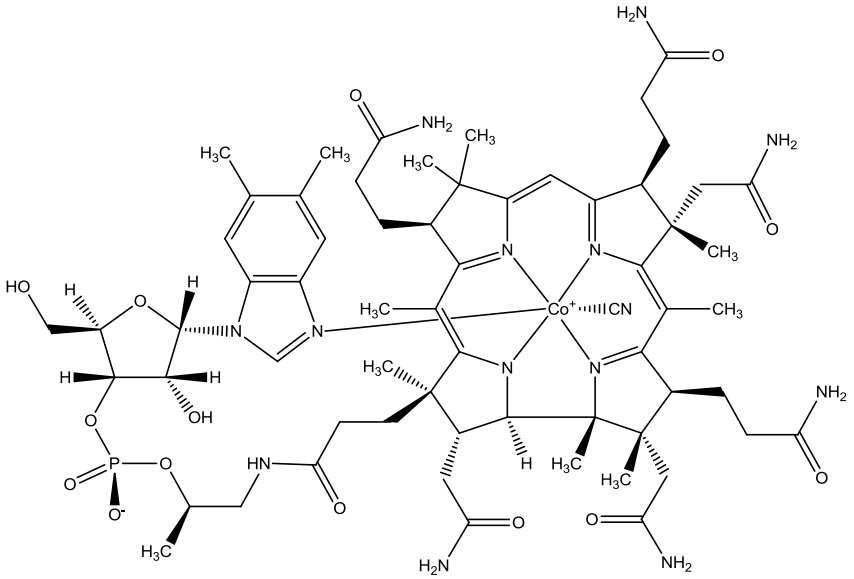
Certificate of Analysis

ISO GUIDE 34
ACLASS Cert# AR-1470

ISO/IEC 17025
ACLASS Cert# AT-1467

CYANOCOBALAMIN

CERTIFIED REFERENCE MATERIAL



CERTIFIED PURITY: 98.7%, $U_{crm} = \pm 0.3\%$ $k = 2$
(Mass Balance/dried basis)

NOMINAL PACKAGE SIZE: 1g

CATALOG #: PHR1234 **LOT #:** P500234

CERTIFICATE VERSION: 500234.2 **ISSUE DATE:** 27 February 2015

Note: Certificates may be updated due to Pharmacopeial Lot changes or the availability of new data.
Check our website at: www.sigma-aldrich.com *for the most current version.*

CRM EXPIRATION: 12 Months from Receipt (Proper Storage and Handling Required).

RECEIPT DATE: _____
Note: this space is provided for convenience only and its use is not required.

STORAGE: Store in a Refrigerator/Protect from Light, keep container tightly closed. Attachment of a 20 mm aluminum crimp seal recommended for unused portions.

CHEMICAL FORMULA: $C_{63}H_{88}CoN_{14}O_{14}P$ **MW:** 1355.4

PHYSICAL DESCRIPTION: Red crystals in amber vial **CAS #:** 68-19-9

HAZARDS: Read Safety Data Sheet before using. All chemical reference materials should be considered potentially hazardous and should be used only by qualified laboratory personnel.

INSTRUCTIONS FOR USE: Dry over silica gel for 4 hours. The internal pressure of the container may be slightly different from the atmospheric pressure at the user's location. Open slowly and carefully to avoid dispersion of the material. This material is intended for R&D use only. Not for drug, household or other uses.

TRACEABILITY ASSAY

Comparative assay demonstrates direct traceability to Pharmacopeial Standards
Specification: 96.0-100.5% (USP)

METHOD: UV (ref.: Cyanocobalamin, USP37)
Solvent: Water
Cell Pathlength: 1cm
Wavelength: 361nm

ASSAY vs. USP REFERENCE STANDARD (dried basis)

ASSAY VALUE	vs. USP LOT
98.8%	**O0H288**
	Labeled Content = 10.4µg/mg in Mannitol

ASSAY vs. EP CRS (dried basis)

ASSAY VALUE	vs. EP BATCH
97.0%	**5.0**
	Labeled Content = None
	Assigned Content = 94.6%*

ASSAY vs. BP CRS (dried basis)

ASSAY VALUE	vs. BP BATCH
97.0%	**3517**
	Labeled Content = None
	Assigned Content = 93.9%*

*The assigned content of the EP CRS and the BP CRS was determined by measuring the absorbance and using 207 as the A(1%, 1cm).

