BDG SYNTHESIS

# Certificate of Analysis

BDG Synthesis certifies that this reference material meets or exceeds the specifications stated herein.

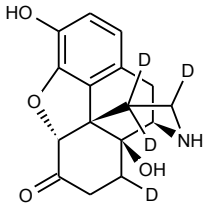
Barry Dent

Barry R. Dent, PhD, Director
24 October 2013

**Name:** **Noroxymorphone-$d_4$**

**CAS Number:** 33522-95-1 (unlabelled)

**Structure:**




| | | |
|---|---|---|
| **Molecular Weight:** | $C_{16}H_{13}D_4NO_4$ = 291.34 | |
| **Lot Number:** | BDG 13907.2 | |
| **Appearance:** | Brown powder | |
| **Purity By HPLC:** | 93.8 % | |
| **Isotopic Purity:** | Under 0.5 % $d_0$ | |
| **Re-test Date:** | 24 October 2018 | |
| **Storage and Handling:** | Temperature: | refrigerate for prolonged storage; may be handled and shipped at ambient temperature. |
| | Humidity: | not believed to be hygroscopic; may be handled in normal laboratory atmosphere. |
| | Light: | protect from strong sunlight. |
| | Caution: | only experienced laboratory personnel should handle the material. |

## Identity and Purity

### Proton NMR Spectrum

Identity: the signals are consistent with the proposed structure and in accord with literature where available.
Isotopic Labelling: the signals corresponding to the sites of deuteration are greatly reduced or absent. However, integration of these signals indicates some deuterium scrambling has occurred during the synthesis.
Residual Solvents: no residual solvents are observed.
Impurities: a minor impurity is observed in the spectrum.

### Carbon-13 NMR Spectrum

Identity: the signals are consistent with the proposed structure and in accord with literature where available.
Isotopic Labelling: the signals corresponding to the sites of deuteration are greatly reduced. However, the peak shape of two of these signals indicates some deuterium scrambling has occurred during the synthesis.

### High-resolution Mass Spectrum (ESI+)

Found *m/z* 292.1491. $C_{16}H_{14}D_4NO_4$ $[M+H]^+$ requires *m/z* 292.1487. The deviation of 1.4 ppm is within normally accepted limits for the establishment of identity by HRMS. No signal for $d_0$ material was seen (detection limit about 0.5 %). However, approximately 30% of $d_5$ material is observed.

### HPLC

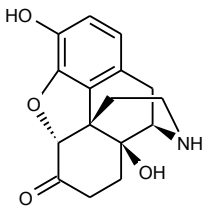
A sharp, slightly tailing peak is observed (93.8 %). Note: in the absence of reference materials for preparing calibration curves, it is assumed that all peaks have the same detector response. Where possible, the conditions of analysis follow a pharmacopeial or literature method, or have been adapted from same.

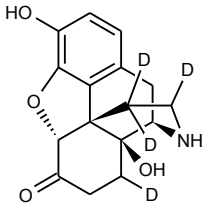
The available quantity of custom-synthesised material is always small, and this limits the extent and type of analytical data which can be obtained. This Certificate is presented in descriptive format for use by analytical chemists who are trained in the use of custom-synthesised materials. Custom materials often contain higher levels of residual solvents and/or water, and we urge you to use the corrected purity where needed rather than the raw HPLC purity. This compound is intended for use as an analytical reference material and it is not for human administration. Structures are shown with relative stereochemistry unless otherwise specified.

The re-test date is assigned from experience gained with the material in the laboratory and/or on storage. It is not possible to perform formal storage studies because of the small amount of material available.

BDG SYNTHESIS

Proton NMR Spectrum of Noroxymorphone (top) and Noroxymorphone-$d_4$ (bottom) in $D_2O$ + DCl

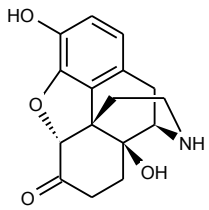



Lot Number: BDG 13907.2

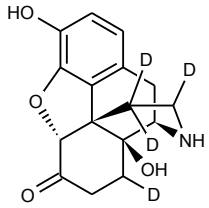
BDG SYNTHESIS

Carbon-13 NMR Spectrum of Noroxymorphone (top) and Noroxymorphone-$d_4$ (bottom) in $D_2O$ + DCl

