

CERTIFICATION
FIXED POINT CELL
FREEZING POINT OF ZINC

MODEL: 5906
SERIAL NUMBER: Zn-06129

Certification

Certification of the Freezing Point of Zinc Cell

Cell Model: 5906 Serial Number: Zn-06129

As a primary defining fixed point of the International Temperature Scale of 1990, the assigned temperature of the freezing point of zinc is 419.527°C.

Fluke Calibration certifies that the above zinc freezing point cell was produced from high purity zinc (99.9999%, Lot #407956), graphite (99.9997%) and argon (99.9999%) through an elaborate procedure. The pressure of argon at the freezing point in the cell is 85.0 kPa.

The freezing point cell was tested in a Fluke Calibration Laboratory by the freezing point slope analysis method. The results of the tests are shown on the following pages. It is certified that the expanded uncertainty ($k=2$) of the above zinc freezing point cell is within 0.0009°C after considering the correction for the pressure difference from one standard atmosphere (101.325 kPa) and the correction for the hydrostatic pressure. (Refer to the user manual or ITS-90 supplementary information for discussions of these corrections.) The height from the bottom of the re-entrant well to the upper surface of the pure metal in the cell is about 195 mm. The actual calculated temperature at a mid-point of the SPRT sensor (immersion depth of 170 mm) during a freezing plateau is 419.52676°C \pm 0.0009°C.

Performed by: Dwight Corn

Approved by: [Signature]

Date: 12/4/17

Fluke Corporation
TCAL Division
799 E Utah Valley Drive
American Fork, Utah 84003-9775

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Results of Purity Analysis

The test was conducted by realizing three freezing plateau of the fixed-point cell inside a maintenance furnace. The performance of the freezing plateau depends on the techniques used to realize the freezing curve, e.g. the inducing nucleation technique, and the furnace maintenance temperature. In the test, one cool fused-silica quartz glass tube was inserted into the re-entrant well of the cell for two minutes to induce the nucleation. The furnace maintenance temperature was set to be 0.5°C below the theoretical freezing point temperature.

The end of the plateau is taken to be at 50% completion of the freezing curve. An approximation of the impurity of the sample can be determined based on the freezing curve and the relationship of the impurity concentration and the variation of the freezing point temperature. The calculated purity constitutes a check of the cell's performance. It is not a direct determination of the impurities of the sample. A direct determination of the impurities in the sample can be found in the "Certificate of Analysis" of metal sample. Refer to the Certification for the actual temperature and associated corrections.

Instruments used in the testing:

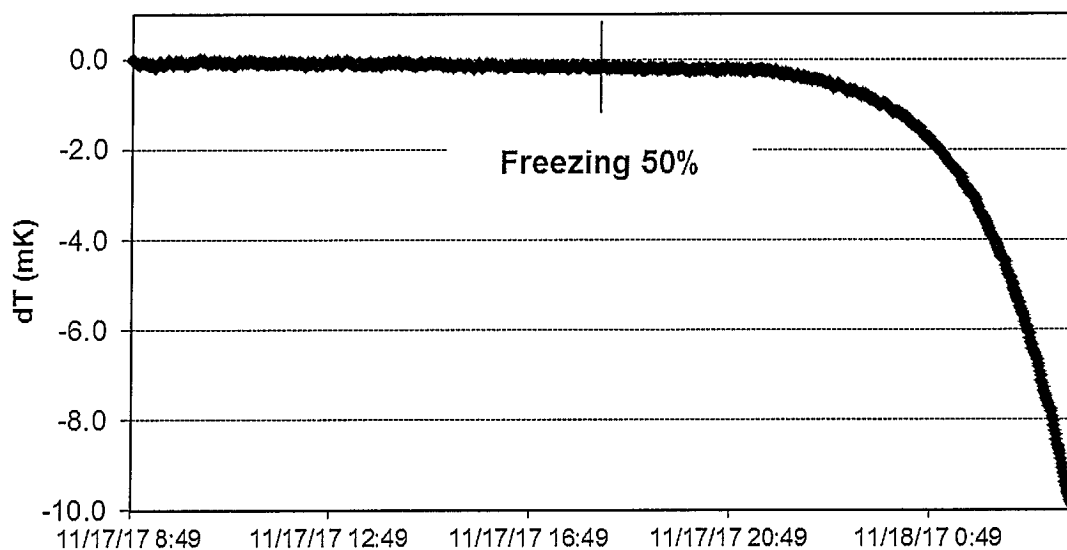
Bridge(s): FLUKE 1595A Thermometry Bridge, S/N: B32124
Reference Resistor(s): 10 Ω Internal Resistor
SPRT: Hart Scientific 5681 SPRT (25.5 Ω), S/N: 1477

The results of the calculated purity of two plateaus:

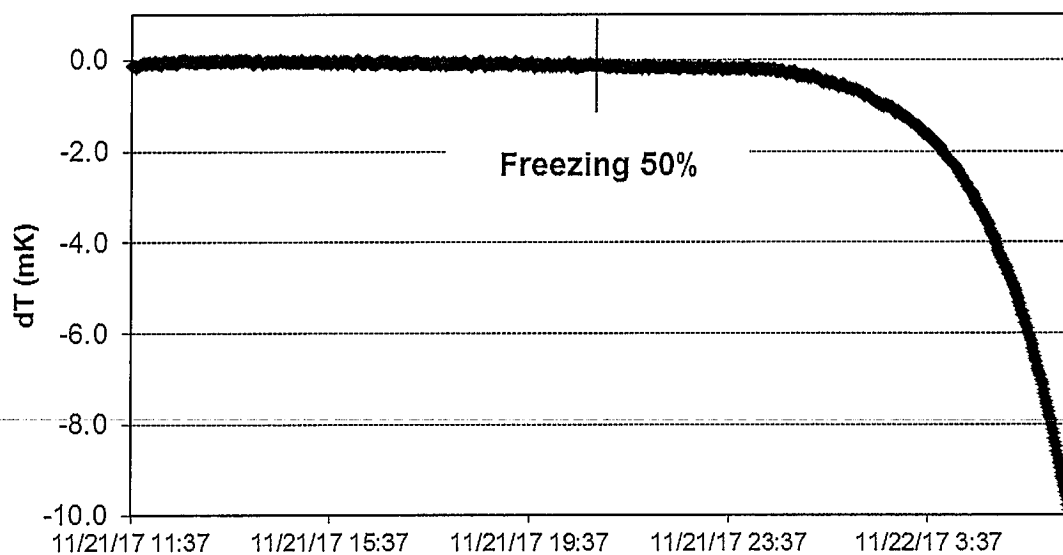
	Relative Temperature at 50% of freezing	Purity
1	-0.16 mK	99.999975 %
2	-0.11 mK	99.999977 %

First Cryoscopic Constant: 0.00185

Freezing Plateau # 1



Freezing Plateau # 2





CERTIFICATE OF ANALYSIS

#17413

2017-11-03
(yyyy-mm-dd)**5N PLUS**

Customer name **Fluke Electronics Corporation**
Part number **3710176**
Customer specification
5N Plus specification **SP-1105-Zn01-R4-C**
Lot number **407956**

P.O. **629900**
Product **Zn 6N (800)**
Quantity **1.000 Kg**
Shape **Shot**

Chemical assay, ppb at.

		Results
Lithium	Li	<2
Beryllium	Be	<1
Boron	B	<1
Carbon	C	490
Nitrogen	N	130
Oxygen	O	330
Fluorine	F	<1
Sodium	Na	<0.7
Magnesium	Mg	<0.8
Aluminum	Al	2
Silicon	Si	0.8
Phosphorus	P	<0.6
Sulfur	S	<20
Chlorine	Cl	3
Potassium	K	<1
Calcium	Ca	<5
Scandium	Sc	<0.2
Titanium	Ti	<0.1
Vanadium	V	<0.2
Chromium	Cr	<5
Manganese	Mn	<0.5
Iron	Fe	46
Cobalt	Co	<0.2
Nickel	Ni	18
Copper	Cu	<25
Gallium	Ga	<2
Germanium	Ge	<85
Arsenic	As	<0.3
Selenium	Se	<2
Bromine	Br	<1
Rubidium	Rb	<0.4

		Results
Strontium	Sr	<0.3
Yttrium	Y	<0.3
Zirconium	Zr	<0.1
Niobium	Nb	<2
Molybdenum	Mo	<0.5
Silver	Ag	<3
Cadmium	Cd	19
Indium	In	<0.2
Tin	Sn	<0.9
Antimony	Sb	<0.4
Tellurium	Te	<0.8
Iodine	I	<5
Cesium	Cs	<30
Barium	Ba	<2
Lanthanum	La	<0.1
Cerium	Ce	<0.3
Hafnium	Hf	<0.2
Tungsten	W	<0.3
Platinum	Pt	<0.9
Gold	Au	<5
Mercury	Hg	<0.9
Thallium	Tl	<0.6
Lead	Pb	<0.2
Bismuth	Bi	<0.2
Thorium	Th	<0.04
Uranium	U	<0.6

Chemical results reported following ASTM E29-08.

The symbol '<' means below the detection limit of the apparatus.

GDMS analysis performed at **NRC**

Note: Due to the semi-quantitative capabilities of GD-MS, the determined mass fractions of impurities may lie in the range of one-half- to two-fold reported values except for C, N and O, for which the range is one-fifth- to five-fold.

This lot conforms to all applicable specifications.

Minimum purity 99,99992% based on detected metallic elements.


