

# Amino Acids

Advancing Your Life Sciences –  
From Discovery to Launch™



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# Introduction

Amino acids are the building blocks of life and therefore they are of fundamental significance to all organisms. They are the building blocks for proteins and other essential substances such as neurotransmitters, hormones and nucleic acids.

Comprehensively researched, amino acids play a major role in the areas of nutrition, medicine and plant protection. The L-Amino acids and their derivatives are key biochemical compounds in the life sciences.

During the last few years they have also become increasingly important as building blocks for biologically active peptides, – i.e. innovative pharmaceuticals. They are used in large quantities as raw materials, excipients and active ingredients in the pharmaceutical and chemical industries. In the area of biotechnology they are essential compounds in most fermentation and cell cultivation processes.

The quality demanded of such amino acids for use in pharmaceutical applications is prescribed by procedures contained in the most commonly used pharmacopoeias (Ph Eur, USP etc.) In addition, when used in biotechnological applications, particularly for the manufacture of pharmaceutical active ingredients, further requirements have to be fulfilled with respect to product properties. Our stringent analytical control procedures take care of high and uniform quality and excellent batch-to-batch consistency.

Our comprehensive range of "extra pure" Amino acids has recently been completed. Additionally specifications of all L-Amino Acids of the "for biochemistry" grade have been re-designed for applications in research & development. This provides additional reliability and facilitates up scaling from laboratory to production scale.



## Amino acids from Merck

- High quality
- Comprehensive specification
- Pharmacopoeia-tested quality
- Individual additional testing
- Special bulk packages on request
- Ready-to-use mixtures
- Easy upscaling – from research to production
- Completely reliable

### Our special service

**Do you require a different package size?**  
If so, ask us; special packaging is almost always possible.

**Do you have other special packaging requirements?**  
If so, ask us; we will suggest alternatives.

**Do you require additional test parameters on the Certificate of Analysis?**  
Just let us know; we will gladly advise you.

**Do you require customised mixtures?**  
Get in touch with us. We will provide a quotation.

### Origin of amino acids

The methods of producing amino acids include extraction from natural raw materials, chemical synthesis as well as fermentation and enzymatic processes. Due to the different manufacturing procedures involved, various starting materials are used.

We will gladly confirm the type of starting material (animal/plant/synthetic) used should you require this. In addition, documentation is available on the manufacturing processes should this be required for submission to the authorities.

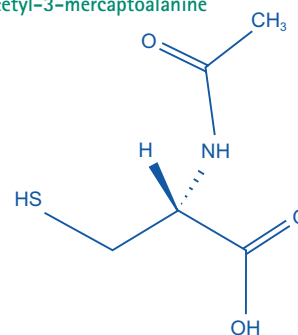
# Amino acids

## N-Acetyl-L-cysteine

Merck Cat. No. 1.12422 (for biochemistry)

|                   |   |
|-------------------|---|
| CAS-No.           | 616-91-1  |
| Summation formula | C <sub>5</sub> H <sub>9</sub> NO <sub>2</sub> S   |
| Molar weight      | 163.19 g/mol  |
| EINECS-No.        | 210-498-3   |
| Description       | White, crystalline powder with max. slight yellowish tint.  |
| Solubility        | Easily soluble in water and mineral acids; soluble in ethanol.  |
| Test solution     | While heating dissolve 3.3 g substance, exactly weighed, in DI water to make 20 ml. The solution is clear and colourless.             |
| Storage           | Well closed at room temperature (+5° to +30°C). Stable for at least 5 years.  |
| Applications      | Reduces the viscosity of mucoproteins (1). Reagent protecting SH groups (2). Merck Index 11, 89. Pharmacopoeia: DAB, BP, Ph Eur, USP. |
| Literature        | (1) Bartfeld, H. Atopynatan, T.: Nature New Biol. 231, 157 (1981). (2) Nealon, D. A., et al.: Clin. Chem. 27, 505 (1981).             |