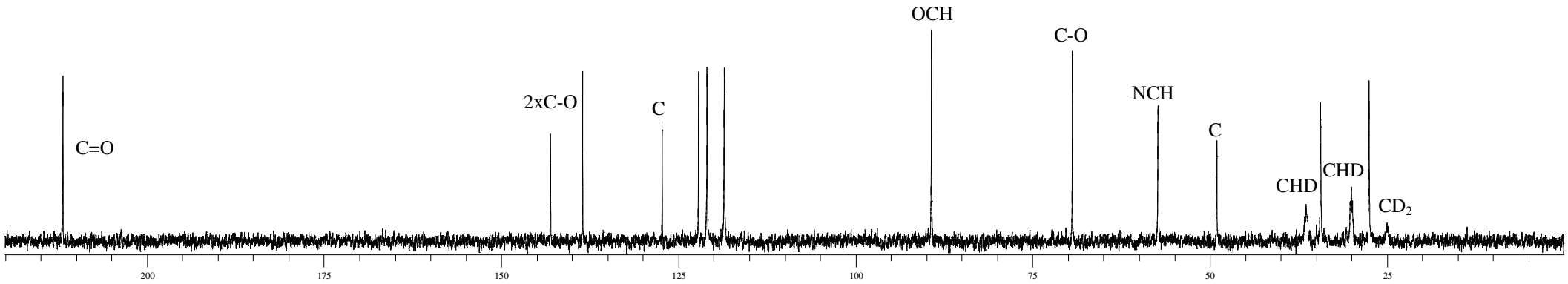








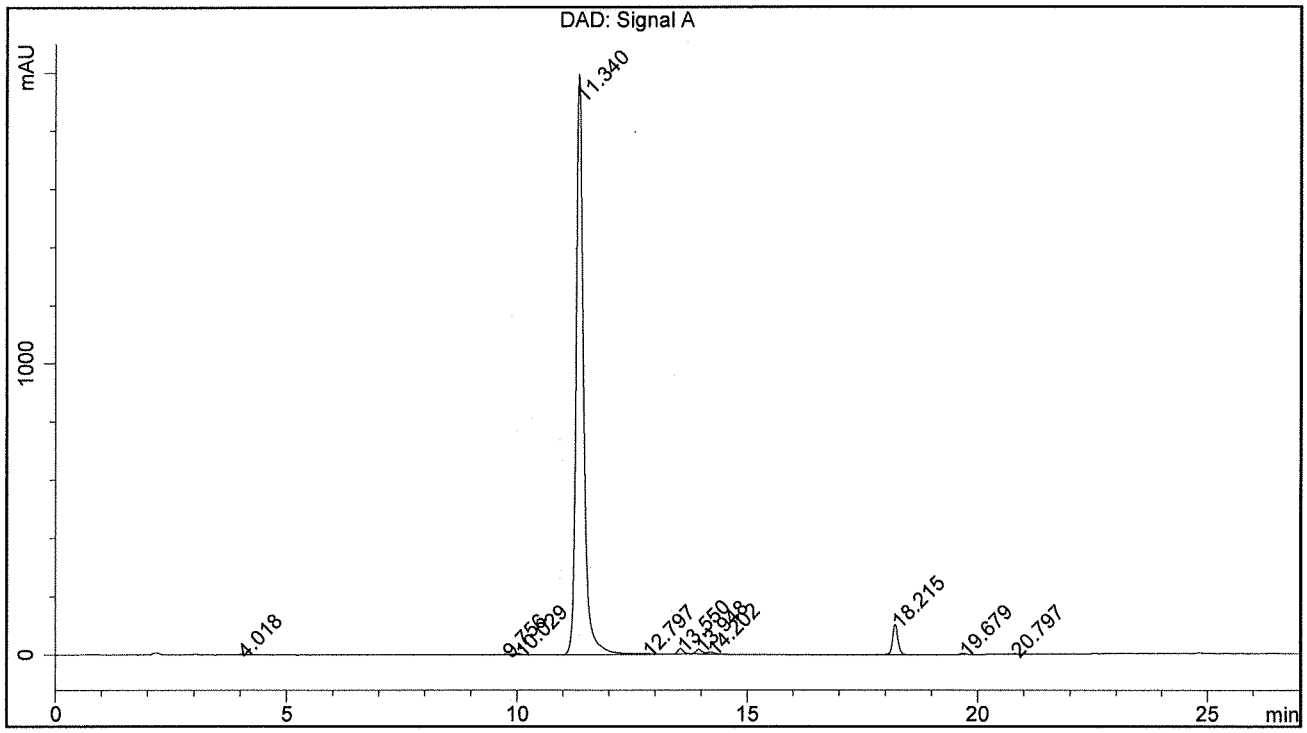

Lot Number: BDG 13907.2



BDG - Analysis of Noroxymorphone-d4

Column : Phenomenex Luna C18(2) 5um 250 x 4.6 mm
Guard : Phenomenex Security Guard C18 RP 4 x 3 mm
Mobile Phase A : 95:5 10mM diPotassium Hydrogen Phosphate pH=7.0 : Acetonitrile
Mobile Phase B : Acetonitrile
Gradient ( A:B ) : T0=100:0, T20=60:40, T24=60:40, T26=100:0, T30=100:0
Flow Rate : 1.0 mL/min . . . . . Sample Solvent : Dilute Phosphoric Acid
Column Temperature : 30C . . . . . Injection Volume : 10 uL . . . . . Detection : UV at 225 nm

| Sample Name | BDG 13907.2 | Instrument | AnalyticalLC01 |
|---|---|---|---|
| Acquisition | 24/10/2013, 20:59:08 | Method (rev.) | LC10590d ( 9) |
| Sequence | BDG_24Oct2013e - Reprocessed | Vial Position | 16 |
| Operator | solvation010\cerityadmin | Injection | 1 of 2 |




**Area Percent Report**

| Peak# | RT | Peak Height | Peak Area | Width | Area % |
|---|---|---|---|---|---|
| 1 | 4.02 min | 2.6574 | 19.1845 | 0.1122 min | 0.080 % |
| 2 | 9.76 min | 2.0422 | 36.0627 | 0.2380 min | 0.151 % |
| 3 | 10.03 min | 4.5546 | 61.7335 | 0.1941 min | 0.258 % |
| 4 | 11.34 min | 1994.1913 | 22406.7847 | 0.1711 min | 93.804 % |
| 5 | 12.80 min | 3.4437 | 58.0505 | 0.2207 min | 0.243 % |
| 6 | 13.55 min | 19.3121 | 166.4619 | 0.1286 min | 0.697 % |
| 7 | 13.95 min | 16.3373 | 150.5543 | 0.1395 min | 0.630 % |
| 8 | 14.20 min | 7.3911 | 77.9797 | 0.1551 min | 0.326 % |
| 9 | 18.22 min | 103.8239 | 852.5154 | 0.1238 min | 3.569 % |
| 10 | 19.68 min | 4.4372 | 34.2744 | 0.1221 min | 0.143 % |
| 11 | 20.80 min | 1.7160 | 23.2204 | 0.1899 min | 0.097 % |