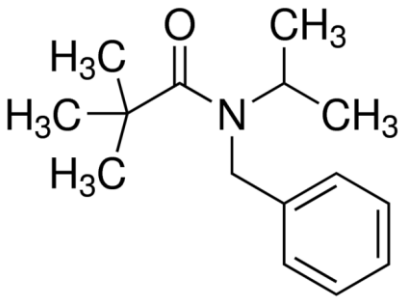
Certificate of Analysis – Certified Reference Material

Tebutam

TraceCERT®
Traceable Certified Reference Materials

Product no.:	41397
Lot no.:	BCCD0591
Description of CRM:	Liquid neat material
Expiry date:	JAN 2023
Storage:	2-8°C; storage under Argon
Chemical formula:	$C_{15}H_{23}NO$
Molecular mass:	233.35 g/mol
CAS No.:	35256-85-0



Sample	Certified value ± Expanded uncertainty, $U=k \cdot u$ (k=2.8)[1][2] as mass fraction (g/g)
Tebutam	**97.5 % ± 1.5 %**

Metrological traceability:	NIST PS1 (Benzoic acid)[3] Details see "Certification process details" on page 2.
Measurement method:	The certified value is established by high-resolution quantitative NMR measurements (qNMR).
Intended use:	Use this certified reference material (CRM) as calibrant for chromatography or any other analytical technique.
Minimum sample size:	There is no recommended minimum sample size. The substance is liquid at room-temperature and therefore homogeneous under these conditions. Potential inhomogeneity is covered by the expanded measurement uncertainty.
Instructions for handling and correct use:	The CRM should be stored in the original bottle. Warm to room temperature before opening. After use the bottle should be tightly closed and protected from excessive moisture and light. The CRM is potentially hygroscopic.
Accreditation:	Sigma-Aldrich Production GmbH is accredited by the Swiss accreditation authority SAS as registered reference material producer SRMS 0001 in accordance with ISO 17034 and registered testing laboratory STS 0490 according to ISO/IEC 17025.[4][5]
Certificate issue date:	25 JAN 2021

ISO 17034
SRMS 0001

ISO/IEC 17025
STS 0490

ISO 9001
005356 QM08

Dr. A. Rück – CRM Operations

Dr. P. Zell – Approving Officer

Health and safety information: Please refer to the Safety Data Sheet for detailed information about the nature of any hazard and appropriate precautions to be taken.

Packaging: Brown glass bottle

Starting material details: Potential raw materials are checked for suitability in terms of purity. Only materials of highest available purity are accepted. 2D-NMR (H-H COSY) measurements are applied to guarantee that no impurities underlie to a peak of interest. Detection limit usually is below 0.1%.

Compatibility of candidate substance with solvent and internal qNMR reference is checked (t=0 and t=24h comparison).

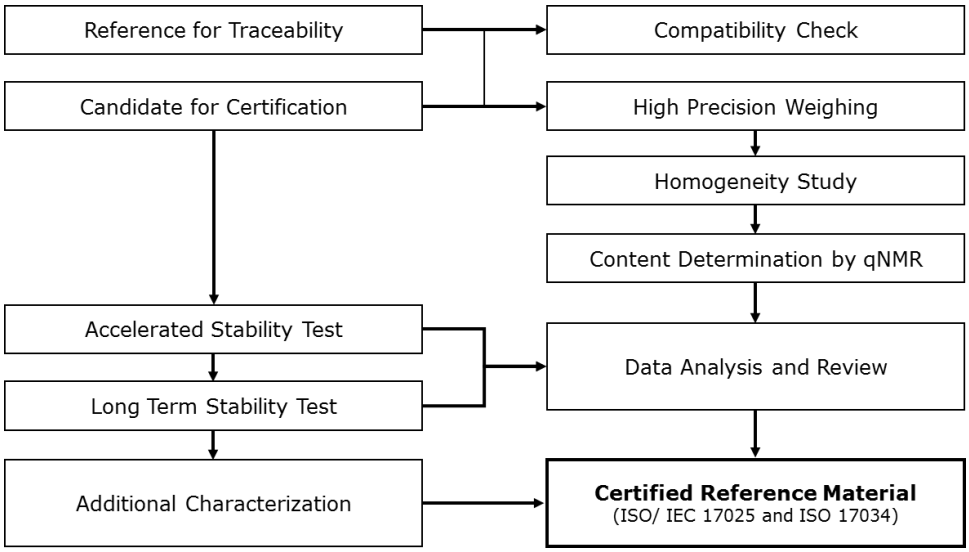
Certification process details:

In order to guarantee highest reliability of this *Trace***CERT** CRM a multi-component approach was applied whereby the certified value is determined by high-resolution quantitative NMR measurements (qNMR on a Bruker 600 MHz Avance III NMR spectrometer).[6] This certified value is determined under double accreditation in accordance with ISO/IEC 17025 and also ISO 17034. The certificate is designed in accordance with ISO Guide 31.[7]

The certified values are confirmed by extended analytical data including impurity determination. These data are not covered by the scope of accreditation but determined following best practices in analytical measurements. See "Indicative Values" for more details.

High precision weighing is performed under ISO/IEC 17025 accreditation with ultra-micro balances certified by DKD and calibrated with OIML Class E2 weights.

Absolute content determination by qNMR is performed using 4-5 separate samples of the candidate substance which are each spiked with an adequate amount of internal reference and then immediately dissolved in deuterated solvent. In most cases 16-32 scans are recorded for every sample with a ^{1}H relaxation time of d1= 60 seconds. Quantification of the candidate content is directly calculated from the ^{1}H-NMR peak areas and the initial weights of the candidate and reference substance. After ANOVA the resulting standard deviation is included into the uncertainty calculation of the certified value. Extensive stability and homogeneity tests are considered for certification.[8]



Homogeneity assessment: Homogeneity of the material is tested by qNMR measurements using 4-5 subsamples which are taken from different positions in the entire bulk material. The recommended minimal sample size is taken for all the homogeneity test samples. Analysis of variance (ANOVA) results are included into the calculation of content uncertainty of this CRM.

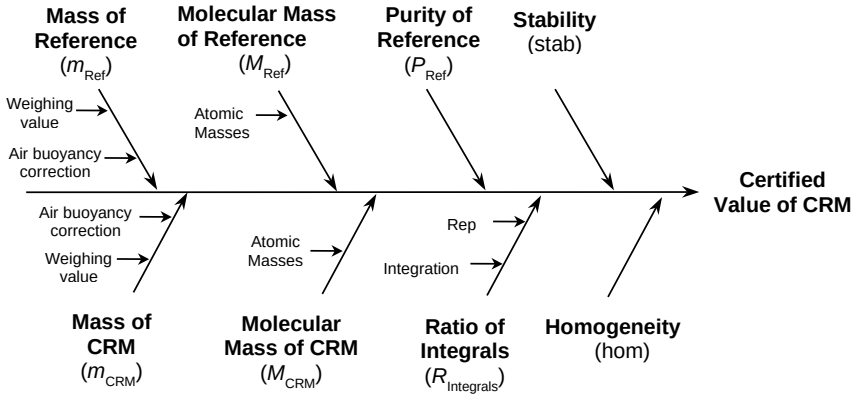
Stability assessment: An accelerated stability test is performed with samples which are stored above the recommended storage temperature. The material is tested by qNMR after 3, 6 and 18 months.
The long-term stability test is performed with samples which are stored at the recommended storage temperature and applying qNMR double determination at appropriate time intervals, e.g. 24 months.

Uncertainty evaluation:

The uncertainty contributions are illustrated by the following cause-effect diagram.

Typical relative contributions are:

$u(P_{Ref})$	< 0.10 %
$u(m_{Ref})$	< 0.05 %
$u(m_{CRM})$	< 0.05 %
$u(M_{Ref})$	< 0.003 %
$u(M_{CRM})$	< 0.003 %
$u(R_{Integrals})$	< 0.15 %
u_{hom}	< 0.05 %
u_{stab}	< 0.10 %

