Australian Government
Department of Industry, Science and Resources

National Measurement Institute

NATA
WORLD RECOGNISED ACCREDITATION

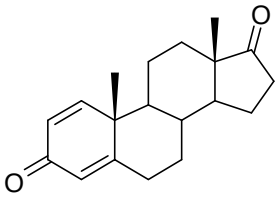
CERTIFIED REFERENCE MATERIAL CERTIFICATE OF ANALYSIS

NMIA D878: 1, 4-Androstadiene-3,17-dione

Report ID: D878.2023.01 (Ampouled 110412)

Chemical Formula: $C_{19}H_{24}O_2$

Molecular Weight: 284.4 g/mol



Certified value

Batch No.	CAS No.	Mass per ampoule
04-S-05	897-06-3	976 ± 15 µg

The uncertainty has been calculated according to ISO Guide 35 and is stated at the 95% confidence limit (k = 2).

IUPAC name: Androsta-1,4-diene-3,17-dione.

Expiration of certification: The property values are valid till 05 October 2028, i.e. five years from the date of re-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 ampoules that have been opened. In such cases it is recommended that the end-user conduct their own in-house stability trials.

Description: The compound is supplied as a dried aliquot in a sealed ampoule and is intended for a single use to prepare a standard solution containing D878. This material was prepared by sourced from an external supplier and certified for identity and purity by NMIA.

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

Instructions for use: Open the ampoule and carefully rinse the interior at least three times with a suitable organic solvent (e.g. chloroform). This will transfer 976 µg of anhydrous androsta-1,4-diene-3,17-dione.

Recommended storage: When not in use, this material should be stored at or below 4 ºC 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 approach all impurities are quantified as a mass fraction and subtracted from 100%.

Stability: This material has demonstrated stability over a minimum period of five years. The measurement uncertainty at the 95% confidence interval includes a stability component which has been estimated from annual stability trials. 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 seven randomly selected ampoules 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 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.
18 October 2023

This report supersedes any issued prior to 18 October 2023.

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:

GC-FID:	Instrument:	Varian CP 3800
	Column:	HP-5, 30 m × 0.32 mm. × 0.25 □m
	Program:	180 °C (1 min), 30 °C/min to 250 °C (10 min), 30 °C/min to 300 °C (3 min)
	Injector:	250 °C
	Detector Temp:	320 °C
	Carrier:	Helium
	Split ratio:	20/1
	Relative mass fraction of the main component:	
	Initial analysis:	Mean = 98.0%, s = 0.03% (7 ampoules in duplicate, April 2011)
	Re-analysis:	Mean = 98.0%, s = 0.2% (5 ampoules in duplicate, February 2014)
GC-FID:	Instrument:	Agilent 7890A
	Column:	HP-5, 30 m × 0.32 mm I.D. × 0.25 µm
	Program:	180 °C (1 min), 30 °C/min to 250 °C (10 min), 30 °C/min to 300 °C (3 min)
	Injector:	250 °C
	Detector Temp:	320 °C
	Carrier:	Helium
	Split ratio:	20/1
	Relative mass fraction of the main component:	
	Re-analysis:	Mean = 97.8%, s = 0.03% (5 ampoules in duplicate, February 2017)
	Re-analysis:	Mean = 97.7%, s = 0.09% (5 ampoules in duplicate, December 2019)
	Re-analysis:	Mean = 98.1%, s = 0.003% (5 ampoules in duplicate, October 2023)

The following analytical data was obtained on the bulk material subsequently used in the preparation of the ampoules.

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 and Karl Fischer analysis. The purity value is calculated as per Equation 1.

Purity = (100 % - I_{ORG}) x (100 % - I_{VOL} – I_{NVR}) Equation 1

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

Supporting evidence is provided by ^{1}H NMR, thermogravimetric analysis and elemental microanalysis.