2-Acetamido-3-mercaptopropionic acid,  
L-α-Acetamido-β-mercaptopropionic acid,  
N-acetyl-3-mercaptoalanine



### Specification:

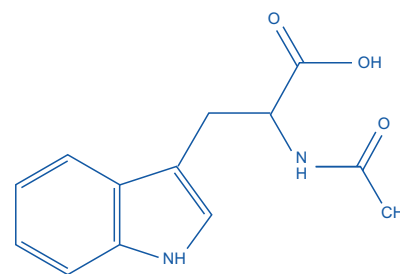
Merck Cat. No. 1.12422  
(for biochemistry)

|   |   |
|---|---|
| Assay (iodometric)                        | ≥ 99 %  |
| Identity (IR-Spectrum)                    | passes test   |
| Appearance                                | white to slightly yellowish crystalline powder or colorless crystals with characteristic odor |
| Appearance of solution (1 mol/l, water)   | clear and colorless   |
| Specific rotation (α 20/D, 50 g/l, water) | + 4.0° to + 5.0°  |
| Heavy metals (as Pb)                      | ≤ 0.001 %   |
| NH <sub>4</sub> (Ammonium)                | ≤ 0.01 %  |
| L-Cysteine (HPLC)                         | ≤ 0.02 %  |
| Other ninhydrine positive substances      | ≤ 0.1 %   |

## N-Acetyl-DL-tryptophan

Merck Cat. No. 1.12423 (for biochemistry), 1.12488 (Ph Eur, BP)

|                         |   |
|-------------------------|---|
| CAS-No.                 | 87-32-1   |
| Summation formula       | C <sub>13</sub> H <sub>14</sub> N <sub>2</sub> O <sub>3</sub>   |
| Molar weight            | 246.27 g/mol  |
| EINECS-No.              | 201-739-3   |
| Melting range           | 108 - 110°C   |
| Solubility              | Soluble in water, mineral acids and organic solvents.   |
| Test solution           | While heating, dissolve 0.5 g substance in methanol to make 50 ml. The solution is clear and colourless to max. slight yellowish. |
| Storage                 | Well closed at room temperature (+5° to +30°C). Stable for at least 5 years.  |
| Applications/Literature | Pharmacopoeia: DAB, Ph Eur, BP.   |



### Specification:

Merck Cat. No. 1.12423  
(for biochemistry)

1.12488  
(Ph Eur, USP)

|  |             |   |
|--|-------------|---|
| Assay (alkalimetric, calculated on dried substance)                    | ≥ 99 %      | 99.0 – 101.0 %  |
| Identity (IR-Spectrum)   | passes test | passes test   |
| Appearance   |             | white to almost white crystalline powder or colorless crystals                                |
| Appearance of solution (10 g/l, sodium hydroxide solution 1 mol/l)     |             | clear and not more intense in color than reference solution Y <sub>7</sub> or GY <sub>7</sub> |
| Specific rotation (α 20/D, 100 g/l, sodium hydroxide solution 1 mol/l) |             | -0.1° to +0.1°  |
| Heavy metals (as Pb)   | ≤ 0.001 %   | ≤ 0.001 %   |
| Fe (Iron)  |             | ≤ 0.001 %   |
| NH <sub>4</sub> (Ammonium)   |             | ≤ 0.02 %  |

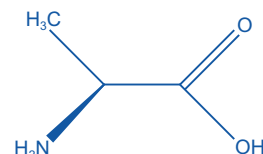
| Specification:                 | Merck Cat. No. 1.12423<br>(for biochemistry) | 1.12488<br>(Ph Eur, USP)          |
|--------------------------------|--|-----------------------------------|
| Residual solvents (Ph Eur/ICH) |  | excluded by manufacturing process |
| Related substances (HPLC)      |  | passes test                       |
| TLC-test                       | passes test                                  |                                   |
| Related substances (HPLC)      |  |                                   |
| biggest singly impurity        |  | ≤ 0.25 %                          |
| sum of all related impurities  |  | ≤ 0.5 %                           |
| Sulfated ash (600°C)           |  | ≤ 0.1 %                           |
| Loss on drying (105°C)         |  | ≤ 0.5 %                           |
| Endotoxins (acc. to LAL-test)  |  | ≤ 50 I.U./g                       |
| Pharmacopoeias                 |  | corresponds to Ph Eur, BP         |

