



**CERTIFIED REFERENCE MATERIAL**  
**BCR<sup>®</sup> – 089**  
**CERTIFICATE OF ANALYSIS**

TITANIUM ALLOY TiAl6V4			
	Mass fraction		Unit
	Certified value <sup>3)</sup>	Uncertainty <sup>4)</sup>	
Al	59.7	0.4	g/kg
C <sup>1)</sup>	38	10	mg/kg
Cr	122	6	mg/kg
Cu	10.3	1.2	mg/kg
Fe	515	16	mg/kg
H <sup>2)</sup>	31	5	mg/kg
Hf	0.126	0.011	mg/kg
Mn	4.2	0.6	mg/kg
Mo	15.2	1.8	mg/kg
N <sup>2)</sup>	212	33	mg/kg
Ni	106	7	mg/kg
O <sup>2)</sup>	1660	60	mg/kg
Sb	1.94	0.12	mg/kg
Sn	10.4	1.7	mg/kg
Ta	0.30	0.09	mg/kg
V	39.76	0.29	g/kg
W	1.6	0.4	mg/kg
Zr	2.8	0.6	mg/kg

1) As obtained by combustion and subsequent quantification by infrared detection.  
2) As obtained by inert gas fusion.  
3) Unweighted mean value of the means of accepted sets of data, each set being obtained in a different laboratory and/or with a different method of determination. The certified value and its uncertainty are traceable to the International System of units (SI).  
4) The uncertainty of the certified value is the expanded uncertainty with a coverage factor  $k = 2$  (except for Al and V with  $k = 2.78$  and  $k = 2.57$ , respectively) corresponding to a level of confidence of about 95 % estimated in accordance with ISO/IEC Guide 98-3, Guide to the Expression of Uncertainty in Measurement (GUM:1995), ISO, 2008.

This certificate is valid for five years after purchase.

Sales date:

The minimum sample intake representative for Cr, Cu, Fe, Mn, Mo, Ni, Sn and W is 10 mg. The minimum sample intake representative for H, Hf, N, O, Sb, Ta, and Zr is 100 mg. The minimum sample intake representative for C is 150 mg. The minimum sample intake representative for Al and V is 200 mg.

Brussels, June 1991

Latest revision: October 2014

Signed: \_\_\_\_\_

Prof. Dr. Hendrik Emons  
European Commission  
Joint Research Centre  
Institute for Reference Materials and Measurements  
Retieseweg 111  
B-2440 Geel, Belgium

**NOTE**

This material has been certified by BCR (Community Bureau of Reference, the former reference material programme of the European Commission). The certificate has been revised under the responsibility of IRMM.

<b>Indicative Values</b>			
	Mass fraction		Unit
	Indicative value <sup>3)</sup>	Uncertainty <sup>5)</sup>	
B	1.9	0.8	mg/kg
Bi <sup>1)</sup>	< 0.5 <sup>4)</sup>		mg/kg
Co	1.9	1.1	mg/kg
Hg	< 1 <sup>4)</sup>		mg/kg
La	< 1 <sup>4)</sup>		mg/kg
Nb	4.5	1.6	mg/kg
Ru	< 10 <sup>4)</sup>		mg/kg
Si <sup>2)</sup>	121	33	mg/kg
Zn	12	6	mg/kg
1) As obtained by acid digestion with HF and subsequent quantification by ICP-MS. 2) As obtained by acid digestion with HF and subsequent quantification by ICP-OES. 3) For Bi, Hg, La and Ru, the given value corresponds to the highest limit of detection of accepted sets of data, each set being obtained in a different laboratory and/or with a different method of determination. The indicative value and its uncertainty are traceable to the International System of units (SI). 4) With a 95 % probability, the indicative value is below this level. 5) The uncertainty of the indicative value is the expanded uncertainty with a coverage factor k = 2 corresponding to a level of confidence of about 95 % estimated in accordance with ISO/IEC Guide 98-3, Guide to the Expression of Uncertainty in Measurement (GUM:1995), ISO, 2008.			

The minimum sample intake representative for B, Co, Nb and Si is 10 mg. The minimum sample intake representative for Bi, Hg, La, Ru and Zn is 100 mg.

<b>Additional Material Information</b>	
	Mass fraction
	Value <sup>1)</sup> [mg/kg]
As	17.8 – 18.3
Cs	< 0.5
Ga	11.2 – 11.7
1) For As and Ga, the values are derived from six measurements only performed by neutron activation analysis. For Cs, the result is derived from two datasets (6 independent measurements) obtained by ICP-OES and ICP-MS.	

**DESCRIPTION OF THE MATERIAL**

The sample is a cylinder with 40 mm diameter and 20 mm height.

