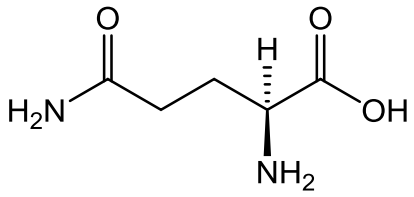
Certificate of Analysis

ISO GUIDE 34
ANAB Cert# AR-1470

ISO/IEC 17025
ANAB Cert# AT-1467

L-GLUTAMINE

CERTIFIED REFERENCE MATERIAL



CERTIFIED PURITY: 100.1%, U_{crm} = ±0.7% k = 2.31
(Titration Assay/dried basis)

NOMINAL PACKAGE SIZE: 1g

CATALOG #: PHR1125 **LOT #:** LRAC0586

CERTIFICATE VERSION: LRAC0586.1 **ISSUE DATE:** 11 September 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 2023 (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, keep container tightly closed. Attachment of a 20 mm aluminum crimp seal recommended for unused portions.

CHEMICAL FORMULA: $C_5H_{10}N_2O_3$ **MW:** 146.1

PHYSICAL DESCRIPTION: White powder in amber vial **CAS #:** 56-85-9

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: 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 Laboratory Use only. Not for drug, household or other uses.

TRACEABILITY ASSAY

Comparative assay demonstrates direct traceability to Pharmacopeial Standards

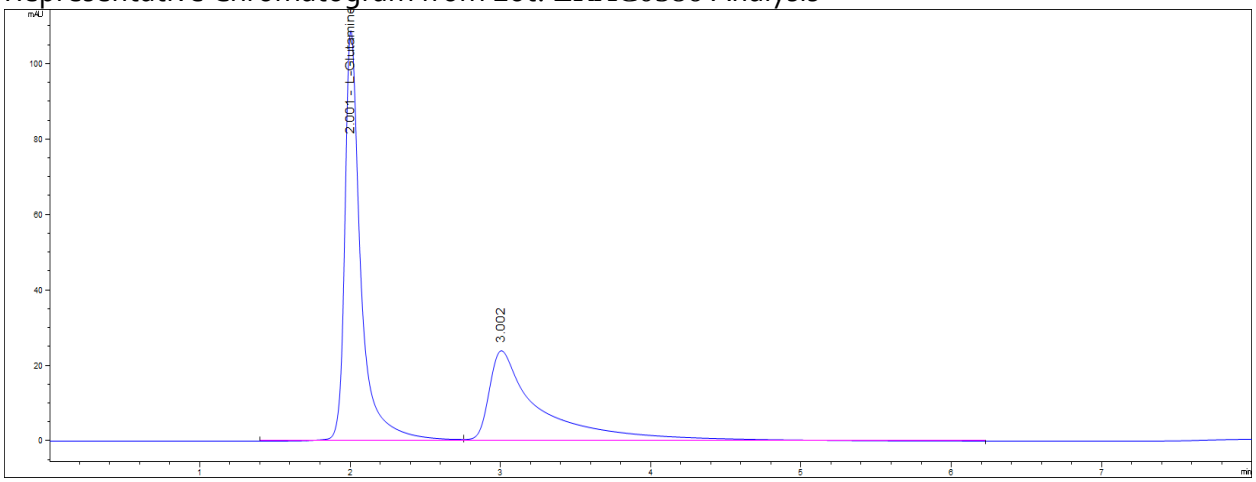
ASSAY vs. USP REFERENCE STANDARD (as is basis)

ASSAY VALUE	vs. USP LOT
99.5%	**R049A0**
	Labeled Content = 0.99 mg/mg

METHOD: HPLC

Column: Ascentis C18, 250 x 4.6 mm, 5 µm
Mobile Phase: Water/acetonitrile, (80:20)
Flow: 1 mL/min
Column Temperature: 35 °C
Injection: 10 µL
Detector: 205 nm

Representative Chromatogram from Lot: LRAC0586 Analysis



ASSAY BY TITRATION *(dried basis)*

Method: Titrate with 0.1N Perchloric Acid to potentiometric endpoint
Ref: Glutamine USP32

Mean of nine determinations: **100.1%** U_{crm} = ±0.7% k = 2.31

IMPURITY PROFILE

RESIDUAL SOLVENTS

Method: GC-MS Headspace (ref.: Residual Solvents USP <467>)
Column: DB-1301
Carrier gas: He
Flow: 1.2 mL/min
Split Ratio: 1:5
Injection/Temperature: 1 µL/250°C
Temperature Program: 40 °C for 20min, 10 °C/min to 240 °C, hold 20 min
Solvents Detected: None