## L-Alanine

Merck Cat. No. 1.01007 (for biochemistry), 1.01700 (Ph Eur, USP)

|                         |  |
|-------------------------|--|
| CAS-No.                 | 56-41-7  |
| Summation formula       | C <sub>3</sub> H <sub>7</sub> NO <sub>2</sub>                                |
| Molar weight            | 89.09 g/mol  |
| EINECS-No.              | 2002738  |
| Melting point           | 295-297°C (Decomposition)  |
| Solubility              | Soluble in water and mineral acids, insoluble in organic solvents.           |
| Storage                 | Well closed at room temperature (+5° to +30°C). Stable for at least 5 years. |
| Applications/Literature | Merck Index 11, 195. Pharmacopoeia: DAB, BP, Ph Franc, Ph Helv, Ph Eur, USP. |

L- $\alpha$ -Alanine, L- $\alpha$ -Aminopropionic acid, (S)-2-Aminopropanoic acid, Ala

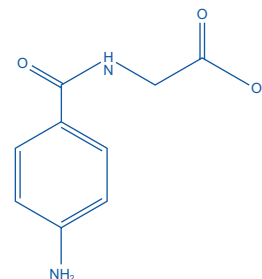


| Specification:  | Merck Cat. No. 1.01007<br>(for biochemistry)    | 1.01700<br>(Ph Eur, USP)   |
|---|---|--|
| Assay (perchloric acid titration, calculated on dried substance)                              | ≥ 99.0 %  | 98.5 – 101.0 %   |
| Identity (IR-Spectrum)  | passes test                                     | passes test  |
| Appearance  | white, crystalline powder or colorless crystals | white, crystalline powder or colorless crystals                                      |
| Appearance of solution (1 mol/l, water)   | clear and colorless                             |  |
| Appearance of solution (25 g/l, water)  |   | clear and not more intense in color than reference solution BY <sub>6</sub> (Ph Eur) |
| Specific rotation ( $\alpha$ 20/D, 50 g/l, hydrochloric acid 1 mol/l, calc. on dried subst.)  | +14.2° to +15.2°                                |  |
| Specific rotation ( $\alpha$ 20/D, 100 g/l, hydrochloric acid 250 g/l, calc. on dried subst.) |   | +13.5° to +15.5°   |
| Specific rotation ( $\alpha$ 25/D, 100 g/l, hydrochloric acid 6 mol/l, calc. on dried subst.) |   | +13.7° to +15.1°   |
| UV-Absorption (260 nm; 1 mol/l; 1 cm; water)  | ≤ 0.02  |  |
| UV-Absorption (280 nm; 1 mol/l; 1 cm; water)  | ≤ 0.02  |  |
| pH-value (50 g/l; CO <sub>2</sub> -free water)  |   | 5.5 – 7.0  |
| Chloride (Cl)   | ≤ 0.01 %  | ≤ 0.02 %   |
| Sulphate (SO <sub>4</sub> )   | ≤ 0.01 %  | ≤ 0.03 %   |
| Heavy metals (as Pb)  | ≤ 0.001 %                                       | ≤ 0.001 %  |
| As (Arsenic)  | ≤ 0.0005 %                                      |  |
| Ca (Calcium)  | ≤ 0.005 %                                       |  |
| Co (Cobalt)   | ≤ 0.0005 %                                      |  |
| Fe (Iron)   | ≤ 0.0005 %                                      | ≤ 0.001 %  |
| K (Potassium)   | ≤ 0.0005 %                                      |  |
| Mg (Magnesium)  | ≤ 0.0005 %                                      |  |
| Na (Sodium)   | ≤ 0.005 %                                       |  |
| NH <sub>4</sub> (Ammonium)  | ≤ 0.01 %  | ≤ 0.02 %   |
| Zn (Zinc)   | ≤ 0.0005 %                                      |  |
| Foreign amino acids   | ≤ 0.3 %   |  |
| Other ninhydrine positive substances  | ≤ 0.1 %   |  |
| Ninhydrine – positive substances (TLC)  |   | ≤ 0.5 %  |
| Residual solvents (Ph Eur/USP/ICH)  |   | excluded by manufacturing process  |
| Organic volatile impurities (acc. to USP)   |   | conforms   |
| Sulfated ash (600°C)  |   | ≤ 0.1 %  |
| Loss on drying (105°C, 3h)  | ≤ 0.2 %   | ≤ 0.2 %  |
| Pharmacopoeias  |   | corresponds to Ph Eur, USP   |