**ANALYTICAL METHODS USED FOR CERTIFICATION****Major elements (Al and V):**

Complexometric titration (Al)

ICP-OES (Al and V)

Potentiometric titration (V)

X ray fluorescence spectrometry (Al and V)

**Minor elements:**

Cold vapour atomic absorption spectrometry (Hg)  
Combustion followed by infrared detection (C)  
Electrothermal atomic absorption spectrometry (Sn)  
Flame atomic absorption spectrometry (Cu, Zn)  
ICP-OES (B, Co, Cr, Cu, Fe, Hg, La, Mo, Mn, Ni, Ru, Sb, Si, Sn, Zn, Zr)  
ICP-MS (B, Bi, Co, Cr, Cu, Fe, Hf, Hg, La, Mo, Mn, Ni, Ru, Sb, Sn, Ta, Zn, Zr)  
Neutron activation analysis (Co, Cr, Cu, Fe, Hf, Hg, La, Mo, Mn, Ni, Sn, Ta, Zn, Zr)  
Prompt gamma activation analysis (B)  
Inert gas fusion (O, N, H)

**PARTICIPANTS****Major elements (Al and V):**

Acières d'Imphy, Imphy (FR)  
Aérospatiale, Suresnes (FR)  
Bundesanstalt für Materialforschung und –prüfung, Berlin (DE)  
CEC Joint Research Centre, Central Bureau for Nuclear Measurements, Geel (BE)  
Compagnie Européenne du Zirconium CEZUS, Usine de Venthon, Albertville (FR)  
Etablissement Technique Central de l'Armement, Centre de Recherches et d'Etudes d'Arcueil, Arcueil (FR)  
GSF-Forschungszentrum für Umwelt und Gesundheit, Neuherberg (DE)  
Instituut voor Nucleaire Wetenschappen (R.U.G.), Gent (BE)  
Krupp Industrietechnik, Sparte Systemtechnik, Essen (DE)  
Laboratoire National d'Essais, Paris (FR)  
Mannesmann Forschungsinstitut, Duisburg (DE)  
Metallwerk Plansee GmbH, Reutte/Tirol (AT)  
Riso National Laboratory, Roskilde (DK)  
Wehrwissenschaftliches Institut für Materialuntersuchungen, Erding (DE)

**Minor elements:**

Activation Laboratories Ltd., Ancaster (CA)  
AREVA/CEZUS, Uginé (FR)  
(measurements performed under the scope of ISO/IEC 17025 accreditation, COFRAC No. 1-0859)  
ATI Allvac, Monroe (US)  
(measurements performed under the scope of ISO/IEC 17025 accreditation, ACLASS No. AT-1776)  
Dirats Laboratories, Westfield (US)  
(measurements performed under the scope of ISO/IEC 17025 accreditation, ACLASS No. AT-1546)  
Evans Analytical Group SAS, Tournefeuille (FR)  
Institut "Jozef Stefan" (IJS), Department of Environmental Sciences, Ljubljana (SI)  
(measurements performed under the scope of ISO/IEC 17025 accreditation, Slovenska Akreditacija-LP090)  
Laboratory Testing Inc., Hatfield (US)  
(measurements performed under the scope of ISO/IEC 17025 accreditation, A2LA No. 0117.05)  
VDM Metals GmbH, Werdohl (DE)  
(measurements performed under the scope of NADCAP AC7101 accreditation, PRI No. 8068147837)  
Perryman company, Houston (US)  
(measurements performed under the scope of NADCAP AC7101 accreditation, PRI No. 13-1936R)  
Umicore Analytical Competence Center, Olen (BE)  
Studiecentrum voor Kernenergie, SCK, Mol (BE)  
(measurements performed under the scope of ISO/IEC 17025 accreditation; BELAC No. 015-TEST)  
TU Delft, Delft (NL)  
(measurements performed under the scope of ISO/IEC 17025 accreditation; Rva L049)

## **SAFETY INFORMATION**

The usual laboratory safety measures apply.

## **INSTRUCTIONS FOR USE AND INTENDED USE**

The usual laboratory safety precautions apply.

The cylinder surface should be cleaned before use by polishing. Care should be taken not to contaminate the surface during preparation.

The material is mainly intended for the calibration and quality control of solid sampling technique (e.g. XRF instruments, glow discharge mass spectrometry, spark-OES).

## **STORAGE**

The materials shall be stored at  $18\text{ °C} \pm 5\text{ °C}$  in the dark.

However, the European Commission cannot be held responsible for changes that happen during storage of the material at the customer's premises, especially of opened samples.

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## **NOTE**

A technical report on the production of BCR<sup>®</sup>-089 is available on the internet ([www.irmm.jrc.be](http://www.irmm.jrc.be)). A paper copy can be obtained from IRMM on request.