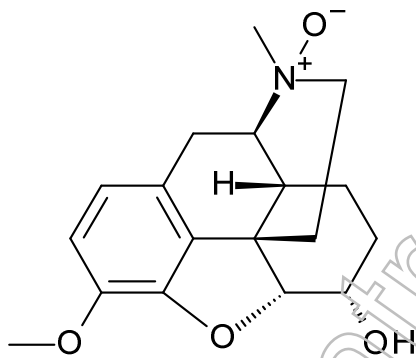




Certificate of Analysis

Reference Standard

Dihydrocodeine N-Oxide



Molecular Formula: $C_{18}H_{23}NO_4$
Molecular Weight: 317.38
CAS Number: [109667-32-5]

Catalogue Number: MM0812.08
Lot Number: 63462
Long-term Storage: 2 to 8 °C, dark
Appearance: white solid
Melting Point: 221 °C (dec.)
very hygroscopic
Assay 'as is': 96.9 %

Date of shipment: **2015-July-05**

This certificate is valid for one year from the date of shipment provided the substance is stored under the recommended conditions.



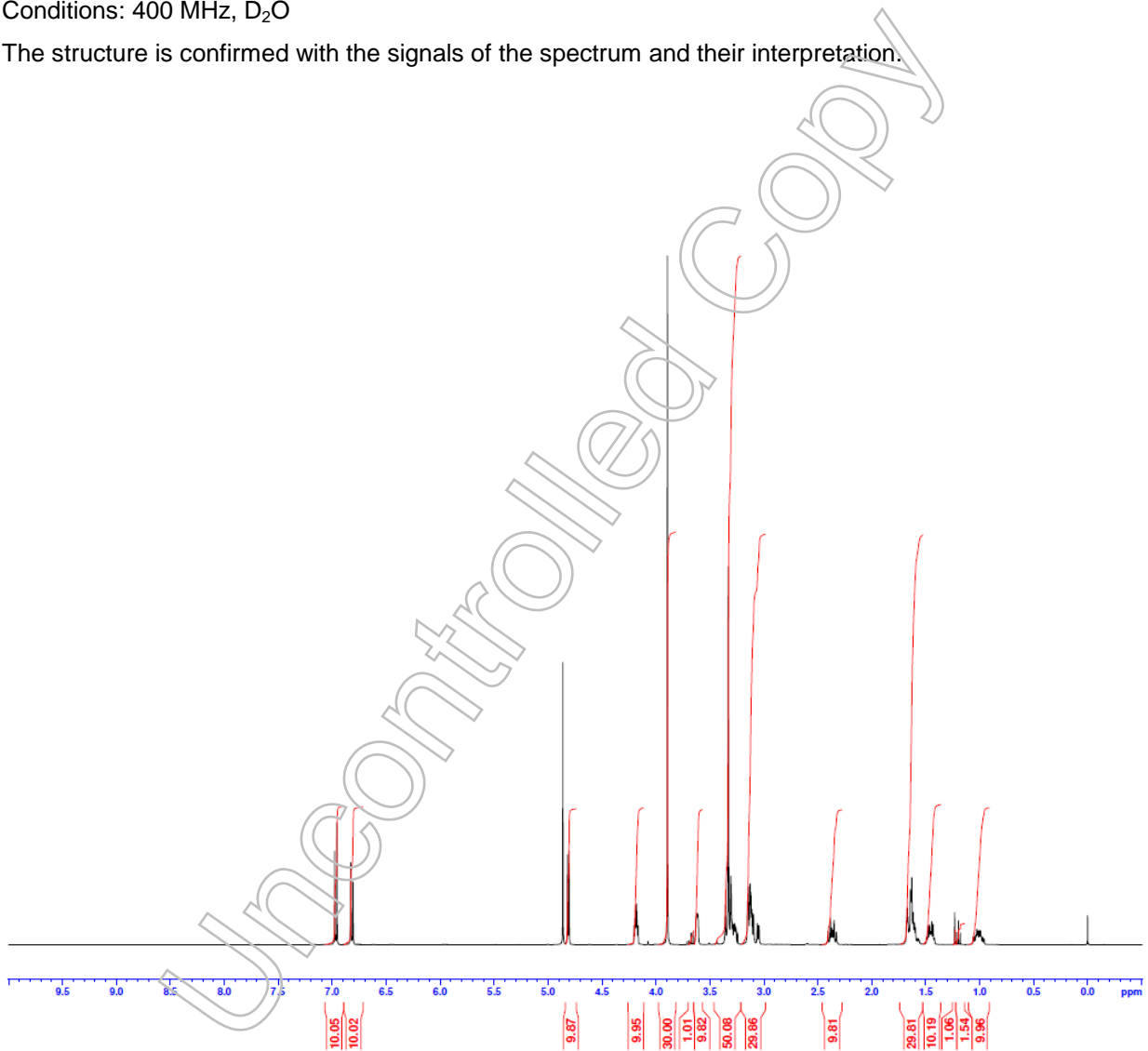
I. Identity

The identity of the reference substance was established by following analyses.

Ia. ¹H-NMR Spectrum

Conditions: 400 MHz, D₂O

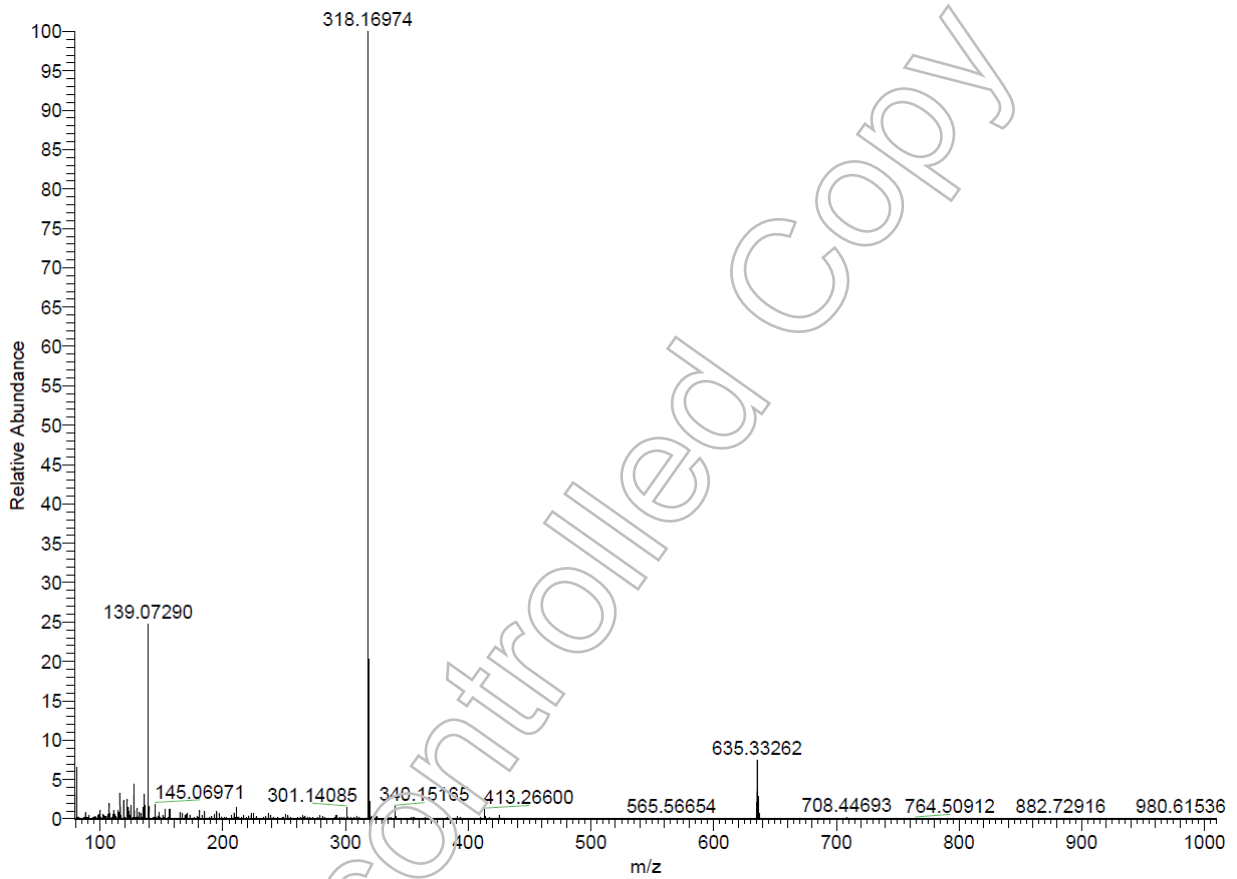
The structure is confirmed with the signals of the spectrum and their interpretation.