LOSS ON DRYING/VOLATILES

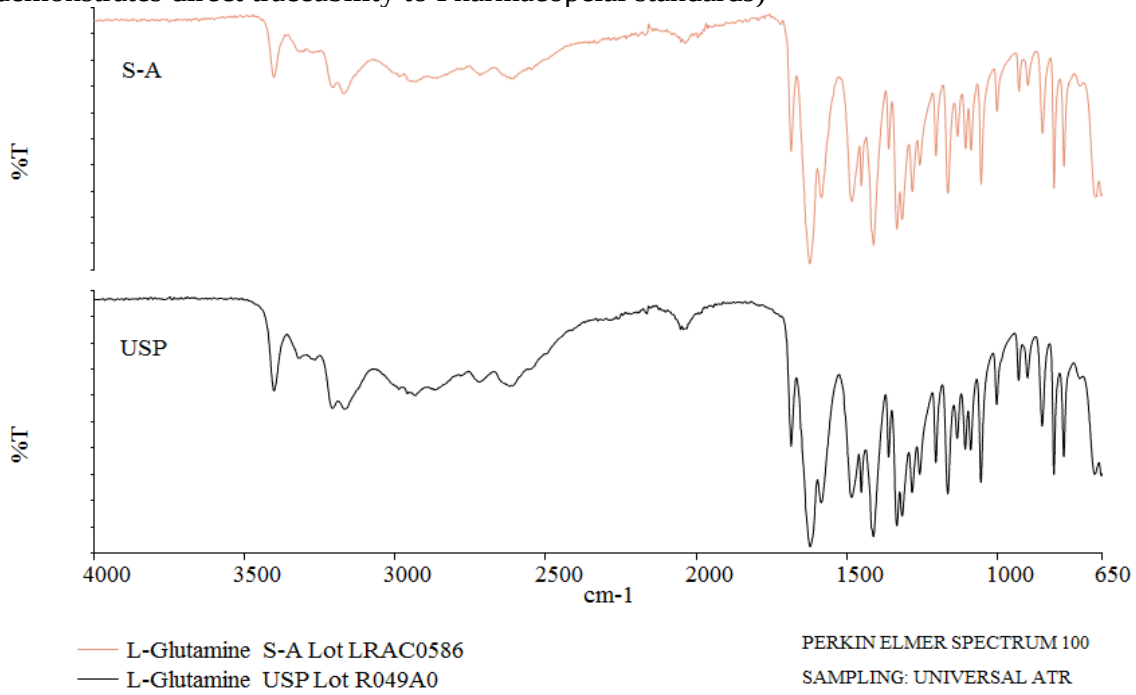
Method: Oven at 105°C
Mean of three measurements, Loss = **0.06%**

RESIDUE ANALYSIS

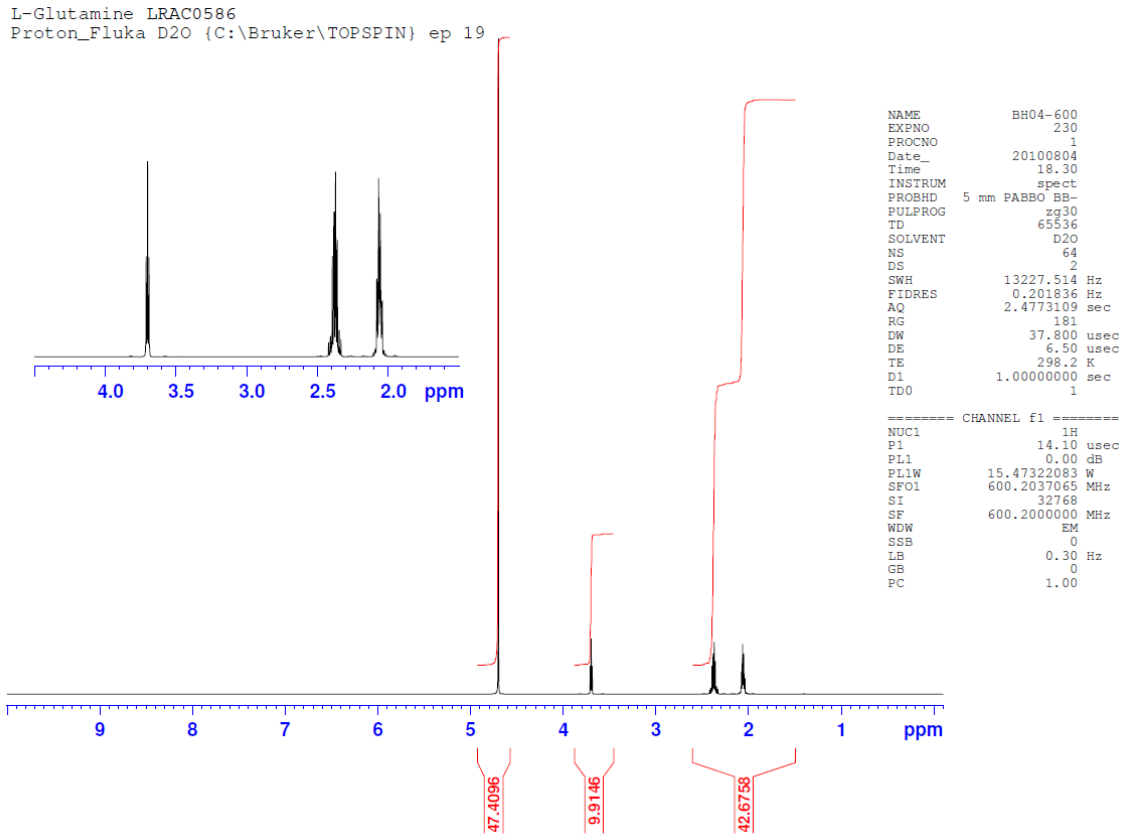
Method: Sulfated Ash
Sample Size: ~1g
Mean of three measurements, Residue = **0.06%**

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)



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	41.09	41.14	41.17	41.16
H	6.90	6.88	6.91	6.90
N	19.17	19.16	19.13	19.15

OPTICAL ROTATION

Specification: Specific Rotation Between +6.3 and +7.3
Perkin Elmer Polarimeter 343
Wavelength: 589nm
Concentration: 4g/100mL in water
Cell Path: 100mm
Mean of three Measurements = **+6.5**

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: ~50 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: 11 September 2018

Manufactured and certified by Sigma-Aldrich RTC, Inc.
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ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

ANAB ACCREDITED ISO GUIDE 34 REFERENCE MATERIAL PRODUCER