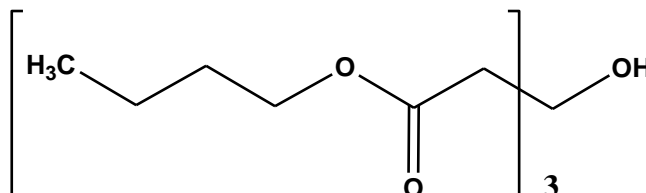


Certificate of Analysis

ISO GUIDE 34
ANAB Cert# AR-1470

ISO/IEC 17025
ANAB Cert# AT-1467

TRIBUTYL CITRATE CERTIFIED REFERENCE MATERIAL



CERTIFIED PURITY: 99.8%, $U_{\text{CRM}} = \pm 0.03\%$ $k = 2.06$
(Mass Balance/as is basis)

NOMINAL PACKAGE SIZE: 1g

CATALOG #: PHR1154

LOT #: LRAA8989

CERTIFICATE VERSION: LRAA8989.2

ISSUE DATE: 31 March 2016

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 2020 (Proper Storage and Handling Required).

RECEIPT DATE: _____

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

STORAGE: Store at Room Temperature, transfer unused portion to a tightly closed container.

CHEMICAL FORMULA: C₁₈H₃₂O₇

MW: 360.45

PHYSICAL DESCRIPTION: Clear liquid in amber ampule **CAS #:** 77-94-1

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.

SIGMA-ALDRICH®

INSTRUCTIONS FOR USE: Do not dry, use as is. 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: NLT 99.0% (USP)

METHOD: GC (ref.: Adapted from Tributyl Citrate, USP38)

ASSAY vs. USP REFERENCE STANDARD (as is basis)

ASSAY VALUE

99.8%

vs. USP LOT

R018F0

Labeled Content = None

Assume 100.0%

Column: SPB-35, 0.32mm x 30m x 0.25 μ m

Carrier: H₂

Flow: 2mL/min

Split Ratio: 1:30

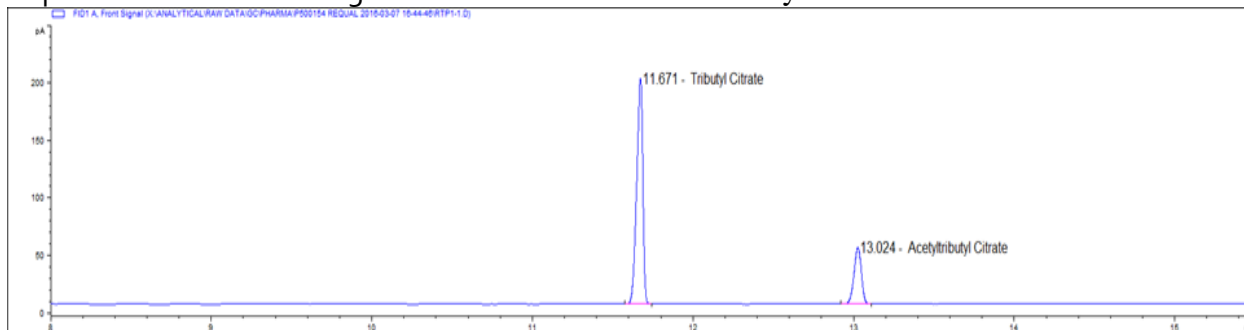
Temperature Program: 80°C for 30 seconds, 20°C/min to 220°C, hold 8min

Injection: 1 μ l/225°C

Detector: FID/275°C

Internal Standard: Acetyltributyl Citrate

Representative Chromatogram from Lot: LRAA8989 Analysis



PURITY DETERMINATION BY MASS BALANCE

CHROMATOGRAPHIC IMPURITY ANALYSIS

METHOD: GC (ref.: Tributyl Citrate, USP34)