## 4-Aminohippuric acid

Merck Cat. No. 1.00084 (for biochemistry)

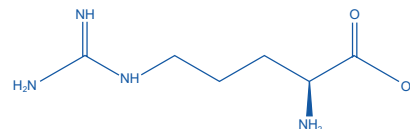
|                            |  |
|----------------------------|--|
| CAS-No.                    | 61-78-9  |
| Summation formula          | C <sub>9</sub> H <sub>10</sub> N <sub>2</sub> O <sub>3</sub>   |
| Molar weight               | 194.19 g/mol   |
| EINECS-No.                 | 200-518-9  |
| Description                | Nearly white to brown-yellowish, crystalline powder with slight odour.                                       |
| Solubility                 | Easily soluble in diluted alkalis.   |
| Test solution              | While heating, dissolve 0.2 g substance in 10.0 ml DI water.<br>The solution is nearly clear and colourless. |
| Storage                    | Well closed at room temperature (+5° to +30°C). Stable for at least 5 years.                                 |
| Applications/Literature    | The substance is light sensitive. Pharmacopoeia: USP.  |
| Specification:             | Merck Cat. No. 1.00084 (for biochemistry)  |
| Assay (acidimetric)        | ≥ 99 %   |
| Identity (IR-Spectrum)     | passes test  |
| Melting range              | 199.0 - 202.0 °C   |
| Heavy metals (as Pb)       | ≤ 0.001 %  |
| Fe (Iron)                  | ≤ 0.0005 %   |
| 4-Nitrohippuric acid (TLC) | ≤ 0.1 %  |
| Sulfated ash               | ≤ 1 %  |

N-(4-aminobenzoyl)aminoacetic acid,  
N-(4-aminobenzoyl)glycine

## L-Arginine

Merck Cat. No. 1.01542 (for biochemistry), 1.01587 (Ph Eur, USP)

|                         |  |
|-------------------------|--|
| CAS-No.                 | 74-79-3  |
| Summation formula       | C <sub>6</sub> H <sub>14</sub> N <sub>4</sub> O <sub>2</sub>                 |
| Molar weight            | 174.20 g/mol   |
| EINECS-No.              | 2008111  |
| Melting point           | 238°C (Decomposition)  |
| Solubility              | Soluble in water and mineral acids, insoluble in organic solvents.           |
| Storage                 | Well closed at room temperature (+5° to +30°C). Stable for at least 5 years. |
| Applications/Literature | Merck Index 11, 805. Pharmacopoeia: DAB, BP, Ph Franc, Ph Helv, Ph Eur, USP. |

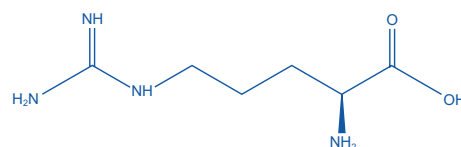
2-Amino-5-guanidinovaleric acid;  
(S)-2-Amino-5-[(aminoiminomethyl)amino]  
pentanoic acid; Arg

