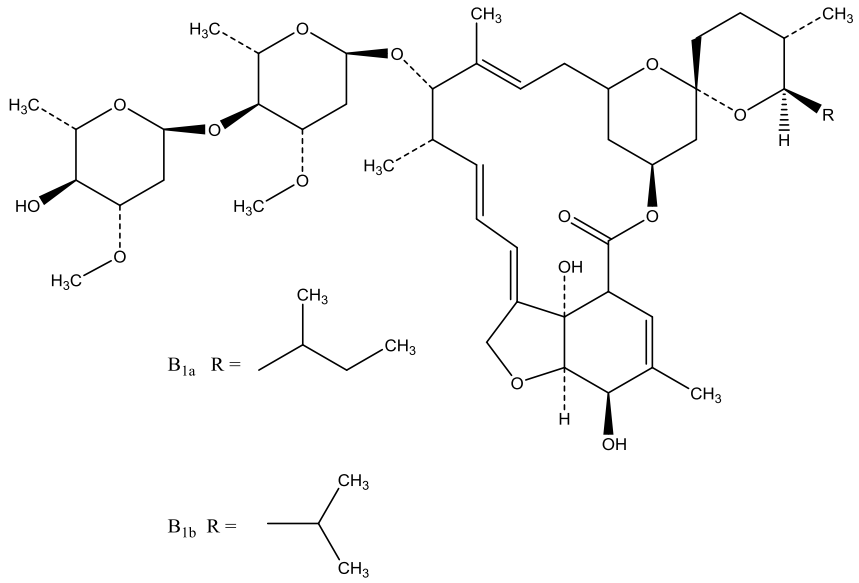
Certificate of Analysis

ISO 17034
ANAB Cert# AR-1470

ISO/IEC 17025
ANAB Cert# AT-1467

IVERMECTIN

CERTIFIED REFERENCE MATERIAL



CERTIFIED PURITY:

89.2%, U_{crm} = ±0.3% k = 2 (Mass Balance, as $C_{48}H_{74}O_{14}$/as is basis)

2.6%, U_{crm} = ±0.2% k = 2 (Mass Balance, as $C_{47}H_{72}O_{14}$/as is basis)

NOMINAL PACKAGE SIZE: 1g

CATALOG #: PHR1380 **LOT #:** LRAA1636

CERTIFICATE VERSION: LRAA1636.3 **ISSUE DATE:** 30 November 2018

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: 31 December 2018 (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: $C_{48}H_{74}O_{14} + C_{47}H_{72}O_{14}$ **MW:** NA

PHYSICAL DESCRIPTION: White powder in amber vial **CAS #:** 70288-86-7

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: Do not dry, use on the as is basis. 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

ASSAY vs. USP REFERENCE STANDARD (as is basis)

ASSAY VALUE	vs. USP LOT
89.0% (B_{1a})	**R091C0**
2.4% (B_{1b})	
	Labeled Content = 0.894mg/mg, B_{1a}
	0.014mg/mg, B_{1b}

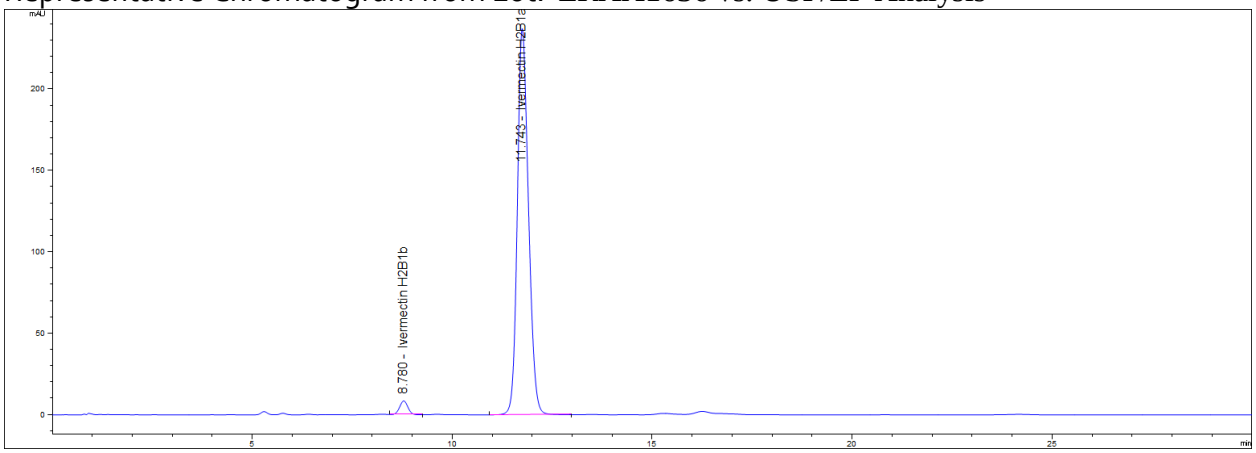
ASSAY vs. EP CRS (as is basis)

