Dynamic

Certificate of Analysis

Reference Material

Product name
Tramadol EP Impurity B (as Hydrochloride)

IUPAC / Chemical name
1-[2-(3-methoxyphenyl)cyclohexen-1-yl]-N,N-dimethylmethanamine;hydrochloride

Catalogue number
CD3007.13

Long-term storage
+5°C, dark and dry (hygroscopic)

CAS number
66170-32-9

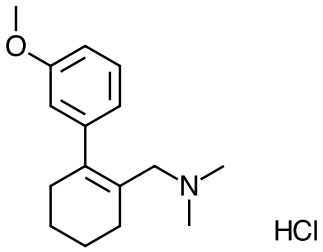
Shipping conditions
Room Temperature

Appearance
White, Solid

Lot number
XXVI-VIII00444

Molecular weight
281.82 g/mol

Molecular formula
$C_{16}H_{23}NO.ClH$



Analytical Information

Test description		Specifications	Results
Identity	(^{1}H, ^{13}C) NMR	Conforms to Structure	Structure confirmed
	FTIR	Conforms to Structure	Structure confirmed
	HRMS	Conforms to Structure	Structure confirmed
Purity	HPLC (210 nm)	>95%	99.97%
Others	Elemental Analysis (EA)	Conforms	Conforms
	TGA	Volatiles %	2.963%
Assay (Mass Balance)	100% - Formula	>90%	97.01%

Release date 08/2026

Retest date 08/2027

Prepared by
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Approved by
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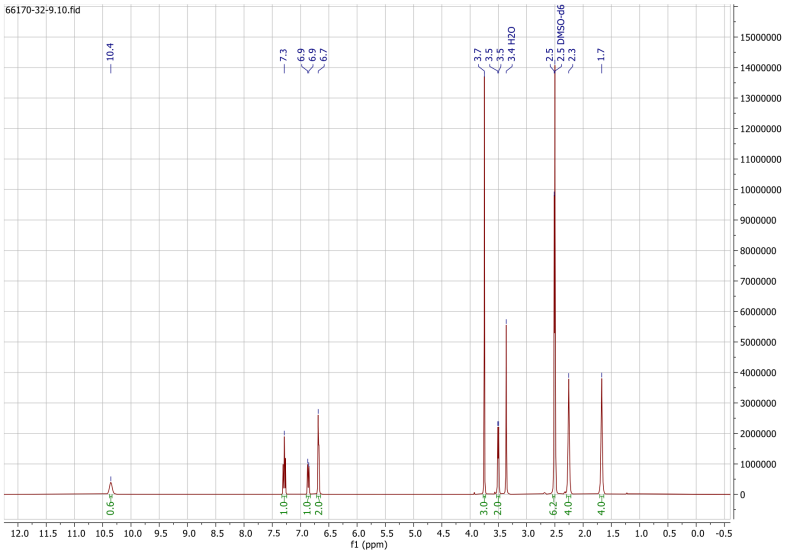
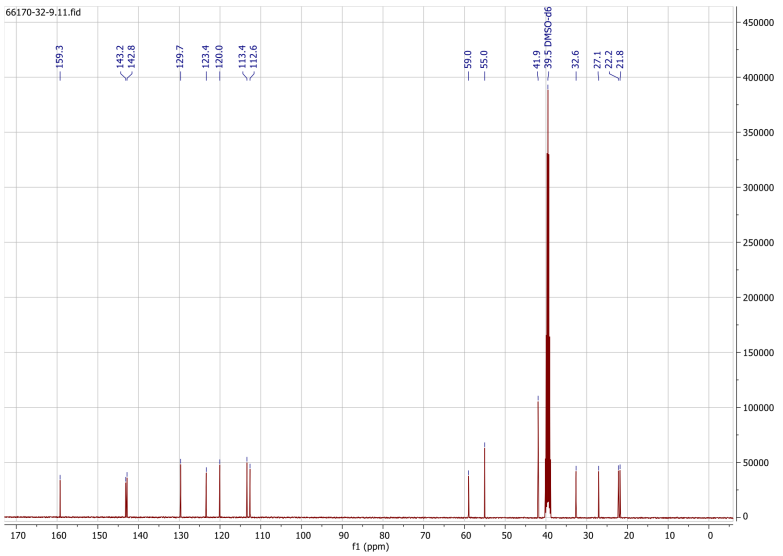
Identity Assessment

The structure of the Tramadol EP Impurity B (as Hydrochloride) sample under analysis was confirmed by (^{1}H, ^{13}C) NMR, FTIR and HRMS.