Column: SPB-35 0.32mm x 30m x 0.25µm

Carrier: He

Flow: 2mL/min

Split Ratio: 1:30

Temperature Program: 80°C for 30 seconds, 20°C/min to 220°C, hold 20min

Injection: 1µl/225°C

Detector: FID/275°C

Impurities Detected

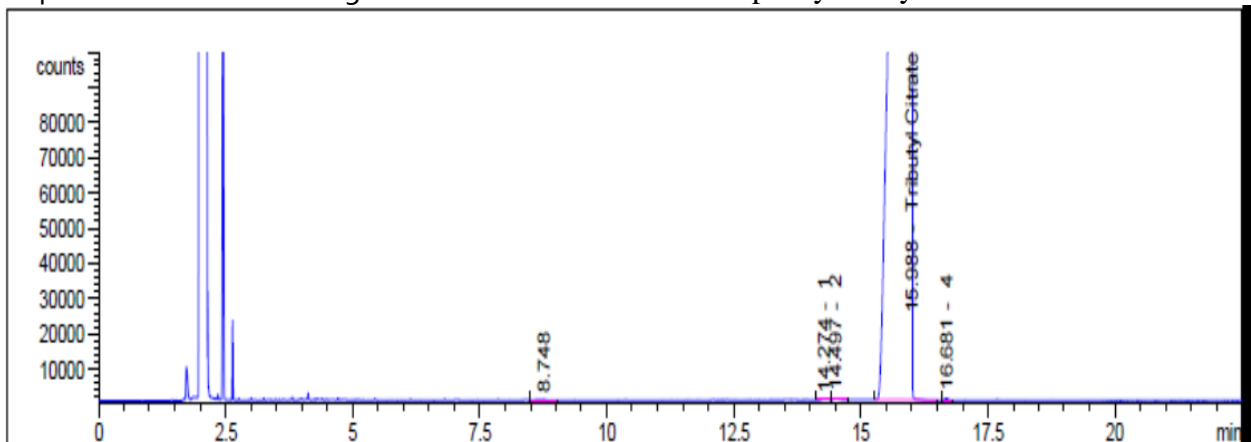
Impurity 1: **0.03%**

Impurity 2: **0.03%**

Impurity 3: **0.04%**

Total Impurities: **0.09%**

Representative Chromatogram from Lot: LRAA8989 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

WATER DETERMINATION

Method: Karl Fisher titration

Mean of three measurements, Water Content = **0.09%**

RESIDUE ANALYSIS

Method: Sulfated Ash

Sample Size: ~1g

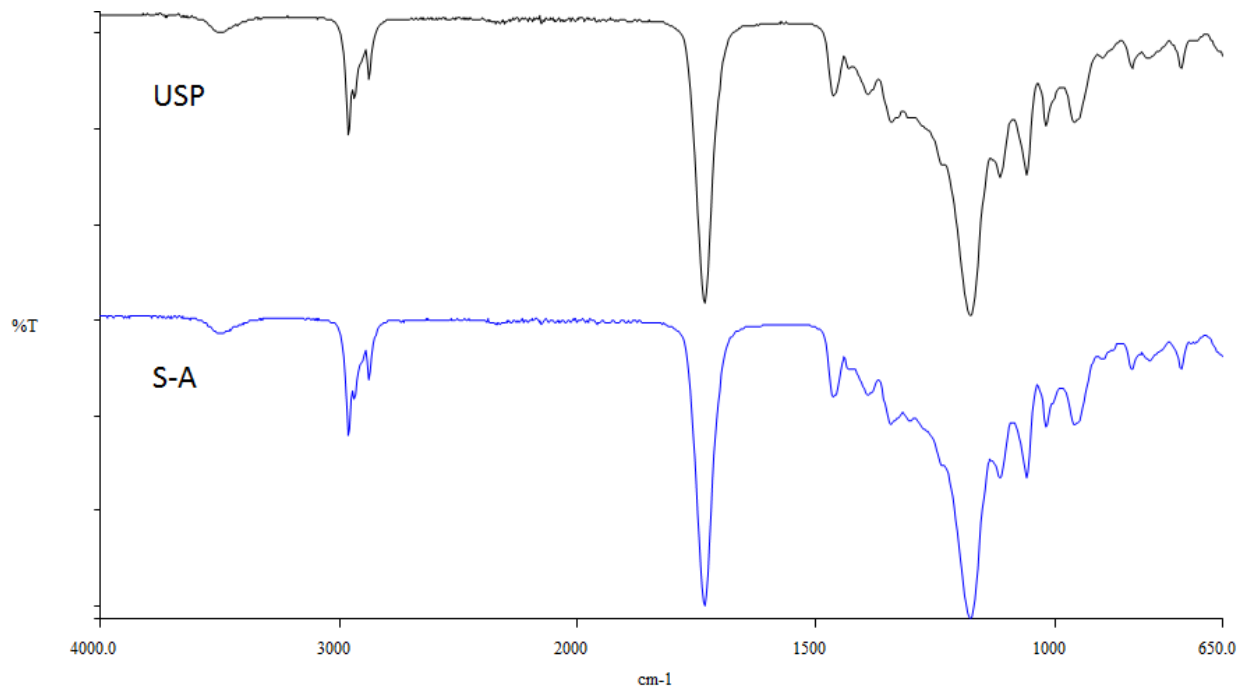
Mean of three measurements, Residue = **0.02%**