ASSAY VALUE	vs. EP BATCH
89.0% (B_{1a})	**3.0**
2.4% (B_{1b})	
	Labeled Content = None
	Assigned Content = 90.7%, B_{1a}
	0.6%, B_{1b}*

*The assigned content of the EP CRS was determined by assay against the USP Reference Standard

METHOD: HPLC (ref.: Ivermectin, Current Compendial Monographs)
Column: Ascentis Express C18, 4.6 x 100mm, 5µm
Mobile Phase: Acetonitrile, Methanol, Water (53:27.5:19.5)
Flow Rate: 1.0 mL/min
Column Temperature: 30 ºC
Injection: 10 µL
Detector: 254 nm

Representative Chromatogram from Lot: LRAA1636 vs. USP/EP Analysis



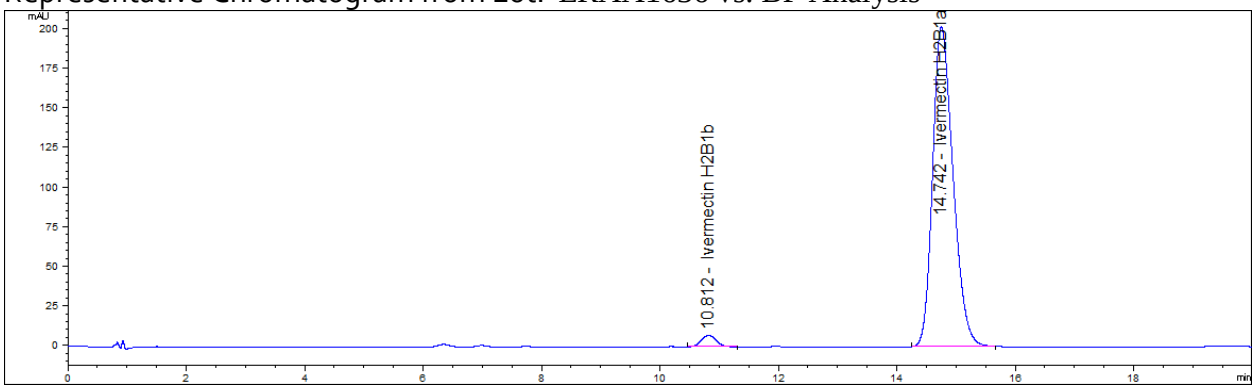
ASSAY vs. BP CRS (as is basis)

ASSAY VALUE	vs. BP BATCH
89.1% (B_{1a})	**3549**
3.0% (B_{1b})	

Labeled Content = 84.7%, B_{1a}
5.9%, B_{1b}

METHOD: HPLC (ref.: Ivermectin, Current Compendial Monographs)
Column: Ascentis Express C18, 4.6 x 100mm, 5µm
Mobile Phase: Acetonitrile, Methanol, Water (53:27.5:19.5)
Flow Rate: 1mL/min
Column Temperature: 30ºC
Injection: 10µL
Detector: 254nm

