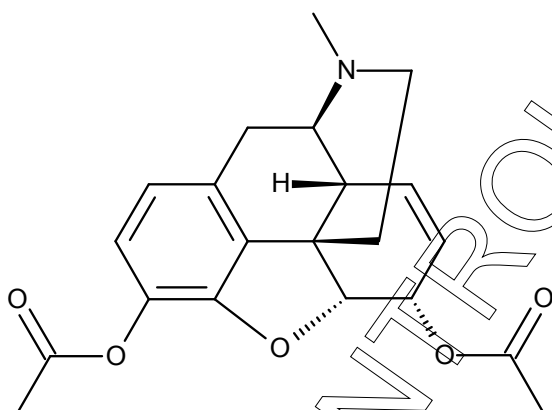




Certificate of Analysis

Primary Reference Standard

Heroin (Diacetylmorphine)



Molecular Formula: $C_{21}H_{23}NO_5$
Molecular Weight: 369.41
CAS Number: 561-27-3

Date of shipment: **2015-October-14**

Catalogue Number: LGCQUANT0037.17

Lot Number: 37246

Long-term Storage: 2 to 8 °C, dark

Appearance: white solid

Melting Point: 172 °C

Assay¹ 'as is': 99.7 %

Uncertainty² U: 0.6 %

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

¹ The value is based on the results of analytical techniques. Calibration and verification were carried out with standards traceable to SI-units. The value is expressed on an "as is" basis.
The identity is verified by data from international scientific literature.

² The uncertainty "U" is the expanded uncertainty estimated in accordance with the Guide to the Expression of Uncertainty in Measurement (GUM). It is corresponding to a level of confidence of about 95 %. Coverage factor $k = 2$.

