Copper is 104-105% IACS.

RRR (R293K/R4.2K) and Thermal Conductivity are expected ~7-1X? times more (at cryogenics) than for classical oxygen-free copper (M006, Cu 10100, Cu OFE etc. with RRR ~ 200-250) and are close to theoretical copper.

Shape, Size and Structure

The shape of ingots is close to cylinder: diameter of 85-95 mm, height/length of 100-150 mm. **Similar to monocrystal** (several single crystals).

It is the basic grade. Parameters of technological process have been studied to achieve the quality of Cu OF 5N5 according to ASTM B170 (USA). The customer can specify additional requirement if they can be fulfilled.