Ib. Mass Spectrum

Method: 3.0 kV ESI; capillary temperature: 320 °C



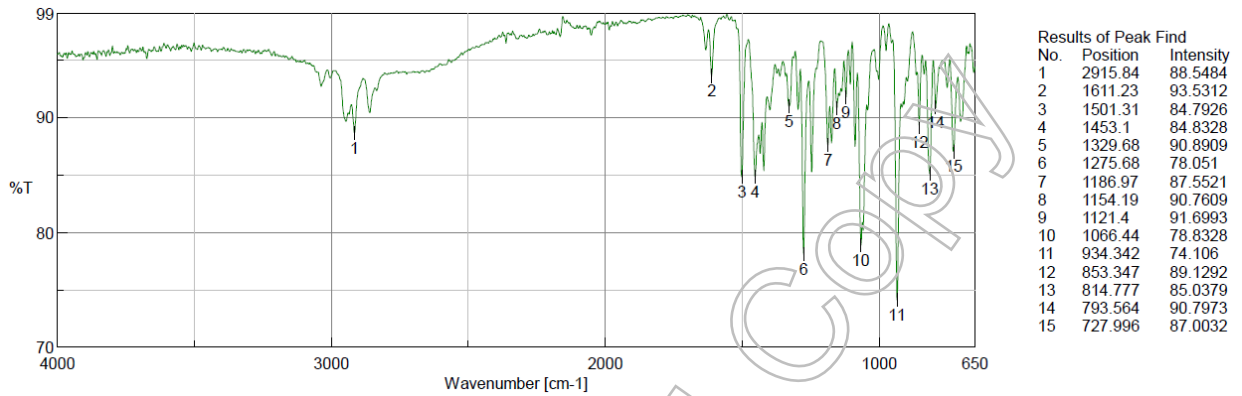
m/z	fragments
318	[MH]

The signals of the mass spectrum and their interpretation are consistent with the structural formula.



Ic. IR Spectrum

Method: Attenuated Total Reflection Fourier Transform Infrared (ATR-FTIR) Spectroscopy



The signals of the IR spectrum and their interpretation are consistent with the structural formula.

II. Purity

The purity of the reference substance was analysed by high performance liquid chromatography (HPLC).

HPLC Conditions:

Column:

Hypersil Gold C18
5 µm, 150 x 4.6 mm

Conditions:

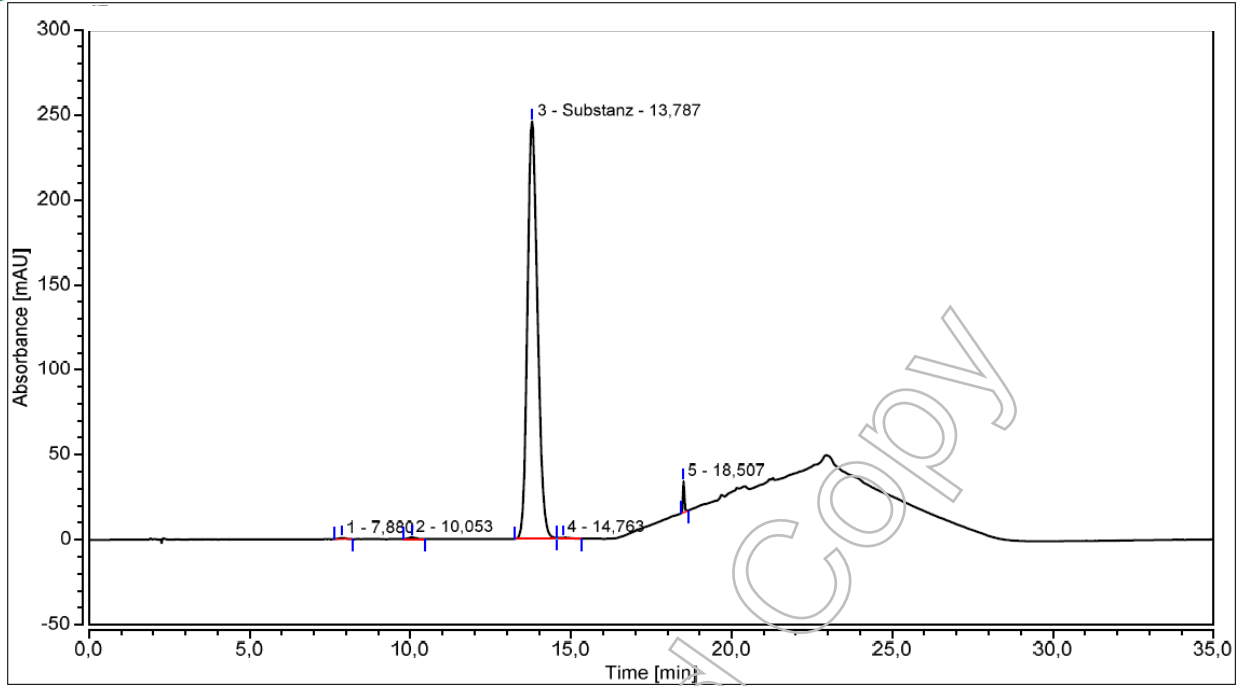
1.0 ml/min, 40 °C
0-13 min Water/Acetonitrile 97/3
13-16 min Water/Acetonitrile to 80/20
16-20 min Water/Acetonitrile to 60/40
20-25 min Water/Acetonitrile to 97/3
25-35 min Water/Acetonitrile 97/3 (v/v);
0.1 % H₃PO₄

Detector:

DAD
210 nm

Injector:

Auto
2.5 µl; 0.1096 mg/ml in
Water/Acetonitrile 50/50 (v/v)



Area Percent Report - Sorted by Signal

Pk #	Retention Time	Area	Area %
1	7.880	0.176	0.19
2	10.053	0.260	0.29
3	13.787	89.049	98.15
4	14.763	0.294	0.32
5	18.507	0.949	1.05
Totals		90.727	100.00

For the calculation the system peaks were ignored. The content of the analyte was determined as ratio of the peak area of the analyte and the cumulative areas of the purities, added up to 100 %.

Results:

Average 98.15 %
Number of results n=3
Standard deviation < 0.01 %



III. Water Content

Method: Karl Fischer titration

Results:

Average	0.19 %
Number of results	n=3
Standard deviation	0.03 %

IV. Residual Solvents

Method: ¹H-NMR

Result: 0.74 % Ethanol
0.33 % *tert*-Butyl methyl ether

V. Final Result

Total impurities (HPLC)	1.85 %
Water content	0.19 %
Residual solvents	1.07 %
Assay (100 % method) ¹	96.91 %

The assay is assessed to be 96.9 % 'as is'

The assay 'as is' is equivalent to the assay based on the not anhydrous and not dried substance respectively.

Release Date: 2014-11-13

LGC GmbH

Dr. Sabine Schröder
Product Release

¹ The calculation of the 100 % method follows the formula:

$$\text{Assay (\%)} = (100 \% - \text{KF} - \text{RES}) \times \frac{\text{Purity HPLC (\%)}}{100 \%}$$

Water (KF) and Residual solvents (RES) are considered as absolute contributions, HPLC purity is considered as relative contribution.