White Horse Reference Materials

Certificate of Analysis

WHRM-THb (Lot B)

ISSUE (MFG) DATE: August 27, 2025 **REVISION DATE:** 04/27/2026

H_2 IN TITANIUM ALLOY

INTENDED USE: This Certified Reference Material (CRM) is intended primarily for use as a calibrant for calibrating instruments used to determine the listed elemental content(s) in refractory alloys. In addition, it can be used to check instrumental performance and harmonization among laboratories.

DESCRIPTION: One bottle consists of ~100 Titanium pins of approximately 2.5 mm diameter by 4.5 mm length with a nominal weight of 0.1 g.

	Mass Fraction	Expanded Uncertainty U=95 %
Hydrogen (H)	**90 mg/kg**	**± 3 mg/kg**
Nitrogen (N_2)	**0.009 %**	**± 0.001 %**
Oxygen (O_2)	**0.178 %**	**± 0.005 %**

VALUE ASSESSMENT: The measurands listed are the amounts of the elements contained in Titanium traceable to the derived SI unit of mass fraction expressed as WT%.

Test results are realized using inert gas fusion method (WHRM ME1447a for hydrogen, and WHRM ME1019 for N_2 and O_2) under repeatability conditions.

For hydrogen analyte, this method employs gas dose spiking and calibration at WHRM. N_2 and O_2 are consensus results from multiple labs.

For propagation of uncertainty, an estimate of the combined standard uncertainty can be obtained as uc = U95%(x)/k, where k = 2 is the approximate coverage factor associated with the 95 % coverage level. The resulting value for uc is at the level of one standard deviation, and it can be combined with a laboratory's standard uncertainty estimates for their own sources of error to calculate estimates of uncertainty for test results from methods with which this CRM was used. A laboratory uncertainty estimate that includes the uncertainty of the CRM value is the basis for a link of metrological traceability from the test result for a sample to the CRM value. In addition, the value of u_c can be used as an estimate of $\hat{\sigma}$ or u_{av} in proficiency testing according to ISO 17043:2023.

MINIMUM SAMPLE QUANTITY: To relate analytical determinations of Hydrogen to the assigned value on this COA, use 2 pins (an unknown sample mass for hydrogen analyses should ideally be ~0.225 g) with 2 pellets of tin flux.

For O2 and N2 analyses, use 1 pin. (An unknown sample mass should be ~0.1-0.15 g) inside a 1 g. high purity nickel basket utilizing a High-temperature graphite crucible with 100-150 mg of graphite powder.

HETEROGENEITY Material Homogeneity of this lot was confirmed per ISO 17034 / ISO 33405. Between-unit difference was not significant ($p > 0.05$).

PERIOD OF VALIDITY: The listed value assignment(s) are valid, within the measurement uncertainty specified, indefinitely, provided the CRM is handled and stored in accordance with the instructions given in this document (see "Instructions for Handling and Use").

STORAGE INSTRUCTIONS: The material should be stored in its original, tightly capped bottle in a dry location <70C.

INSTRUCTIONS FOR HANDLING AND USE: The material does not require additional preparation prior to weighing, if stored as outlined per instructions given in this document (see "Storage Information"). Use a clean, dry tool to handle the pins, and do not touch the pins with any material likely to contaminate the surface.

MAINTENANCE OF RM DOCUMENT: WHRM will monitor this RM over the period of validity. If substantive technical changes affect the value assignment, WHRM will publish on its website the revised document, and the purchaser will be notified (register online). Users of this CRM should ensure the COA in their possession is current.

PREPARATION AND ANALYSIS: The material for WHRM-THb was obtained in the form of pins prepared by White Horse Technical Services (WHTS) using a proprietary process. The material was blended and bottled at WHTS. The starting material for preparation of WHRM-THb was a Titanium weld wire of unknown alloy provided by the customer.

Quantitative analysis of the listed elemental content of the material [single-heat (lot)] for WHRM-THb was performed at WHRM using inert gas fusion with thermal conductivity detection (H_2, O_2 and N_2).

QUALITY ASSURANCE: For quality assurance, various CRMs were analyzed by WHRM at the same time as blunder checks and showed no statistically significant bias.

WHRM certifies that THb was produced and is maintained in a manner compliant with the requirements of ISO 17034 and associated documents. WHRM remains committed to a responsible adherence to best practices as developed and demonstrated in both public and private sector organizations and as set forth in international Reference Material Producer requirements.

HEALTH AND SAFETY INFORMATION: This product is Non-Hazardous in solid form.

STATISTICAL ANALYST: Curtis Vancura

Curtis Vancura, Owner WHRM

Legal Notice: Remedies for any claimed defect in this product will be limited to product replacement or refund of the purchase price. In no event shall WHTS be liable for incidental or consequential damages. For good laboratory practice it is recommended that all standards be verified prior to use.