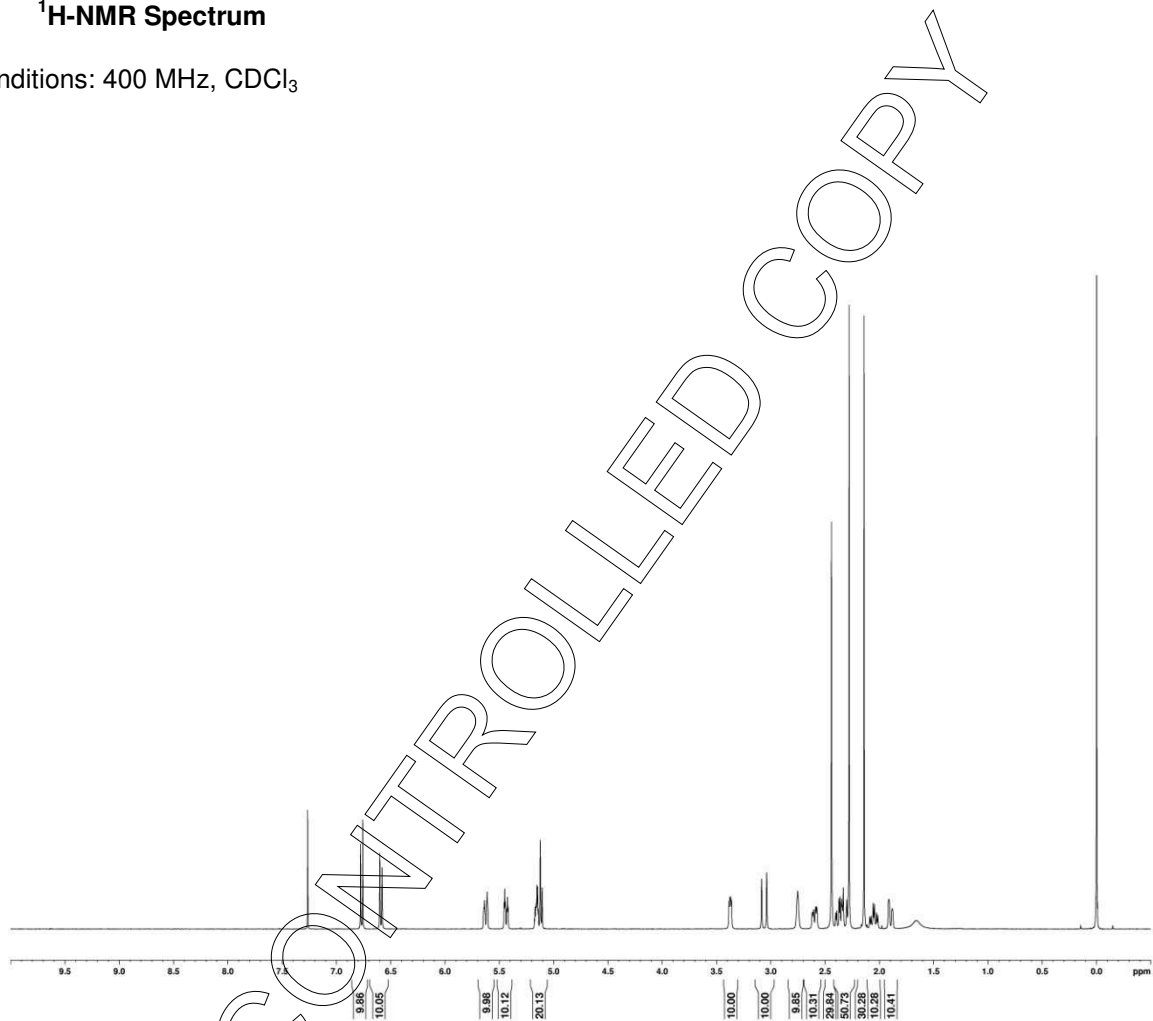


I. Identity

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

1a. ¹H-NMR Spectrum

Conditions: 400 MHz, CDCl₃

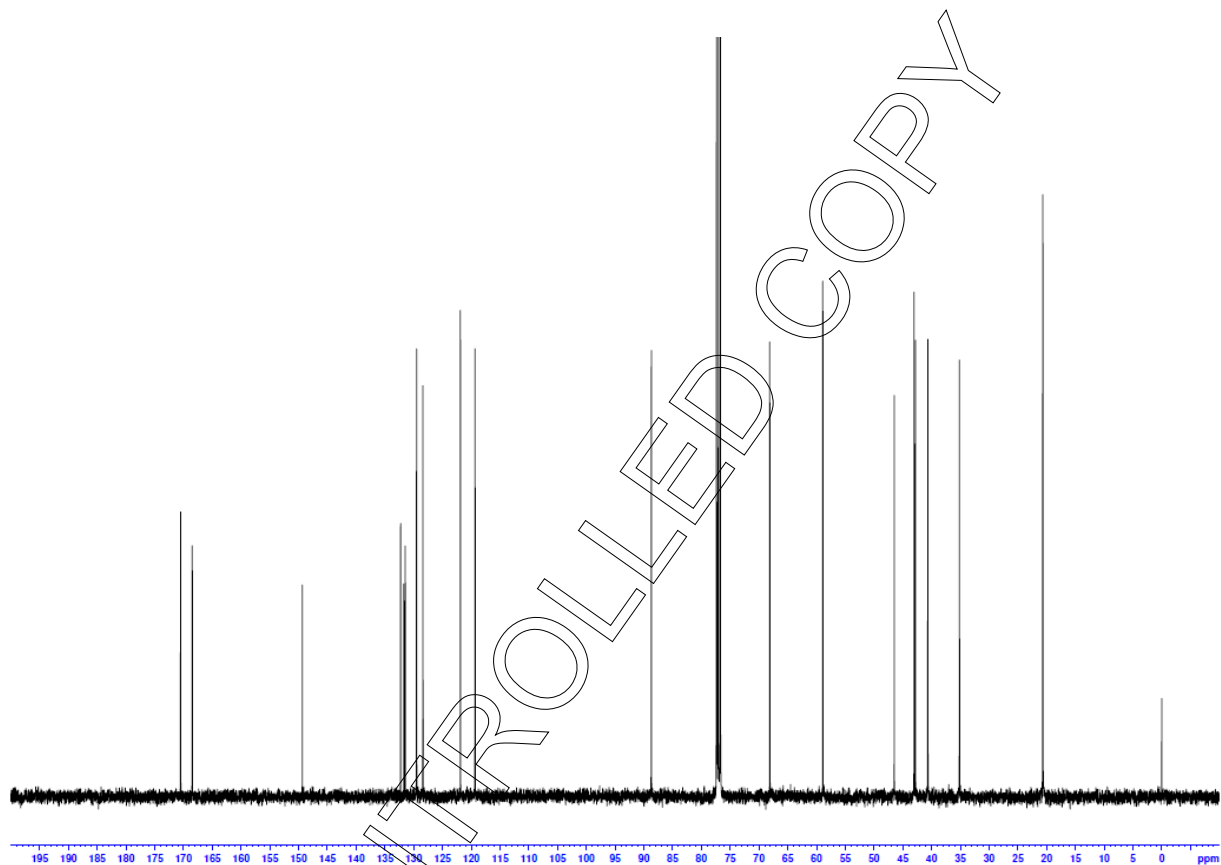


