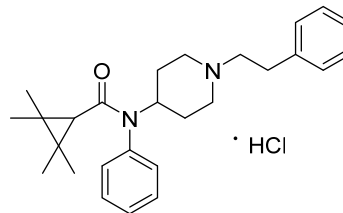


CERTIFICATE OF ANALYSIS



2,2,3,3-tetramethyl-Cyclopropyl fentanyl (hydrochloride)

Item #: 22744
 Batch #: 0549997
 CAS Registry Number: N/A
 Expiry Date: 06FEB2025 (valid from date of certification)
 Description: neat solid
 Storage and Handling: Unopened at -20°C. Warm to room temperature prior to opening.
 Safety: Poison



ISO/IEC 17025
 #AT-1773
 ISO Guide 34
 #AR-1774



Intended Use: For analytical testing purposes. Not intended for human or animal use.

Instructions for Use: Once opened this material should be minimally exposed to ambient conditions and returned to recommended storage conditions immediately after use. Ongoing stability testing supports a negligible decrease in purity over a series of thaw-refreeze cycles. It is recommended that laboratories perform periodic testing to verify the material remains fit for the intended use.

Compound Information

Chemical Formula	C ₂₇ H ₃₆ N ₂ O • HCl
Formula Weight	441.1 amu
UV λ _{max}	204 nm

Quality Information

Qualifier	Method	Result
Appearance	Visual inspection	White solid
Chromatographic Purity, HPLC	Cayman Method TST SD139	99.65% ± 0.18%
Identity, LCMS	Cayman Method TST SD13, +ESI	405.2 amu
Identity, GCMS	Cayman Method TST SD12	Conforms
FTIR	USP<851> (diamond ATR)	Conforms
% LOD	Cayman Method TST SD24	0.50% ± 0.49%
% ROI	Cayman Method TST SD06	<0.10% ± 0.21%
*Identity, NMR	¹ H NMR	Conforms

*NMR and optical rotation data are provided as supplemental information but is not within scope of ISO accreditation. Property values are traceable to SI units through an unbroken chain of measurements.

Measurement Uncertainty

All measurement uncertainties are expressed as expanded uncertainties in accordance with ISO 17025 and Guide 34 at the approximate 95% confidence interval using the appropriate coverage factor. Where applicable, optical rotation, chiral purity, and/or isotopic purity testing are performed to support the identification of the reference material, therefore the uncertainty is considered null.

Approval: Title: Cayman Chemical ISO Quality Manager Certification Date: 06FEB2019

Cayman Chemical certifies that this standard meets the specifications stated in this certificate and warrants this product to meet the stated acceptance criteria through the expiration date when stored unopened as recommended.

