Australian Government
Department of Industry, Science and Resources

National Measurement Institute

NATA
WORLD RECOGNISED ACCREDITATION

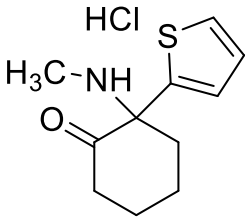
CERTIFIED REFERENCE MATERIAL CERTIFICATE OF ANALYSIS

NMIA D1095: Tilmetamine hydrochloride

Report ID: D1095.2026.01

Chemical Formula: $C_{11}H_{15}NOS{\cdot}HCl$

Molecular Weight: 245.8 g/mol (HCl), 209.1 g/mol (base)



Certified value

Batch No.	CAS No.	Purity (mass fraction)
26-D-03	3032479-25-4 (free base)	99.7 ± 1.4%

The uncertainty has been calculated according to ISO 33405 and is stated at the 95 % confidence limit (k = 2).

IUPAC name: 2-(Methylamino)-2-(2-thienyl)cyclohexanone.

Expiration of certification: The property values are valid till 4 August 2029, three years from the date of certification provided the **unopened** material is handled and stored in accordance with the recommendations below. The material as issued in the unopened container and stored as recommended below should be suitable for use beyond this date, subject to confirmation of batch stability from the issuing body. The expiry date/shelf life does not apply to sample bottles that have been opened. In such cases it is recommended that the end-user conduct their own in-house stability trials. The material will be re-tested periodically to ensure that the property values are still valid. In the event a product fails the stability trial, notification will be sent to all impacted customers.

Description: White powder prepared by synthesis and certified for identity and purity by NMI Australia. Packaged in amber glass bottles with a septum and crimped aluminium cap.

Intended use: This certified reference material is suitable for use as a primary calibrator.

Instructions for use: Equilibrate the bottled material to room temperature before opening.

Recommended storage: When not in use this material should be stored at or below 25 °C in a closed container in a dry, dark area.

Metrological traceability: The certified purity value is traceable to the SI unit for mass (kg) through Australian national standards via balance calibration. In the mass balance all impurities are quantified as a mass fraction and subtracted from 100 %.

Stability: In the absence of long-term stability data, the measurement uncertainty at the 95 % coverage interval has been expanded to accommodate any potential change in the property value. The stability component has been estimated from stability trials conducted on similar materials by NMI Australia over the last ten years. The measurement uncertainty at the 95 % confidence interval also includes a stability component determined from accelerated stability trials conducted at 40 °C and 75 % humidity for 14 days.

The long-term stability of the compound in solution has not been examined.

Homogeneity assessment: The homogeneity of the material was assessed using purity assay by GC-FID on ten randomly selected 1–2 mg sub samples of the material. The material was judged to be sufficiently homogeneous at this level of sampling as the variation in analysis results between samples was not significantly different at a 95 % confidence level from that observed on repeat analysis of the same sample.

Safety: Treat as a hazardous substance. Use appropriate work practices when handling to avoid skin or eye contact, ingestion or inhalation of dust. Refer to the provided safety data sheet.

S. R. Davies

Dr Stephen R. Davies,
Team Leader,
Chemical Reference Materials, NMI.
25 August 2026

NATA Accreditation No. 198 / Corporate Site No. 14214.

Legal notice: Terms and Conditions associated with the provision of this reference material can be found on the NMIA website.

Characterisation Report:

The identity was confirmed by a range of spectroscopic techniques, NMR, IR and MS. The certified purity value was obtained by mass balance from a combination of traditional analytical techniques, including GC-FID, thermogravimetric analysis, Karl Fischer analysis, and ^{1}H NMR spectroscopy. The purity value is calculated as per Equation 1.

$$\text{Purity} = (100\ \% - I_{ORG}) \times (100\ \% - I_{VOL} - I_{NVR}) \qquad \text{Equation 1}$$

I_{ORG} = Organic impurities of related structure, I_{VOL} = volatile impurities, I_{NVR} = non-volatile residue.

Supporting evidence is provided by elemental microanalysis and ^{1}H NMR spectroscopy.

GC-FID:	Instrument:	Agilent 8890
	Column:	HP-5 (30 m × 0.32 mm I.D. × 0.25 μm)
	Program:	130°C (1 min), 5 °C/min to 200 °C and 20 °C/min to 300 °C (3 min).
	Injector:	200 °C
	Detector Temp:	320 °C
	Carrier:	Helium (2 mL/min)
	Split ratio:	20/1
	Relative mass fraction of the main component as the free base:	
	Initial analysis:	Mean = 99.9 %, s = 0.02 % (10 sub samples in duplicate, August 2026)
Karl Fischer analysis:		Moisture content < 0.2% mass fraction (July 2026)
Thermogravimetric analysis:		Non-volatile residue < 0.2% mass fraction (August 2026)