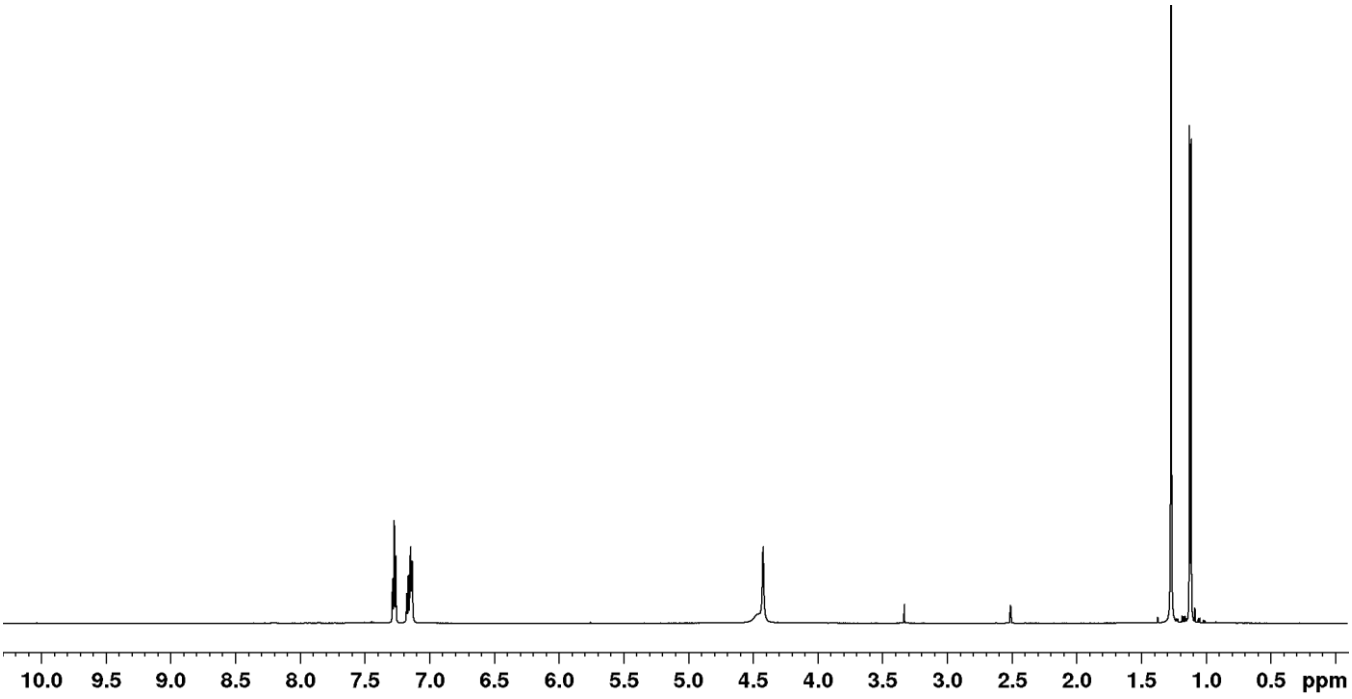


The combined standard uncertainty is calculated by combination of the standard uncertainties of the input estimates according to Eurachem/CITAC Guide "Quantifying Uncertainty in Analytical Measurement" and ISO 17034.[2][4]

Expanded uncertainty is then calculated to a confidence level of 95%, typically by multiplying with a confidence level factor of k=2.8.

Indicative values:

^{1}H-NMR Spectrum (600 MHz, Tebutam in DMSO-d6)



References:

[1] ISO Guide 35:2017, "Reference materials - Guidance for characterization and assessment of homogeneity and stability"
[2] Eurachem/CITAC Guide, 3rd Ed. (2012), "Quantifying uncertainty in analytical measurement"
[3] Eurachem/CITAC Guide, 2nd Ed. (2019), "Metrological traceability in chemical measurement"
[4] ISO 17034:2016, "General requirements for the competence of reference material producers"
[5] ISO/IEC 17025:2017, "General requirements for the competence of testing and calibration laboratories"
[6] Weber M, Hellriegel C, Rueck A, Sauermoser R, Wuethrich J, Accred. Qual. Assur. 18 (2013) 91-98
[7] ISO Guide 31:2015, "Reference materials - Contents of certificates, labels and accompanying documentation"
[8] Weber M, Hellriegel C, Rueck A, Wuethrich J, Jenks P, JPBA 93 (2014) 102-110

Certificate of analysis revision history:

Certificate version	Date	Reason for version
01	25 JAN 2021	Initial version

Disclaimer:

The purchaser must determine the suitability of this product for its particular use. Sigma-Aldrich Production GmbH makes no warranty of any kind, express or implied, other than its products meet all quality control standards set by Sigma-Aldrich Production GmbH. We do not guarantee that the product can be used for a special application.