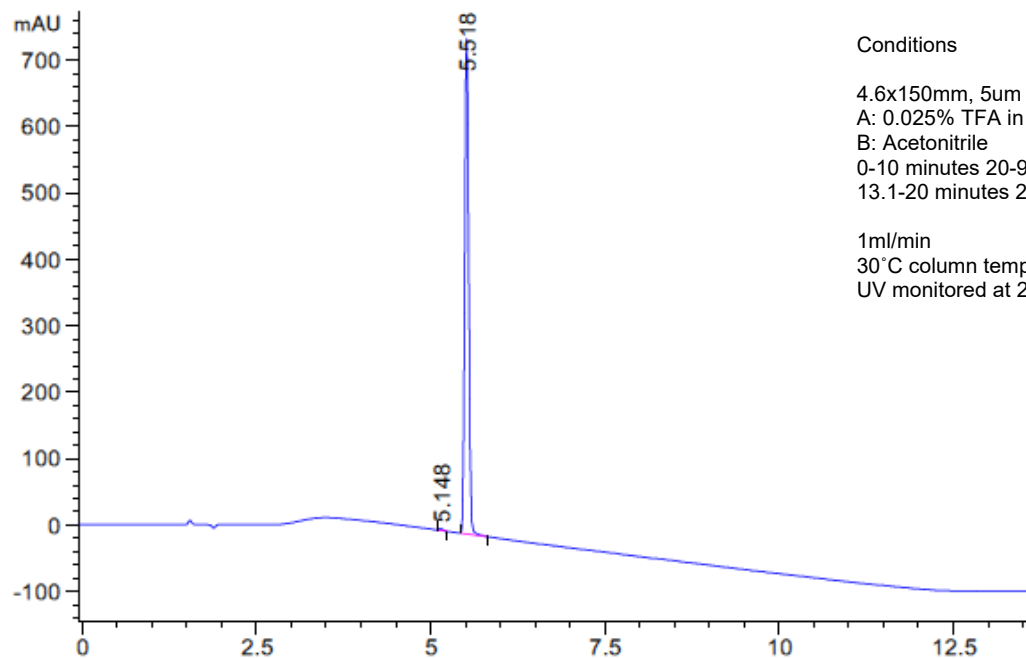
CERTIFICATE OF ANALYSIS



Supplemental Data

HPLC-UV

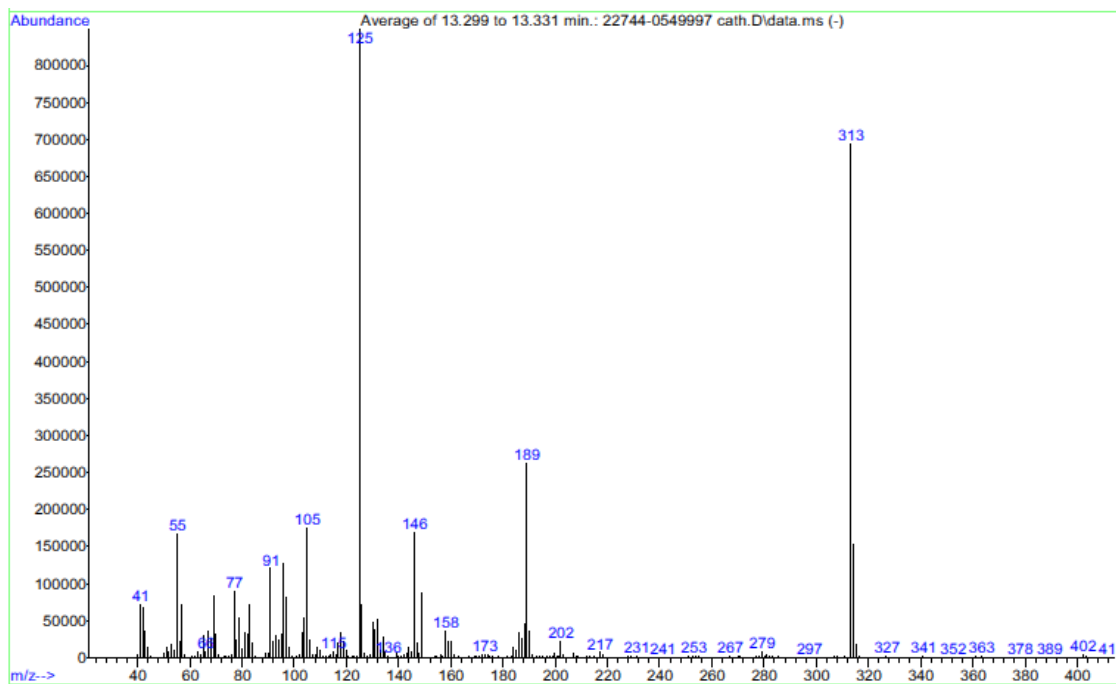
DAD1 B, Sig=210,8 Ref=450,16 (C:\CAYMAN\...549997 PUR\22744-0549997 PUR 2019-0