Julien Veilleux
Quality Technician

ISO 9001:2008 Certified

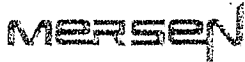
ISO 14001:2004 Certified

OHSAS 18001:2007 Certified

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www.5nplus.com

FOR-1109-006-R4

**FLUKE ELECTRONICS CORPORATION**

PURCHASE ORDER #: 473146-63	
CUSTOMER PART #: 4227794 B027-5003-1	
MERSEN PART #: B013623-133	
MERSEN JOB #: 185395	
LOT #: 342-17-17	
DESCRIPTION: CRUCIBLE OUTSIDE WALL	
MATERIAL: CX2360	QTY: 4

ELEMENTAL ANALYSIS

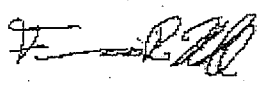
B	Boron	ND	Si	Silicon	ND
Al	Aluminum	ND	Pb	Lead	ND
Fe	Iron	ND	Sn	Tin	ND
Ca	Calcium	ND	Mo	Molybdenum	ND
Cu	Copper	ND	W	Tungsten	ND
Mg	Magnesium	ND	Zn	Zinc	ND
Ni	Nickel	ND	Zr	Zirconium	ND
Ti	Titanium	ND	Cr	Chromium	ND
V	Vanadium	ND	Total Spot PPM		0.0

Note: ND means non-detectable reading for the element

CERTIFICATE OF CONFORMANCE

Physical Properties	
Density:(gm/cc)	1.83
Resistivity: (ohm-in)	0.00053
Hardness: Shore	72
Flex. Str. (psi)	10554

This is to certify that the above product was made in accordance with the geometry specified on the blueprint and that all requirements of the purchase order have been met.

Inspector: 

Date: 10/16/2017



Praxair Distribution, Inc.
2801 Montopolis Dr.
Austin, TX 78741
Tel: (512) 389-2323
Fax: (512) 389-2599

Date: 11/20/14

CERTIFICATE OF ANALYSIS
Argon, 6.0 Semiconductor Process Gas
Minimum Purity: 99.9999%

<u>Components</u>	<u>Specification</u>	<u>Results</u>	<u>Analytical Principle</u>
Oxygen	≤ 0.2 ppm	0.20 ppm	O
Moisture	≤ 0.2 ppm	0.16 ppm	P
Total Hydrocarbons	≤ 0.1 ppm	0.02 ppm	Q
Nitrogen	≤ 0.5 ppm	0.48 ppm	S
Carbon Dioxide	≤ 0.1 ppm	<0.1 ppm LDL	A
Carbon Monoxide	≤ 0.1 ppm	<0.1 ppm LDL	A
Hydrogen	≤ 0.1 ppm	0.06 ppm	U

Product Batch Number: 530-4324-41

Filling Method: Pressure/Temperature

Date of Fill: 11/20/2014

Cylinder Style: AT

Expiration Date: 12/31/2019

Cylinder Pressure @70°F: 2200 psig

Valve Outlet Connection: 580

Cylinder Volume: 272 ft³

Analytical Instruments: Delta F O2 Analyzer

Model FA30111A

Meeco Aquamatic Plus

Rosemount 400A

Gowmac 1200B

HP5890

Cylinder Serial Numbers: ND39621

Approved Signature: _____

The gas calibration cylinder standard prepared by Praxair Distribution, Inc. is considered a certified standard. It is prepared by gravimetric, volumetric, or partial pressure techniques. The calibration standard provided is certified against Praxair Reference Materials which are either prepared by weights traceable to the National Institute of Standards and Technology (NIST) or by using NIST Standard Reference Materials where available.

Note: All expressions for concentration (e.g., % or ppm) are for gas phase, by volume (e.g., ppmv) unless otherwise noted

Key to Analytical Techniques:

A. Flame Ionization with Methanizer	F. Gas Chromatography with Helium Ionization Detector	K. Gas Chromatography with Ultrasonic Detector	P. Specific Water Analyzer
B. Gas Chromatography with Discharge Ionization Detector	G. Gas Chromatography with Methanizer Carbonizer	L. Infrared - FTIR or NDIR	Q. Total Hydrocarbon Analyzer
C. Gas Chromatography with Electrolytic Conductivity Detector	H. Gas Chromatography with Photoionization Detector	M. Mass Spectrometry - MS or GC/MS	R. Wet Chemical
D. Gas Chromatography with Flame Ionization Detector	I. Gas Chromatography with Reduction Gas Analyzer	N. Proprietary	S. Emission Spectroscopy
E. Gas Chromatography with Flame Photometric Detector	J. Gas Chromatography with Thermal Conductivity Detector	O. Specific Oxygen Analyzer	U. Bulk Supplier COA

IMPORTANT

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