(^{1}H, ^{13}C) NMR

Equipment	Bruker Avance Neo 400 MHz Nuclear Magnetic Resonance Spectrometer
^{1}H and ^{13}C NMR conditions	400 MHz, DMSO-d_6



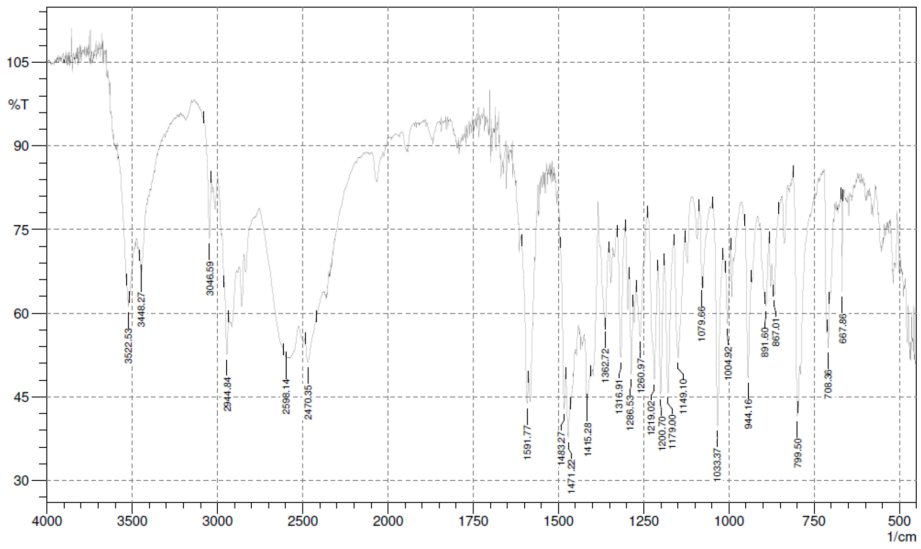


Remarks

The obtained ^{1}H and ^{13}C NMR spectra are in agreement with the proposed structure.

FTIR

Description	Shimadzu IRPrestige-21 instrument (KBr Tablet)
Spectral Range	4000-450 cm^{-1}
Number of scans	4

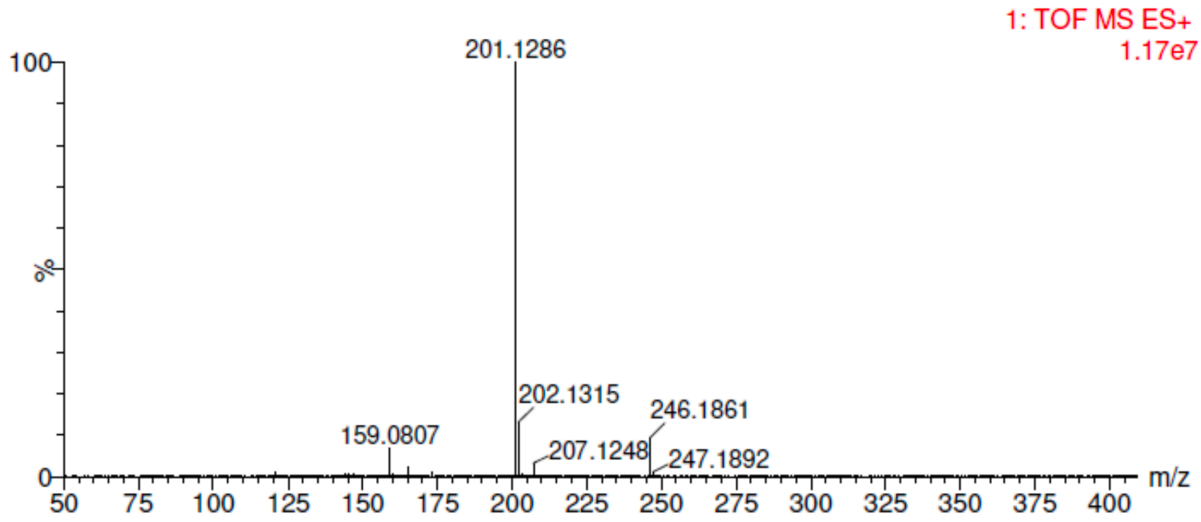


No.	Position	Intensity
1	3522.53	61.13
2	2944.84	52.59
3	2598.14	52.06
4	2470.35	51.16
5	1591.77	43.83
6	1471.22	37.67
7	1415.28	44.39
8	1316.91	52.09
9	1286.53	49.04
10	1179.00	45.71
11	1033.37	39.81
12	944.16	48.37
13	799.5	41.52
14	708.36	53.80

Remarks
The bands observed in the FTIR spectrum are compatible with the functional groups present in the molecule.

HRMS

Equipment	Waters Synapt G2-Si Q-IMS-TOF mass spectrometer
Conditions	ESI+, Capillary 0.7 kV, Cone 40 V



Expected mass (m/z)	Observed monoisotopic mass (m/z)	For. Mol.	Ion type	Error (ppm)
246.1858	246.1861	$C_{16}H_{23}NO$	[M + H]+	1.2

Remarks

HRMS data is consistent with the proposed structure. An additional ion at m/z 201.1286 was observed, tentatively assigned to an in-source fragmentation product arising from loss of the dimethylamino group, affording the corresponding $[M-NMe_2]^+$ carbocation.