The structure is confirmed by the signals of the spectrum and their interpretation.



Ib. ^{13}C -NMR Spectrum

Conditions: 100 MHz, CDCl_3

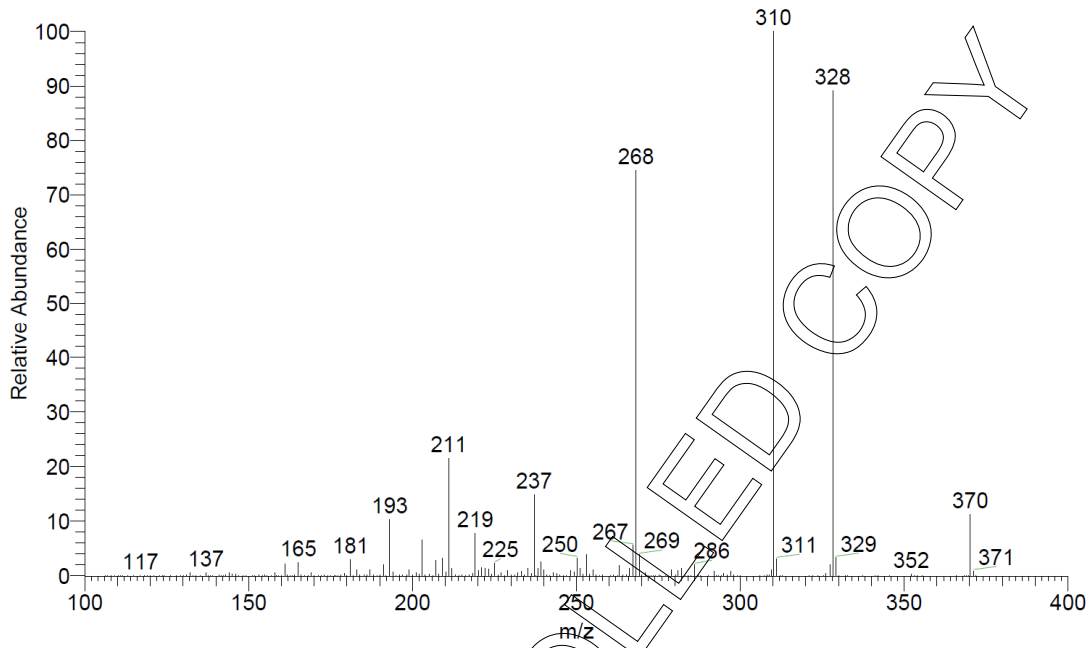


The structure is confirmed by the signals of the spectrum and their interpretation.