Conditions

4.6x150mm, 5um Zorbax RP Bonus column
A: 0.025% TFA in H₂O
B: Acetonitrile
0-10 minutes 20-95% B, 10-13 minutes 95% B,
13.1-20 minutes 20% B
1ml/min
30°C column temp
UV monitored at 210 nm

GC-MS



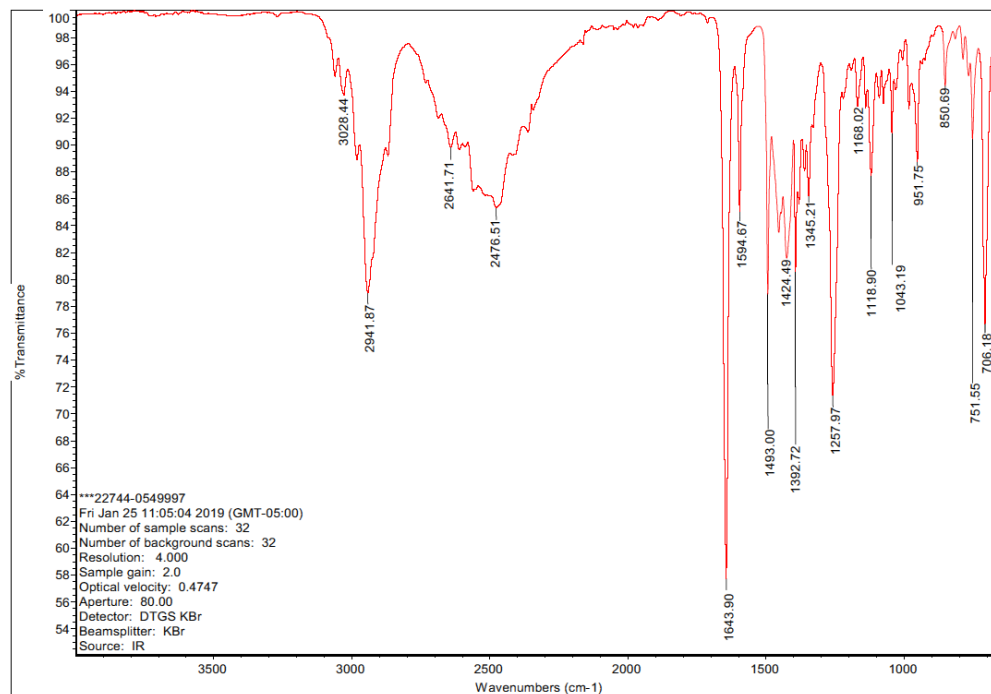
Conditions

Agilent 6890 GC/
5973 MSD
30m x 0.32mm, 0.5um
Rtx-5MS column
He carrier gas;
Flow: 2mL/min
Inlet temp: 300°C
15:1 split
Oven Program:
50°C for 1 minute,
ramp to 300°C at
30°C / minute, hold at
300°C to 15 minutes
Transfer line temp:
300°C
70ev EI MS
40-600 m/z
Apex spectrum -
background
(1 minute window in
front of peak)
Tune File: stune

