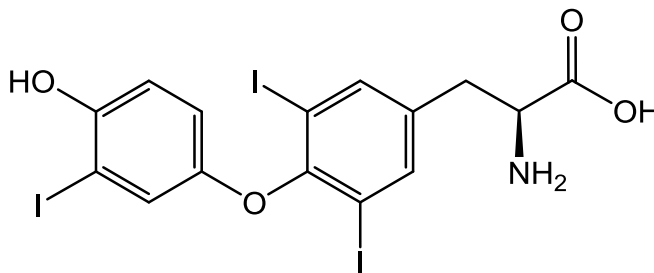


Certificate of Analysis

ISO 17034
ANAB Cert# AR-1470

ISO/IEC 17025
ANAB Cert# AT-1467

LIOTHYRONINE CERTIFIED REFERENCE MATERIAL



CERTIFIED PURITY: 98.5%, $U_{\text{CRM}} = \pm 0.5\%$ $k = 2.1$
(Mass Balance/ as is basis)

NOMINAL PACKAGE SIZE: 500mg

CATALOG #: PHR1504

LOT #: LRAC2088

CERTIFICATE VERSION: LRAC2088.1

ISSUE DATE: 05 August 2019

*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 August 2023 (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: $C_{15}H_{12}I_4NO_4$

MW: 650.98

PHYSICAL DESCRIPTION: White Solid in Amber Vial **CAS #:** 6893-02-3

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)

<u>ASSAY VALUE</u>	<u>vs. USP LOT</u>
98.8%	R069P0
	Labeled Content = 0.993 mg/mg

ASSAY vs. EP CRS (as is basis)

<u>ASSAY VALUE</u>	<u>vs. EP BATCH</u>
98.8 %	9.0
	Labeled Content = None
	Assigned Content = 93.2%*

METHOD: HPLC (ref.: Adapted from Liothyronine Sodium, Current Compendial Monographs)

Column: Ascentis Express ES-CN 100 x 4.6 mm, 2.7µm

Mobile Phase: 40 % Acetonitrile, 60 % Water, 0.05 % Phosphoric Acid

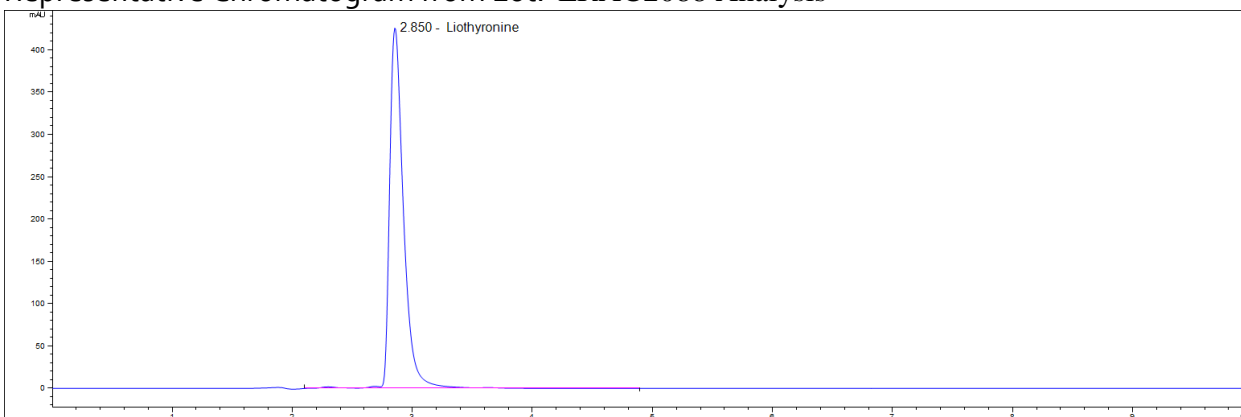
Flow Rate: 0.5 mL/min

Column Temperature: 25 °C

Injection: 2.5 µL

Detector: 225 nm

Representative Chromatogram from Lot: LRAC2088 Analysis



PURITY DETERMINATION BY MASS BALANCE

METHOD: HPLC (ref.: Adapted from Liothyronine Sodium, Current Compendial Monographs)

Column: Ascentis Express C18, 3.0 x 150 mm, 2.7 μ m

Mobile Phase A: 4.85 g/L Sulfamic acid + 0.75 g/L NaOH in Water, pH: 2.0

Mobile Phase B: Acetonitrile

Time (min)	% A	% B
0-3	75	25
3-4	75→70	25→30
4-14	70	30
14-44	70→20	30→80
44-54	20	80
54-54.1	20→75	80→25
54.1-65	75	25