Representative Chromatogram from Lot: LRAA1636 vs. BP Analysis



PURITY DETERMINATION BY MASS BALANCE

CHROMATOGRAPHIC IMPURITY ANALYSIS
METHOD: HPLC (ref.: Ivermectin, Current Compendial Monographs)

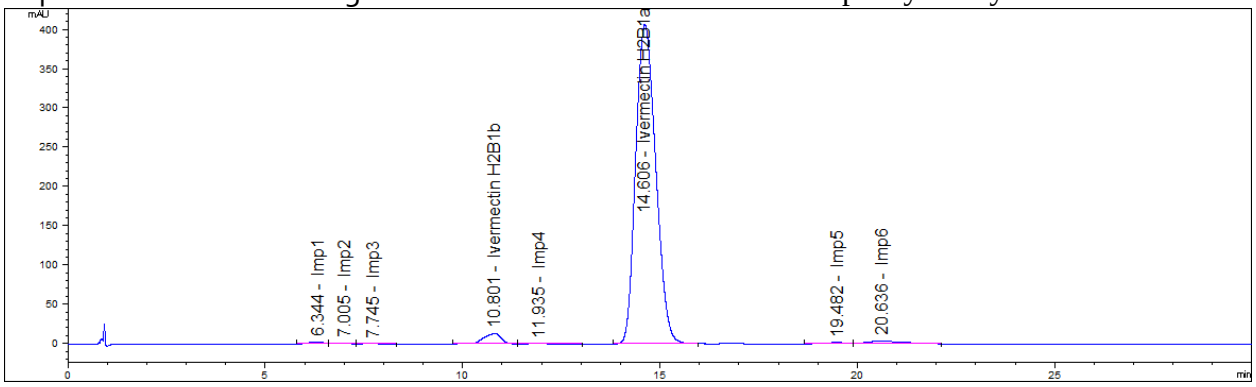
See Assay

Impurities Detected:

Impurity 1:	0.4%
Impurity 2:	0.2%
Impurity 3:	0.1%
Impurity 4:	0.1%
Impurity 5:	0.5%
Impurity 6:	1.6%

Total Impurities: **2.9%**

Representative Chromatogram from Lot: LRAA1636 HPLC Impurity Analysis

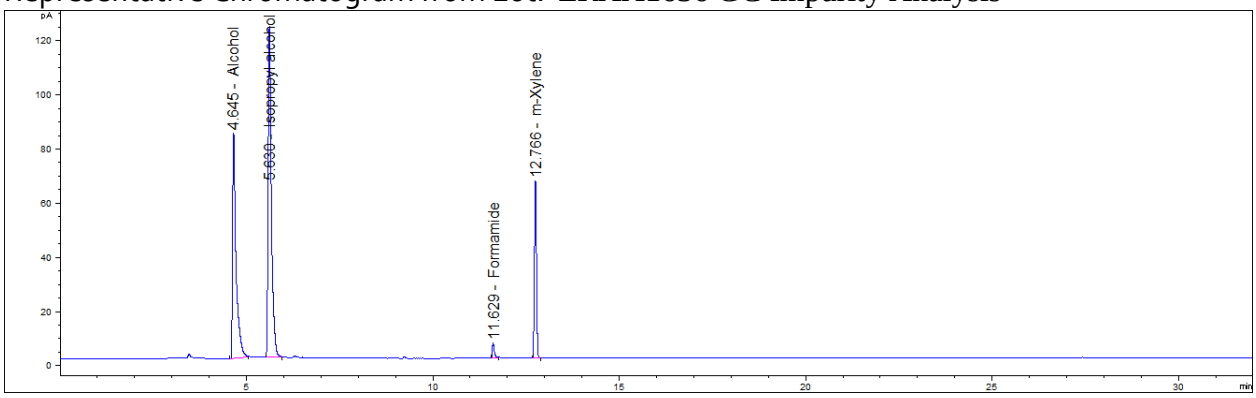


METHOD: GC (ref.: Ivermectin, Current Compendial Monographs)
Column: SPB-624, 30m x 0.53mm x 3.0µm
Carrier gas: H_2
Flow: 0.4mL/min
Split Ratio: 10:1
Injection/Temperature: 1µL/220°C
Temperature Program: 40°C for 5min, 20°C/min to 180°C, hold 20min
Detector/Temperature: FID/230°C
Internal Standard: Isopropyl Alcohol