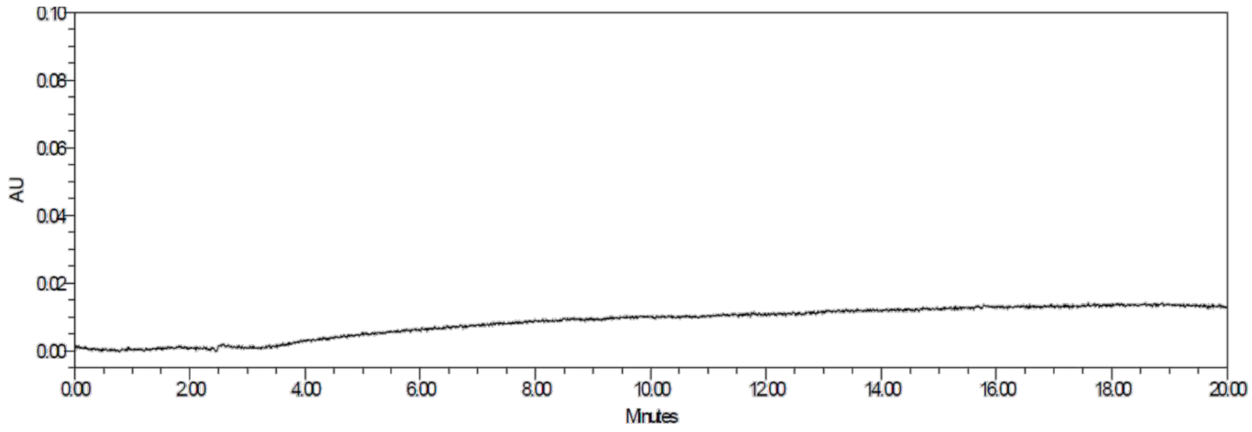
Purity Confirmation

The purity of the analyte was confirmed by HPLC (210 nm).

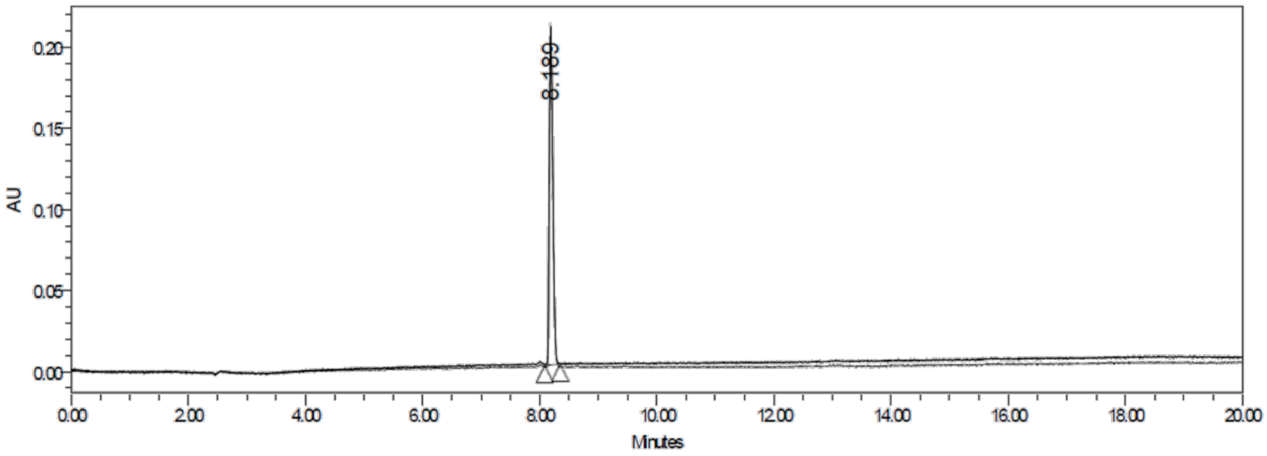
HPLC (210 nm)

Sample Preparation	2.31 mg/mL in water with 5% MeCN/0.1% H_3PO_4
Column	Apollo C18 150x4.6 mm, 5 µm
Column Temperature	40 °C
Detector	DAD, 210 nm
Injection Volume	10 µL
Flow rate	1 mL/min
Mobile Phase A	Water + 0.1% H_3PO_4
Mobile Phase B	Acetonitrile
Gradient Program	0–15 min linear gradient from 5% B to 95% B, 15–20 min isocratic 95% B, 20–23 min linear gradient to 5% B, 23–25 min isocratic 5% B.