Flow Rate: 0.5 mL/min

Column Temperature: 30 °C

Injection: 25 μ L

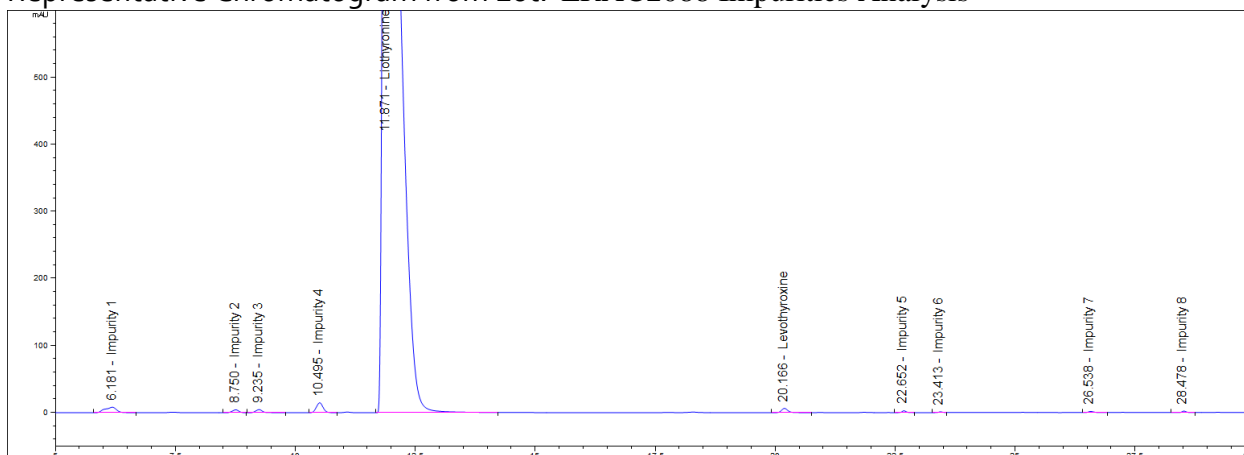
Detector: 225 nm

Impurities Detected:

Impurity 1:	0.343 %	Impurity 2:	0.101 %
Impurity 3:	0.108 %	Impurity 4:	0.353 %
Levothyroxine:	0.140 %	Impurity 5:	0.058 %
Impurity 6:	0.027 %	Impurity 7:	0.042 %
Impurity 8:	0.044 %		

Total Impurities: **1.217 %**

Representative Chromatogram from Lot: LRAC2088 Impurities Analysis



RESIDUAL SOLVENTS

Method: GC-MS Headspace (ref.: Adapted from Residual Solvents USP <467>)

Column: SPB-624

Carrier gas: He

Flow: 1.2 mL/min

Split Ratio: 1:5

Injection/Temperature: 1 mL/220 °C

Temperature Program: 40 °C for 5 min, 8 °C/min to 200 °C, hold 5 min

Solvents Detected:

Ethanol: 0.278 %

WATER DETERMINATION

Method: Karl Fisher titration (ref.: Current Compendial Monographs)

Mean of three measurements, Water Content = **None**

RESIDUE ANALYSIS

Method: Sulfated Ash (ref.: Current Compendial Monographs)

Sample Size: ~ 0.1 g

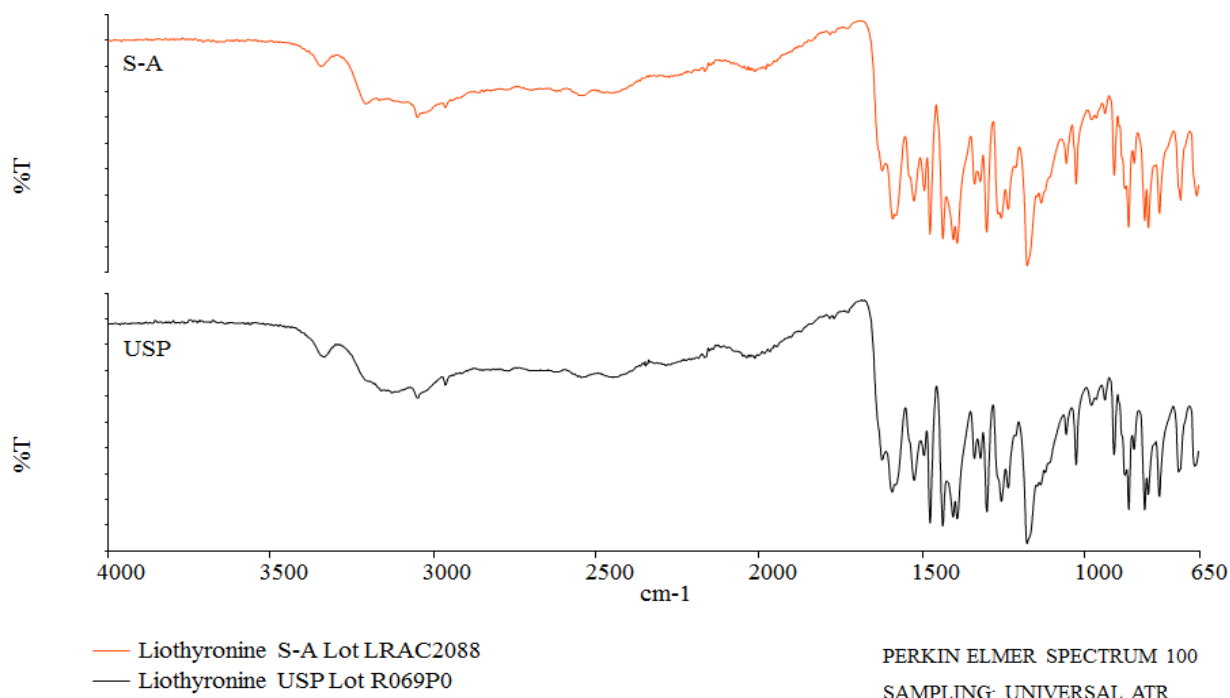
Mean of three measurements, Residue = **None**

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

98.5% $U_{\text{crm}} = \pm 0.5\%$, $k = 2.1$
(as is basis)

IDENTIFICATION TESTS

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



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 August 2019