PURITY DETERMINATION BY MASS BALANCE

CHROMATOGRAPHIC IMPURITY ANALYSIS

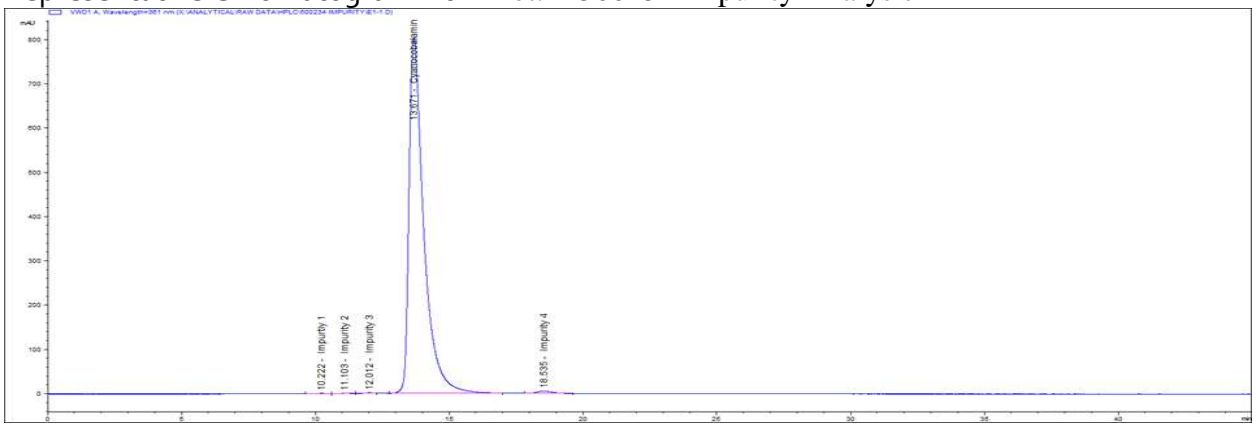
METHOD: HPLC (ref.: Cyanocobalamin, EP7)

Column: Nucleosil 100-5C8, 4.6 x 250mm, 5µm
Mobile Phase: 10g/L Dibasic Sodium Phosphate in Water adjusted to pH 3.5, Methanol (73.5:26.5)
Flow Rate: 0.8mL/min
Column Temperature: 30ºC
Injection: 20µL
Detector: 361nm

Impurities Detected:

Impurity 1:	**0.1%**
Impurity 2:	**0.1%**
Impurity 3:	**0.2%**
Impurity 4:	**0.9%**
Total Impurities:	**1.3%**

Representative Chromatogram from Lot: P500234 Impurity Analysis



RESIDUAL SOLVENTS

Method: GC-MS Headspace (ref.: Residual Solvents <467>, USP34)
Column: DB-1301
Carrier gas: He
Flow: 1.2mL/min
Split Ratio: 1:5
Injection/Temperature: 1µl/250°C
Temperature Program: 40°C for 20min, 10°C/min to 240°C, hold 20min

Solvents Detected: None

LOSS ON DRYING/VOLATILES

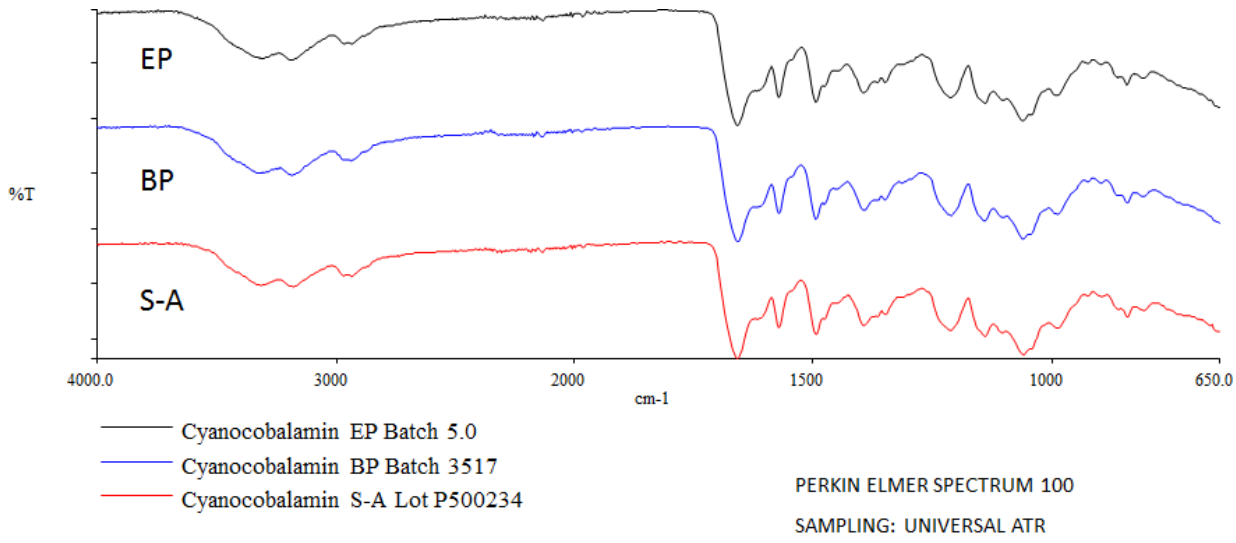
Method: Oven at 105°C
Mean of three measurements, Loss = **0.3%**

CERTIFIED PURITY BY MASS BALANCE [100% - Impurities (normalized)]

98.7% U_{crm} = ±0.2%, k = 2
(dried basis)