Blank Chromatogram



Analyte Chromatogram



Sample name	RT (min)	Area (AU.min.)	% Area
Tramadol EP Impurity B (as Hydrochloride)	8.19	841269.8	99.97

Result (n=3)	**99.97%; SD= 0.00%**

Remarks
The HPLC purity by relative integration obtained for Tramadol EP Impurity B (as Hydrochloride) is 99.97%.

Others

This section encompasses a set of analytical techniques that support the analysis that were performed for identification and purity of the compound under evaluation.

Elemental Analysis (EA)

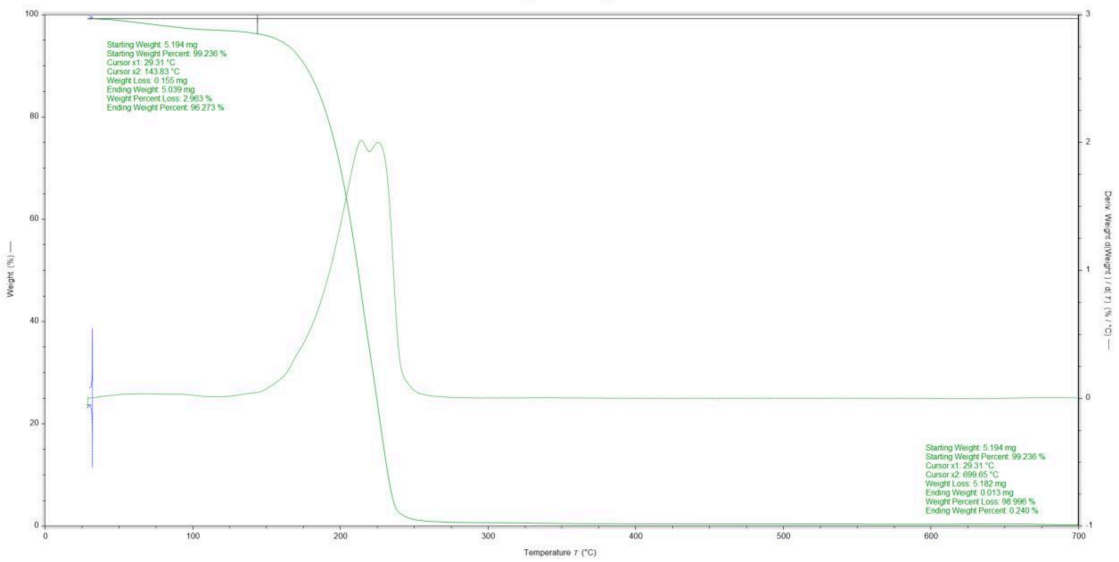
	% C	% H	% N
Calculated	68.2	8.58	4.97
Found	65.9	8.57	4.73

Remarks
Elemental analysis showed good agreement between the experimental and theoretical values for H and N. A deviation was observed in the carbon content, which may be associated with adsorbed moisture, consistent with the hygroscopic nature of the compound.

TGA

Thermogravimetric analysis (TGA) allows to calculate the Assay by Mass balance, using the 100% Formula.

TGA Conditions	
Equipment	Discovery TGA, TA Instruments
Temperature Range	25 - 700 °C: nitrogen atmosphere
Heating Rate	10 °C /min



Temperature interval °C	**Mass loss %**
29 - 144	2.963
145 - 700	96.033

Remarks
Thermogravimetric analysis (TGA) revealed an initial mass loss of 2.96% between 29 and 144 °C, consistent with the presence of adsorbed moisture and/or other volatile components. This was followed by a single major mass-loss event of 96.03%, corresponding to the main thermal decomposition of the sample, leaving negligible residual mass.

100% - Formula

The Mass Balance (100% Formula) has been applied to determine the assay value of the compound and was calculated using the following formula:

$$\text{Assay (\%)} = (100\,\% - \text{volatile contents (\%)}) \times \frac{\text{Purity (\%)}}{100}$$

Analytical technique	Result
HPLC	99.97
TGA	2.96
Assay (%)	97.01

Remarks
The mass balance of the compound was calculated to assign the assay value. HPLC analysis indicates a purity of 99.97% by relative integration. The volatile content determined by TGA (2.96%) was used to correct the final purity, resulting in a final assay of 97.01%.

Final Remarks
The structure of the compound was confirmed by $^{1}H/^{13}C$ NMR, FTIR, and HRMS. Chromatographic purity was determined by HPLC at 210 nm and was found to be 99.97% by relative peak integration. TGA analysis showed an initial mass loss of approximately 2.96%, consistent with the presence of adsorbed moisture and/or volatile components. The low residual mass observed at 700 °C is consistent with the absence of significant inorganic residues. The EA and TGA results are consistent with the hygroscopic nature of the material, with the deviation in carbon content potentially associated with moisture uptake. Taken together, these results support the structural assignment and high purity of the material.