GC-FID:	Instrument:	Varian CP 3800
	Column:	HP-5, 30 m × 0.32 mm. × 0.25 µm
	Program:	180 °C (1 min), 30 °C/min to 250 °C (10 min), 30 °C/min to 300 °C (3 min)
	Injector:	250 °C
	Detector Temp:	320 °C
	Carrier:	Helium
	Split ratio:	20/1
	Relative mass fraction of the main component:	
	Initial analysis:	Mean = 98.0%, s = 0.05% (5 sub samples in duplicate, September 2010)
GC-FID:	Instrument:	Agilent 6890N
	Column:	HP-1, 30 m × 0.32 mm I.D. × 0.25 µm
	Program:	180 °C (1 min), 40 °C/min to 250 °C (10 min), 40 °C/min to 300 °C (2 min)
	Injector:	250 °C
	Detector Temp:	320 °C
	Carrier:	Helium
	Split ratio:	20/1
	Relative mass fraction of the main component:	
	Initial analysis:	Mean = 98.0%, s = 0.04% (10 sub samples in duplicate, September 2004)
	Re-analysis:	Mean = 98.0%, s = 0.04% (5 sub samples in duplicate, September 2007)
Thermogravimetric analysis:		Volatile content < 0.1% and non volatile residue < 0.2 % mass fraction (April 2004 & August 2006)
Karl Fischer analysis:		Moisture content 0.32% mass fraction (September 2007) Moisture content 0.21% mass fraction (September 2010)

Spectroscopic and other characterisation data

GC-MS:	Parent compound:	
	Instrument:	Agilent 6890/5973
	Column:	Zebron ZB-5, 30 m x 0.25 mm I.D. x 0.30µm
	Program:	220 °C (1 min), 10 °C/min to 300 °C (5 min)
	Injector:	220 °C
	Transfer line temp:	280 °C
	Carrier:	Helium, 1.0 mL/min
	Split ratio:	20/1
	Bis-TMS derivative:	
	Instrument:	Agilent 6890/5973
	Column:	HP Ultra 1, 17 m × 0.22 mm I.D. × 0.11 µm
	Program:	187 °C (0.2 min), 3 °C/min to 238 °C, 10 °C/min to 265 °C, 30 °C/min to 310 °C (2 min)
	Injector:	250 °C
	Transfer line temp:	300 °C
	Carrier:	Helium, 1.0 mL/min
	Split ratio:	12/1
	The retention times of the parent compound and *bis*-TMS derivative are reported along 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 (9.47 min):	284 (M+, 6), 159 (13), 122, (100), 107 (10), 91, (21), 67 (5), 55 (6) *m/z*
	Bis-TMS (11.1 min):	428 (M+, 63), 413 (19), 323 (14), 229 (15), 206 (65), 191 (17), 181 (35), 73 (100) *m/z*
TLC:	Conditions:	Kieselgel 60F_{254}. Hexane/ethyl acetate (4/1) Single spot observed, R_f = 0.25. Visualisation with UV at 254 nm
IR:	Instrument:	Biorad FTS300MX FT-IR
	Range:	4000-400cm^{-1}, KBr pellet
	Peaks:	2934, 2844, 1741, 1655, 1621, 1602, 1448, 1404, 1376, 1295, 1241, 1158, 1088, 1006, 935, 894, 707 cm^{-1}
^{1}H NMR:	Instrument:	Bruker DMX-600
	Field strength:	600 MHz
	Solvent:	$CDCl_3$ (7.26 ppm)
	Spectral data:	δ 0.94 (3H, s), 1.08-1.16 (2H, m), 1.23-1.31 (2H, m), 1.25 (3H, s), 1.58 (1H, m), 1.69 (1H, m), 1.76-1.89 (3H, m), 1.96 (1H, m), 2.04-2.13 (2H, m), 2.39-2.54 (3H, m), 6.08 (1H, s), 6.23 (1H, dd, *J* = 10.1, 1.6 Hz), 7.04 (1H, d, *J* = 10.1 Hz) ppm
^{13}C NMR:	Instrument:	Bruker DMX-600
	Field strength:	151 MHz
	Solvent:	$CDCl_3$ (77.2 ppm)
	Spectral data:	δ 13.8, 18.7, 21.9, 22.0, 31.1, 32.3, 32.5, 35.1, 35.6, 43.4, 47.6, 50.4, 52.2, 124.1, 127.7, 155.2, 168.2, 186.1, 219.9 ppm
Melting point:		140-141 °C
Microanalysis:	Found:	C = 80.4%, H = 8.4% (September, 2004)
	Calculated:	C = 80.2%, H = 8.5% (Calculated for $C_{19}H_{24}O_2$)