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

99.8% $U_{\text{CRM}} = \pm 0.03\%$, $k = 2.06$

IDENTIFICATION TESTS

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

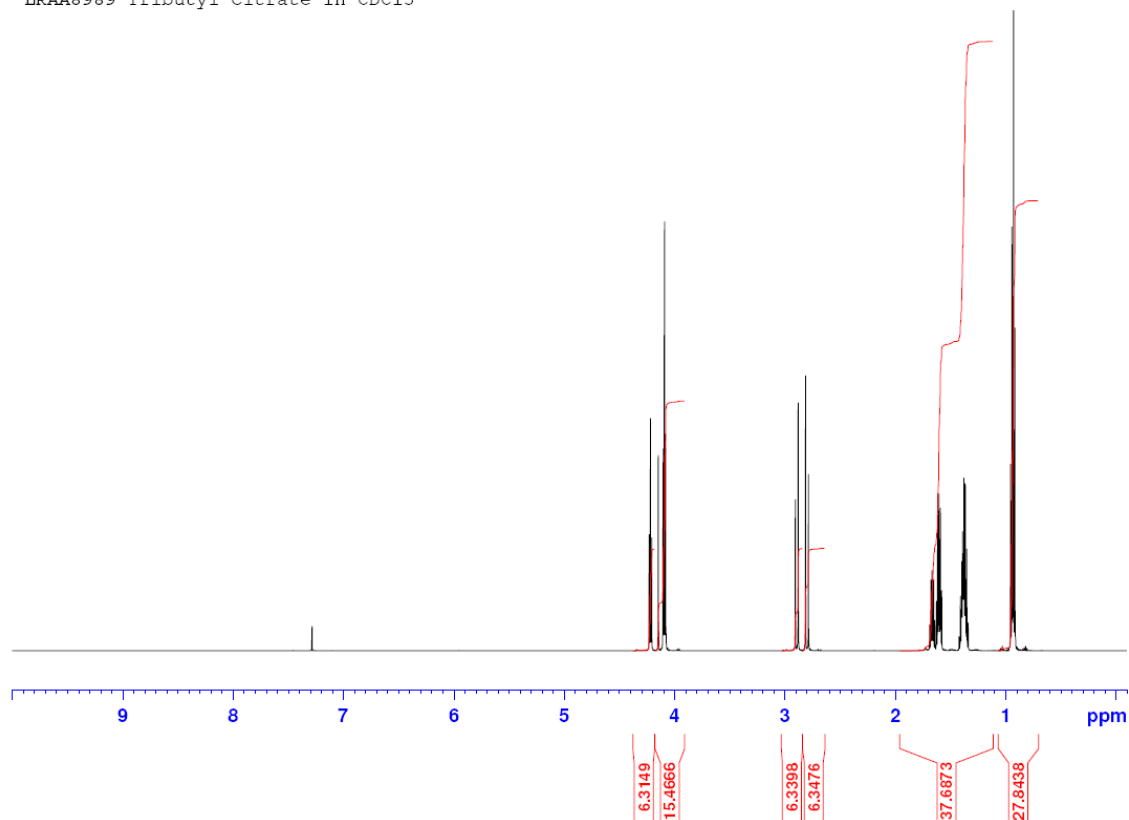


—— Tributyl Citrate USP Lot R018F0
—— Tributyl Citrate S-A Lot LRAA8989

PERKIN ELMER SPECTRUM 100
SAMPLING: UNIVERSAL ATR

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

LRAA8989 Tributyl Citrate in CDCl₃



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	59.98	60.11	60.25	60.18
H	8.95	8.87	8.85	8.86

REFRACTIVE INDEX

Specification: Between 1.443 and 1.445

Mettler Toledo RA-510M Refractoanalyzer

Temperature: 25°C

Mean of three measurements = **1.443**

SPECIFIC GRAVITY

Specification: Between 1.037 and 1.045

Anton Paar DMA38 Density Meter

Temperature: 25°C

Mean of three measurements = **1.042**

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: GC

Sample size: ~35mg

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 Supervisor



QA Supervisor

APPENDIX

Original Release Date: 04 September 2015

Reloquification Test Date: 31 March 2016