Ic. Mass Spectrum

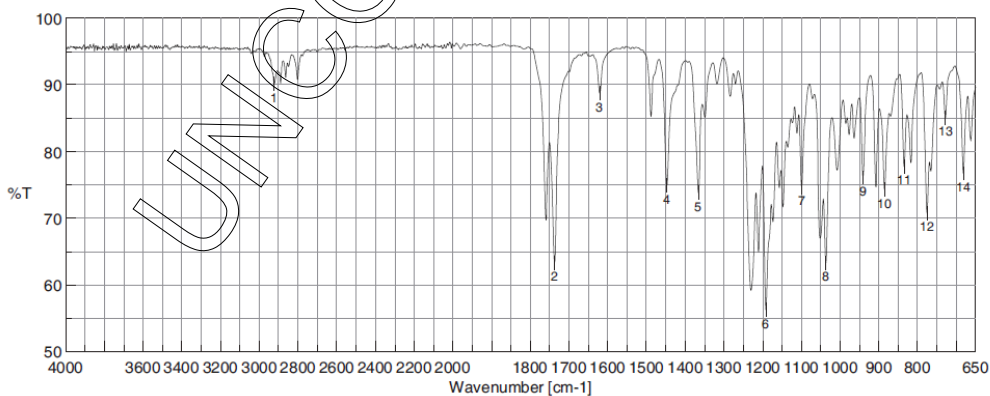
Method: 4.5 kV ESI+; vaporization temperature: 200 °C



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

Id. IR Spectrum

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



The signals of the IR spectrum and their interpretation are consistent with scientific literature.



Ie. Melting Point

Method: Capillary Method

Arithmetic mean (n=3): 172 °C

II. Purity

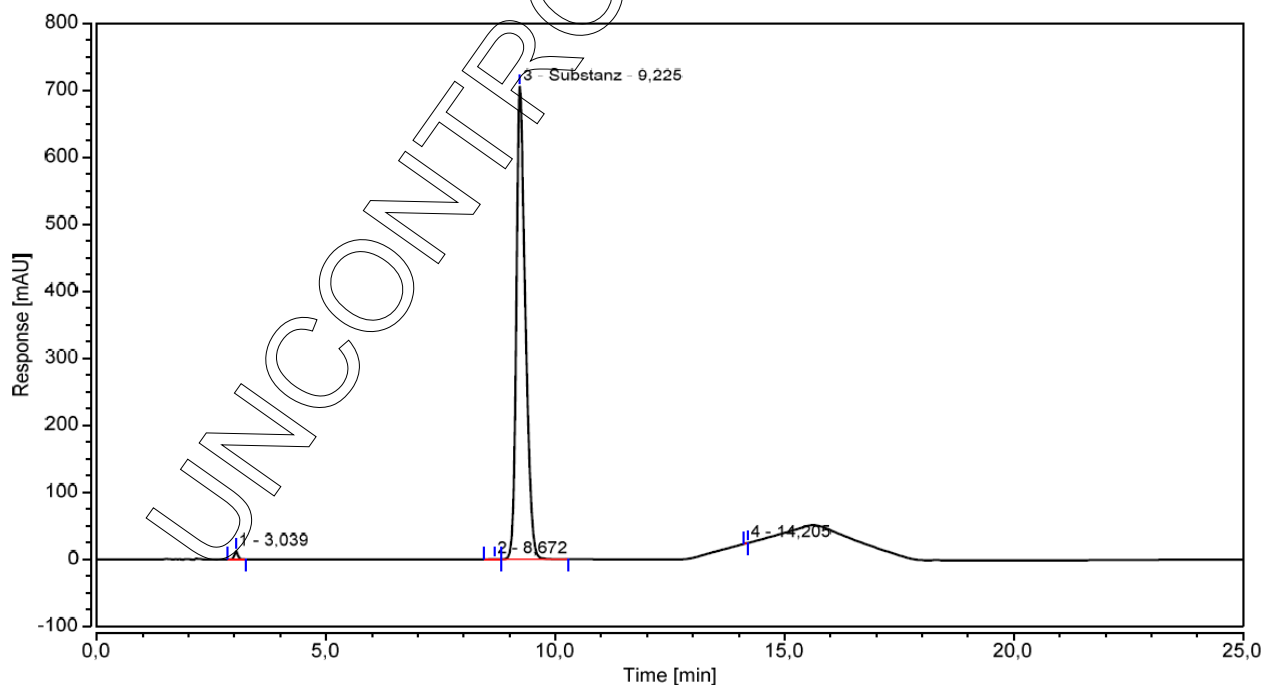
Ila. High Performance Liquid Chromatography (HPLC)

The purity of the reference material was determined by high performance liquid chromatography (HPLC).