Impurities Detected:

Ethanol:	**2.9%**
Formamide:	**2.3%**

Representative Chromatogram from Lot: LRAA1636 GC Impurity Analysis



RESIDUAL SOLVENTS

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

Solvents Detected: None

WATER DETERMINATION

Method: Karl Fisher titration (ref.: Current Compendial Monographs)
Mean of three measurements, Water Content = **0.05%**

RESIDUE ANALYSIS

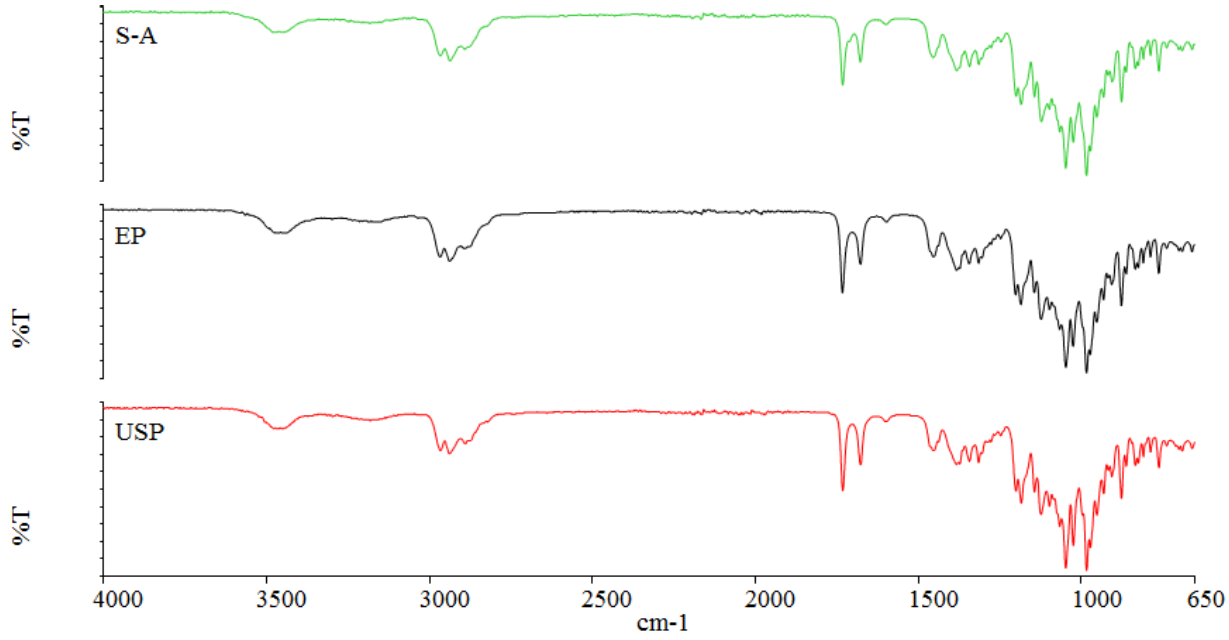
Method: Sulfated Ash (ref.: Current Compendial Monographs)
Sample Size: ~1g
Mean of three measurements, Residue = **0.02%**

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

89.2% U_{crm} = ±0.3%, k = 2 (as $C_{48}H_{74}O_{14}$, as is basis)
2.6% U_{crm} = ±0.2%, k = 2 (as $C_{47}H_{72}O_{14}$, as is basis)