CERTIFICATE OF ANALYSIS



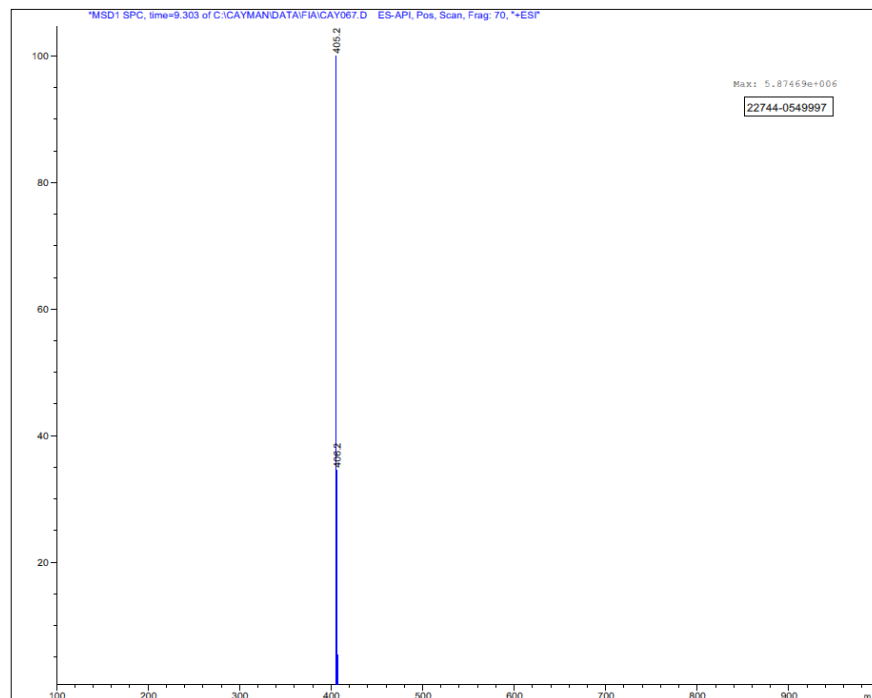
FTIR



Conditions

Thermo Nicolet iS10 FTIR /
 Diamond SmartATR (single bounce)
 32 scans / 32 background scans
 Range: 650-4000cm⁻¹
 Resolution: 4.000
 ATR and background corrected

ESI-MS



Conditions

Agilent 1260 HPLC /
 G6125MSD
 FIA-MS (no column)
 Mobile phase: 50:50:0.1
 MeOH/H₂O/Acetic Acid
 Flow: 0.5mL/min
 +ESI 100-1000m/z range
 Nebulizer: 60psi
 Desolvation Gas: 13L/min
 Desolvation Temp: 350°C
 Electrospray Voltage: 4kV
 MS collected across peak
 width at half height

CERTIFICATE OF ANALYSIS



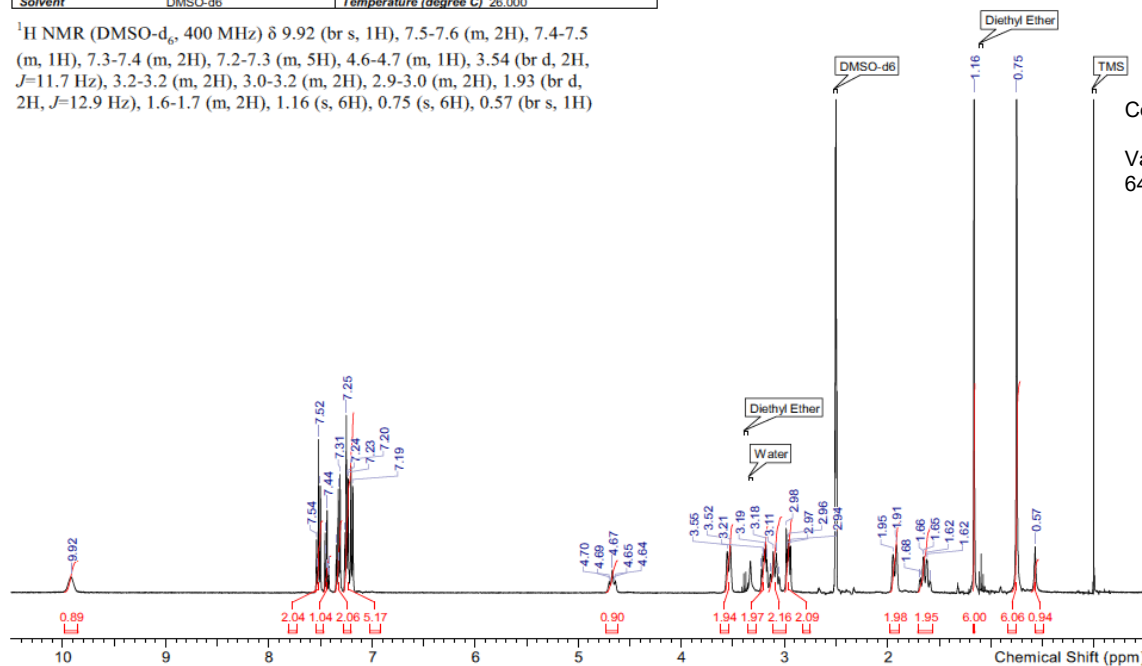
NMR **not within scope of ISO 17025/Guide 34 accreditation*