HPLC Conditions^{*}:

Column:	Conditions:	Detector:	Injector:
Hypersil Gold C18	1.0 ml/min, 40 °C	DAD	Auto
5 µm, 150 x 4.6 mm	0-10 min Water/Acetonitrile 85/15	210 nm	3 µl; 0.1599 mg/ml in
	10-13 min Water/Acetonitrile to 50/50		Water
	13-15 min Water/Acetonitrile to 85/15		
	15-25 min Water/Acetonitrile 85/15 (v/v);		
	0.1 % H ₃ PO ₄		

* not accredited testing method





Area Percent Report - Sorted by Signal

Pk #	Retention Time	Area	Area %
1	3.039	1.065	0.65
2	8.672	0.061	0.04
3	9.225	163.750	99.30
4	14.205	0.023	0.01
Totals		164.900	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 99.29 %
Number of results n=6
Standard deviation 0.02 %

IIb. Water Content

Method: Karl Fischer titration (not accredited testing method)

No significant amounts of water were detected (< 0.05 %).

IIc. Residual Solvents

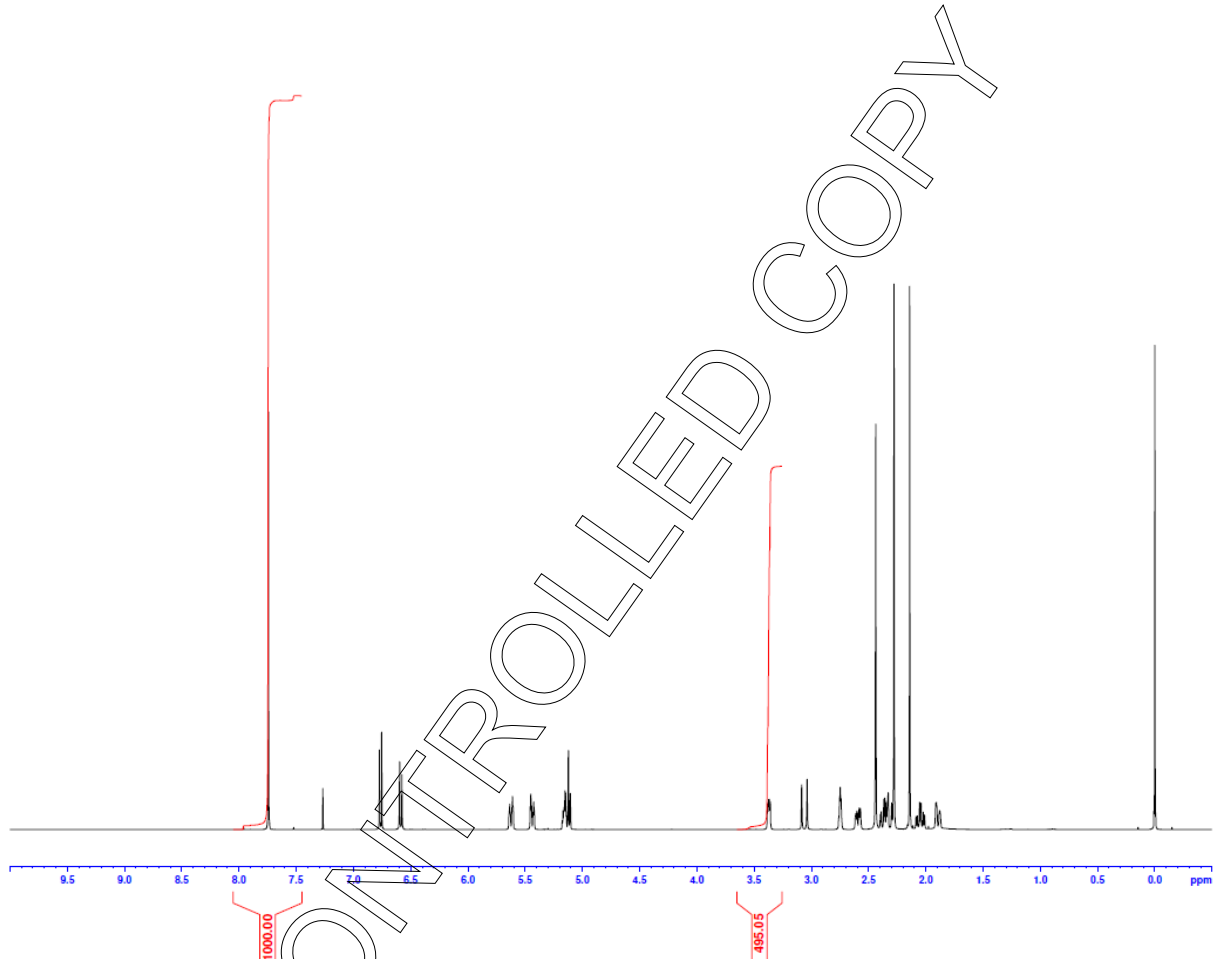
Method: ¹H-NMR (not accredited testing method)