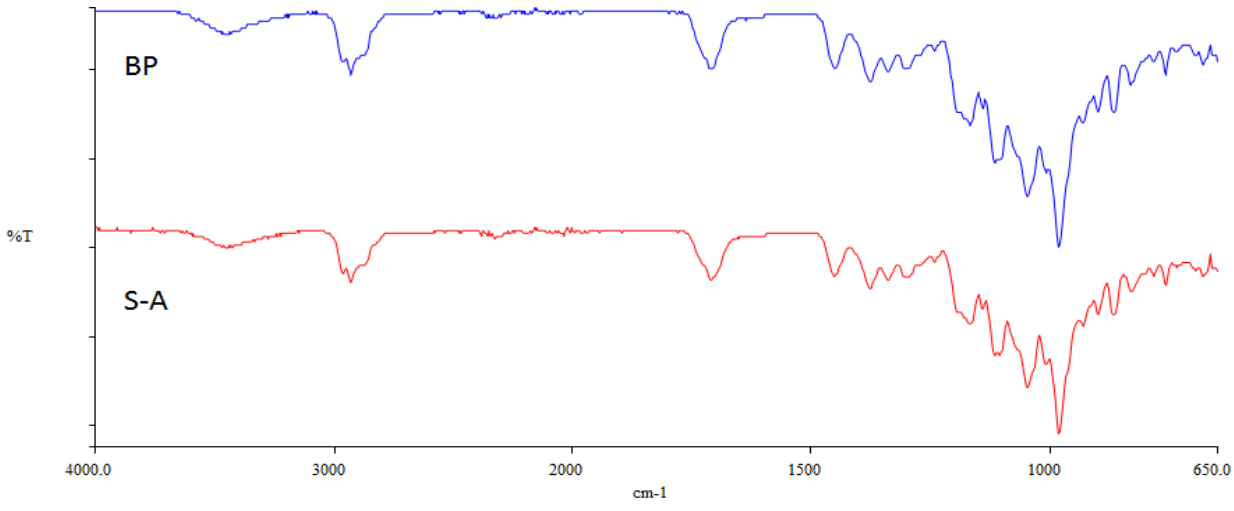
IDENTIFICATION TESTS

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



Ivermectin S-A Lot LRAA1636
Ivermectin EP Batch 3.0
Ivermectin USP Lot R091C0

PERKIN ELMER SPECTRUM 100
SAMPLING: UNIVERSAL ATR

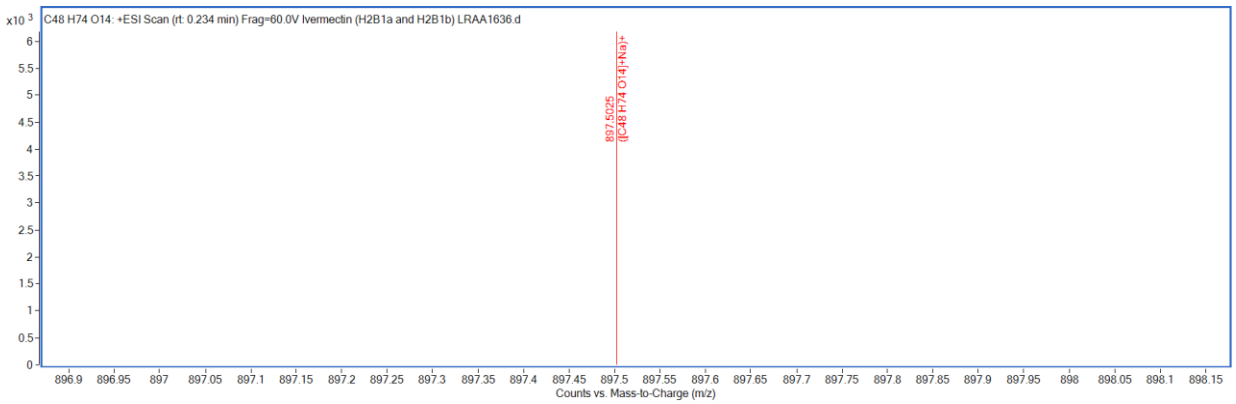


Ivermectin BP Batch 3549
Ivermectin S-A Lot LRAA1636

PERKIN ELMER SPECTRUM 100
SAMPLING: UNIVERSAL ATR
Recrystallized in MeOH

MASS SPECTRUM

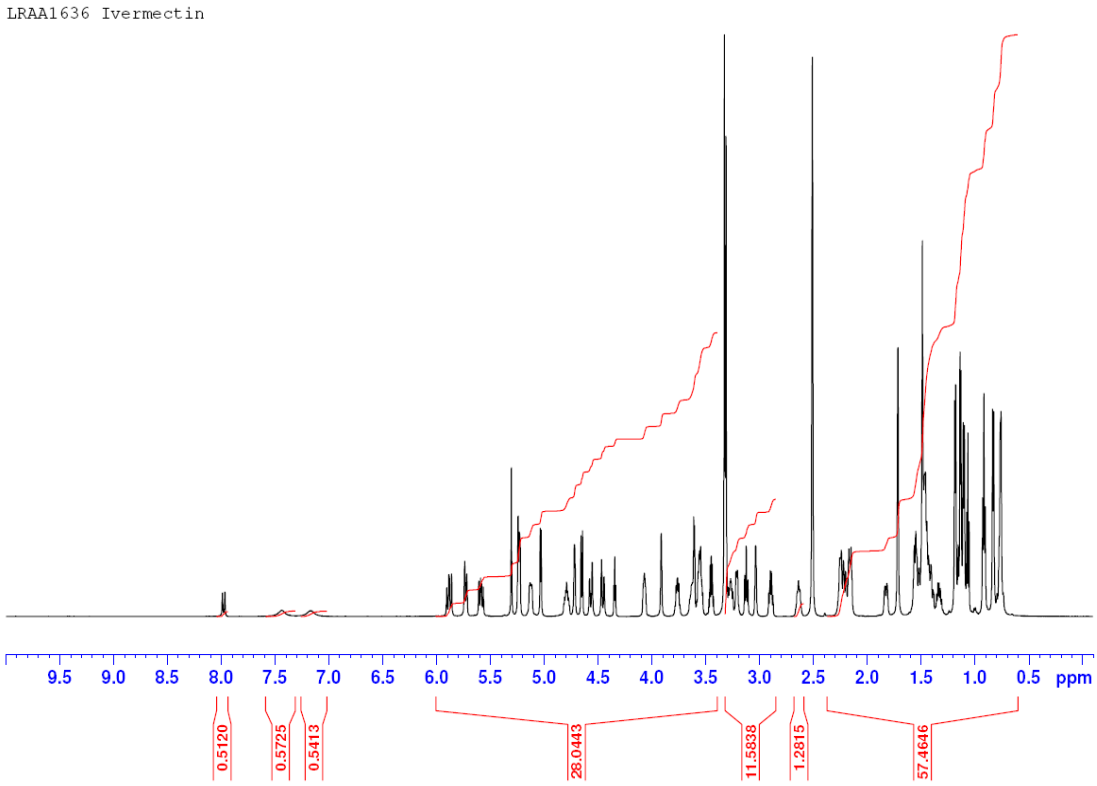
Method: HR-QTOF; 4.0 kV ESI+; temperature: 325 °C



Theoretical value: 897.4976 m/z

The signal of the MS spectrum is consistent with the theoretical value and its interpretation is consistent with the structural formula.

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



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	65.88	64.68	64.66	64.67
H	8.52	8.46	8.50	8.48

OPTICAL ROTATION

Specification: -17º to -20º (USP)
Perkin Elmer Polarimeter 343
Wavelength: 589nm
Concentration: 2.3g/100mL
Cell Path: 100mm
Mean of three Measurements = **-18°**

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: HPLC Sample size: ~ 20 mg

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.

QC Manager

Head Quality Assurance

APPENDIX

Original Release Date:	05 May 2014
Stability Test Date:	31 December 2016
Requalification Test Date:	31 December 2016
Requalification Test Date:	30 November 2018

Manufactured and certified by Sigma-Aldrich RTC, Inc.
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