Date	Jan 18 2019		
File Name	\\sulfur\private\nmrdata\ 2019\22744-0549997_20190118_ \22744-0549997_20190118_01\22744-0549997_20190118_001.fid\fid		
Frequency (MHz)	399.9680	Nucleus	1H
Solvent	DMSO-d6	Temperature (degree C)	26.000
		Number of Transients	32

¹H NMR (DMSO-d₆, 400 MHz) δ 9.92 (br s, 1H), 7.5-7.6 (m, 2H), 7.4-7.5 (m, 1H), 7.3-7.4 (m, 2H), 7.2-7.3 (m, 5H), 4.6-4.7 (m, 1H), 3.54 (br d, 2H, J=11.7 Hz), 3.2-3.2 (m, 2H), 3.0-3.2 (m, 2H), 2.9-3.0 (m, 2H), 1.93 (br d, 2H, J=12.9 Hz), 1.6-1.7 (m, 2H), 1.16 (s, 6H), 0.75 (s, 6H), 0.57 (br s, 1H)

Conditions

Varian Inova 400MHz NMR
64 scans



Homogeneity

A minimum sample size of 1.0 μg was used to determine homogeneity of the bulk solid. The recommended minimum quantity for use is 1.0 μg. Quantities below this have not been evaluated.

Short Term Stability Summary

No decrease in purity was observed at ambient conditions or 60°C after two weeks. This data supports shipping of this product at ambient temperature.

Long Term Stability

Long term stability data predicts 6 years stability at the -20°C storage temperature.

CERTIFICATE OF ANALYSIS



Revision History

Revision #	Date	Reason for Revision
01	06FEB2019	Initial version

Disclaimers

Material Safety Data

This material should be considered hazardous until information to the contrary becomes available. Do not ingest, swallow, or inhale. Do not get in eyes, on skin, or on clothing. Wash thoroughly after handling. This information contains some but not all of the information required for the safe and proper use of this material. Before use, review the complete Material Safety Data Sheet, which has been sent via email to your institution.

Warranty and Limitation of Remedy

Cayman Chemical Company makes no warranty or guarantee of any kind, whether written or oral, expressed or implied, including without limitation, any warranty of fitness for a particular purpose, suitability and merchantability, which extends beyond the description of the chemicals hereof. Cayman warrants only to the original customer that the material will meet our specifications at the time of delivery.

Cayman will carry out its delivery obligations with due care and skill. Thus, in no event will Cayman have any obligation or liability, whether in tort (including negligence) or in contract, for any direct, indirect, incidental or consequential damages, even if Cayman is informed about their possible existence.

This limitation of liability does not apply in the case of intentional acts or negligence of Cayman, its directors or its employees.

Buyer's exclusive remedy and Cayman's sole liability hereunder shall be limited to a refund of the purchase price, or at Cayman's option, the replacement, at no cost to Buyer, of all material that does not meet our specification.

Said refund or replacement is conditioned on Buyer giving written notice to Cayman within thirty (30) days after arrival of the material at its destination. Failure of Buyer to give said notice within thirty (30) days shall constitute a waiver of Buyer of all claims hereunder with respect to said material.

For further details, please refer to our Warranty and Limitations of Remedy located on our website and in our catalog.

This Certificate shall not be reproduced except in full, without written approval from the Cayman Chemical ISO Quality Manager

ISO CRT SD01 v 2.0



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