No significant amounts of residual solvents were detected (< 0.05 %).



III. Assay by Quantitative NMR Spectroscopy

The assay of the reference substance was established by quantitative NMR spectroscopy using CDCl_3 as the solvent and with 2,3,5,6-Tetrachloro-1-nitrobenzene (certified reference material, signal 7.45 – 8.05 ppm, 1 H) as internal standard.



Results:

Average	99.68 %
Number of results	n=6
Uncertainty U (expanded)	0.57 %



IV. Final Result

Chromatographic purity (HPLC)	99.29 %
Water content	No significant amounts of water were detected (< 0.05 %).
Residual solvents	No significant amounts of water were detected (< 0.05 %).
Assay:	
Quantitative NMR spectroscopy	99.68

The assay is assessed to be 99.7% 'as is'

The assay 'as is' is equivalent to the assay based on the not anhydrous and not dried substance respectively. It is determined by quantitative NMR spectroscopy and its expanded uncertainty ($k = 2$) is 0.6 %.

The assay is verified by the 100 % method (HPLC): 99.3 % which is inside our acceptance criteria (less than 0.6 %).

V. Stability and Homogeneity

Accelerated stability studies indicate no significant instability. The given validity period is based on this data. This is backed up by additional stability testing and historical data over the range of several years. Homogeneity assured by qualified process of preparation, verified by homogeneity testing.

Due to the homogeneity studies the minimum amount of sample to be used is 10 mg.

VI. Further Information

General

For laboratory use only. Not suitable for human or animal consumption.

This material conforms to the characteristics of a primary standard as described within ISO Guide 30 (Terms and definitions used in connection with reference materials).

The values quoted in this certificate are LGC's best estimate of the true values within the stated uncertainties and based on the techniques described in this certificate.

The production of this reference material was realized taking into account the principles of ISO Guide 34.



Intended Use

Use for identification and quantification.

Handling of the RM

Before usage of the RM, it should be allowed to warm to room temperature. No drying required, as the certified value is already corrected for the content of water and other volatile materials.

Assay and Uncertainty

The identity and the assay are assessed by an ISO/IEC 17025 accredited testing method.

Uncertainty of the assay is expressed as an expanded uncertainty in accordance with ISO/IEC 17025 at the about 95 % level of confidence.

For quantitative applications use the assay as a calculation value on the as is basis. The uncertainty of the assay can be used for estimation/calculation of your own measurement uncertainty.

The calculation of the 100 % method follows the formula:

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

Volatile contents are considered as absolute contributions, purity is considered as relative contribution.

Quality Control Assessment

The product quality is controlled by regularly performed quality control tests (retests).

Release Date:

Luckenwalde, 2015-05-13

Dr. Sabine Schröder
Product Release