Spectroscopic and other characterisation data

GC-MS:	Instrument:	Agilent 6890/5973
	Column:	HP-5MS, 30 m × 0.25 mm I.D. × 0.25 μm
	Program:	130 °C (1 min), 5 °C/min to 220 °C, 20 °C/min to 300 °C (3 min)
	Injector:	200 °C
	Split ratio:	20/1
	Transfer line temp:	280 °C
	Carrier:	Helium, 1.0 mL/min
	Scan range:	50–300 *m/z*
	The retention time of tilmetamine free base is reported with the major peaks in the mass spectra. The latter are reported as mass/charge ratios and (in brackets) as a percentage relative to the base peak.	
	Parent (10.8 min):	181 (30), 152 (100), 148 (37), 123 (42), 110 (42), 97 (21) *m/z*
LC-MS:	Instrument:	Shimadzu LC-TQ-MS 8045
	Column:	X-bridge C18, 150 mm × 4.6 mm I.D. × 5 μm
	Column temp:	40 °C
	Solvent system:	A = 20 mM ammonium acetate (pH 10.8); B = Acetonitrile 0-10 min 35%B; 10-15 min 35-80%B; 15-20 min 80%B; 20-22 min 80-35%B ; 22-25 min 35%B
	Flow rate:	1.0 mL/min
	Sample prep:	10 μg/g in MeOH/MilliQ water (25:75)
	Injection volume:	10 μL
	Ionisation mode:	Electrospray positive ion
	Interface voltage:	4.0 kV
	The retention time of tilmetamine is reported with the major peak in the mass spectrum. The latter is reported as a mass/charge ratio.	
	6.6 min:	210 ($M+H^+$) *m/z*
TLC:	Conditions:	Kieselgel 60 F_{254}. TBME/diethyl ether/triethylamine (45:45:10, *v/v*) Single spot observed, R_f = 0.6. Visualisation with UV at 254 nm.
IR:	Instrument:	Bruker ALPHA II PLATINUM-ATR
	Range:	4000–400 cm^{-1}, neat
	Peaks:	3053, 2896, 2659, 2535, 2475, 2442, 1718, 1459, 1295, 742 cm^{-1}
^{1}H-NMR:	Instrument:	Bruker Avance III-500
	Field strength:	500 MHz
	Solvent:	D_2O (4.79 ppm)
	Spectral data:	δ 1.76 (1H, dddd, *J* = 4.1, 4.1, 13.4, 14.0 Hz), 1.94 (1H, dddd, *J* = 3.5, 3.5, 6.8, 14.1 Hz), 2.02 (1H, m), 2.09 (1H, m), 2.14 (1H, ddd, *J* = 4.2, 13.2, 14.2 Hz), 2.48 (3H, s), 2.56 (1H, dm, *J* = 14.5 Hz), 2.69 (1H, ddd, *J* = 6.4, 14.2, 15.2 Hz), 3.05 (1H, ddd, *J* = 3.0, 6.1, 13.7 Hz), 7.20-7.30 (2H, m), 7.76 (1H, dd, *J* = 2.8, 3.6 Hz) ppm Propan-2-ol was quantified at 0.2% mass fraction.
^{13}C-NMR:	Instrument:	Bruker Avance III-500
	Field strength:	126 MHz
	Solvent:	D_2O
	Spectral data:	δ 21.4, 26.3, 26.4, 34.2, 38.4, 69.0, 128.6, 130.0, 130.8, 132.6, 207.1 ppm
^{1}H NMR (free base):	Instrument:	Bruker Avance III-500
	Field strength:	500 MHz
	Solvent:	$CDCl_3$ (7.26 ppm)
	Spectral data:	δ 1.74 (1H, m), 1.84-1.91 (2H, m), 1.92-2.10 (2H, m), 2.14 (3H, s), 2.45-2.54 (2H, m), 2.67 (1H, ddd, *J* = 3.4, 6.4,14.0 Hz), 6.88 (1H, dd, *J* = 1.1, 3.6 Hz), 7.00 (1H, dd, *J* = 3.6, 5.1 Hz), 7.30 (1H, dd, *J* = 1.1, 5.1 Hz) ppm
^{13}C-NMR (free base):	Instrument:	Bruker Avance III-500
	Field strength:	126 MHz
	Solvent:	$CDCl_3$ (77.16 ppm)
	Spectral data:	δ 22.4, 27.2, 29.3, 38.3, 39.3, 67.9, 125.5, 126.1, 127.1, 144.9, 209.7 ppm
Melting point:		220 ℃ (decompose)
Microanalysis:	Found:	C = 53.9%; H = 6.9%; N = 5.6%; (July 2026)
	Calculated:	C = 53.8%; H = 6.6%; N = 5.7%; (Calculated for $C_{11}H_{15}NOS.HCl$)