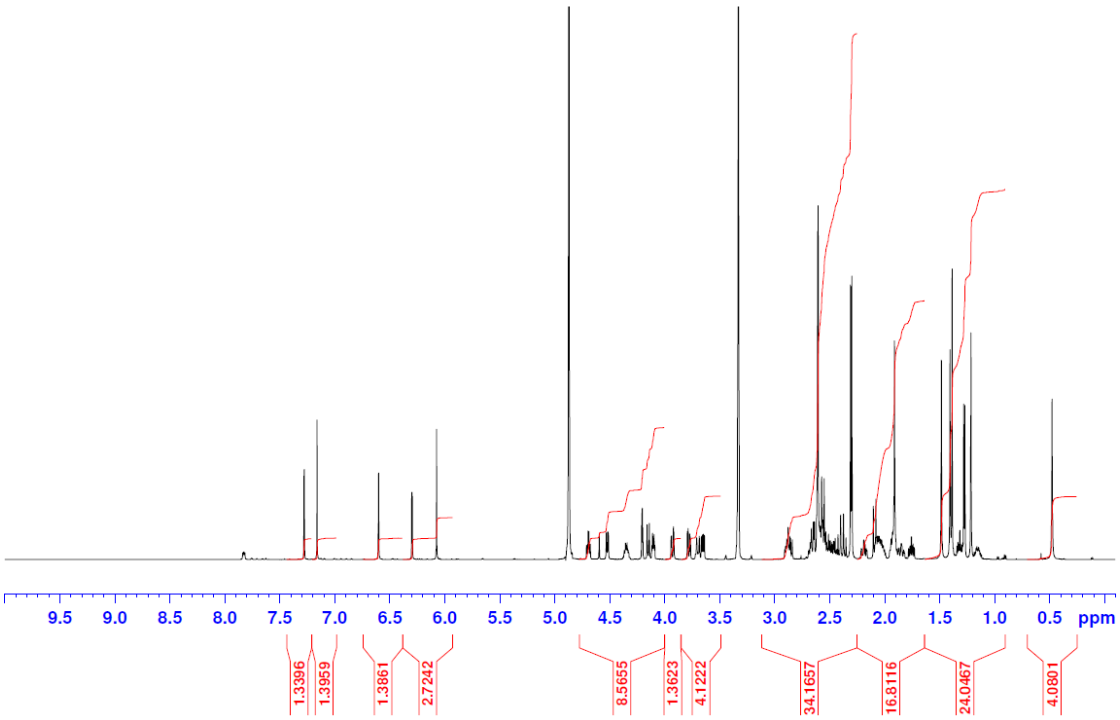
IDENTIFICATION TESTS

INFRARED SPECTROPHOTOMETRY (Comparative identification analysis demonstrates direct traceability to Pharmacopeial standards)



^{1}H NMR (Data provided by an external laboratory; not in scope of accreditation)

P500234 Cyanocobalamin in MeOD



Consistent with structure

ELEMENTAL ANALYSIS (Data provided by an external laboratory; not in scope of accreditation)

Exeter Analytical 440 Elemental Analyzer
Combustion method

%	Theoretical	Result 1	Result 2	Mean
C	55.84	54.08	52.69	53.39
H	6.55	6.90	6.93	6.92
N	14.47	13.96	13.59	13.78

HOMOGENEITY ASSESSMENT

Homogeneity was assessed in accordance with ISO Guide 35. Completed units were sampled using a random stratified sampling protocol. The results of chemical analysis were then compared by Single Factor Analysis of Variance (ANOVA). The uncertainty due to homogeneity was derived from the ANOVA. Heterogeneity was not detected under the conditions of the ANOVA.

Analytical Method: UV-Vis Sample size: ~60mg

UNCERTAINTY STATEMENT

Uncertainty values in this document are expressed as Expanded Uncertainty (U_{crm}) corresponding to the 95% confidence interval. U_{crm} is derived from the combined standard uncertainty multiplied by the coverage factor k, which is obtained from a *t*-distribution and degrees of freedom. The components of combined standard uncertainty include the uncertainties due to characterization, homogeneity, long term stability, and short term stability (transport). The components due to stability are generally considered to be negligible unless otherwise indicated by stability studies.

STABILITY ASSESSMENT

Significance of the stability assessment will be demonstrated if the analytical result of the study and the range of values represented by the Expanded Uncertainty do not overlap the result of the original assay and the range of its values represented by the Expanded Uncertainty. The method employed will usually be the same method used to characterize the assay value in the initial evaluation.

Long Term Stability Evaluation - An assessment, or re-test, versus a Compendial Reference Standard may be scheduled, within the 3 year anniversary date of a release of a Secondary Standard. The re-test interval will be determined on a case-by-case basis.

Short Term Stability Study - It is useful to assess stability under reasonably anticipated, short term transport conditions by simulating exposure of the product to humidity and temperature stress. This type of study is conducted under controlled conditions of elevated temperature and humidity.

Operations Manager

QA Supervisor

APPENDIX

Original Release Date:	12 June 2012
Stability Test Date:	27 February 2015
Requalification Test Date:	27 February 2015

Manufactured and certified by Sigma-Aldrich RTC, Inc.
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ACCREDITED REFERENCE MATERIAL PRODUCER

ACCREDITED TESTING