| Specification:  | Merck Cat. No. 1.01542 (for biochemistry)       | 1.01587 (Ph Eur, USP)  |
|---|---|--|
| Assay (perchloric acid titration, calculated on dried substance)                        | ≥ 99.0 %  | 98.5 - 101.0 %   |
| Identity (IR-Spectrum)  | passes test                                     | passes test  |
| Appearance  | white, crystalline powder or colorless crystals | white, crystalline powder or colorless crystals                                      |
| Appearance of solution (0.5 mol/l, water)   | clear and colorless                             |  |
| Appearance of solution (50 g/l; water)  |   | clear and not more intense in color than reference solution BY <sub>6</sub> (Ph Eur) |
| Specific rotation (α 20/D, 50 g/l, hydrochloric acid 1 mol/l, calc. on dried substance) | +25.0° to +26.5°                                |  |
| Specific rotation (α 20/D, 80 g/l, hydrochloric acid 250 g/l, calc. on dried substance) |   | +25.5° to +28.5°   |
| Specific rotation (α 25/D, 80 g/l, hydrochloric acid 6 mol/l, calc. on dried substance) |   | +26.3° to +27.7°   |
| UV-Absorption (260 nm; 0.5 mol/l; 1 cm; water)  | ≤ 0.3   |  |
| UV-Absorption (280 nm; 0.5 mol/l; 1 cm; water)  | ≤ 0.1   |  |
| Chloride (Cl)   | ≤ 0.02 %  | ≤ 0.02 %   |
| Sulphate (SO <sub>4</sub> )   | ≤ 0.01 %  | ≤ 0.03 %   |
| Heavy metals (as Pb)  | ≤ 0.001 %                                       | ≤ 0.001 %  |
| As (Arsenic)  | ≤ 0.0005 %                                      |  |
| Ca (Calcium)  | ≤ 0.001 %                                       |  |
| Co (Cobalt)   | ≤ 0.0005 %                                      |  |
| Fe (Iron)   | ≤ 0.0005 %                                      | ≤ 0.001 %  |
| K (Potassium)   | ≤ 0.0005 %                                      |  |
| Mg (Magnesium)  | ≤ 0.0005 %                                      |  |
| Na (Sodium)   | ≤ 0.005 %                                       |  |
| NH <sub>4</sub> (Ammonium)  | ≤ 0.01 %  | ≤ 0.02 %   |

| Specification:                            | Merck Cat. No. 1.01542<br>(for biochemistry) | 1.01587<br>(Ph Eur, USP)          |
|---|--|-----------------------------------|
| Zn (Zinc)                                 | ≤ 0.0005 %                                   |                                   |
| Foreign amino acids                       | ≤ 0.3 %                                      |                                   |
| Other ninhydrine positive substances      | ≤ 0.1 %                                      |                                   |
| Ninhydrine – positive substances (TLC)    |  | ≤ 0.5 %                           |
| Residual solvents (Ph Eur/USP/ICH)        |  | excluded by manufacturing process |
| Organic volatile impurities (acc. to USP) |  | conforms                          |
| Sulfated ash (600°C)                      |  | ≤ 0.1 %                           |
| Loss on drying (105°C, 3h)                | ≤ 0.5 %                                      | ≤ 0.5 %                           |
| Bacterial endotoxins                      |  | ≤ 2.0 I.U./g                      |
| Pharmacopoeias                            |  | corresponds to Ph Eur, USP        |

## L-Arginine monohydrochloride Merck Cat. No. 1.01543 (for biochemistry), 1.01544 (extra pure Ph Eur, BP, USP)

|                         |  |
|-------------------------|--|
| CAS-No.                 | 1119-34-2  |
| Summation formula       | C <sub>6</sub> H <sub>13</sub> ClN <sub>4</sub> O <sub>2</sub>                                 |
| Molar weight            | 210.66 g/mol   |
| EINECS-No.              | 2142751  |
| Solubility              | soluble in water and mineral acids, insoluble in organic solvents.                             |
| Storage                 | Well closed at room temperature (+5° to +30°C). Stable for at least 5 years.                   |
| Applications/Literature | Merck Index 11, 805. Römpf 8, 263. Pharmacopoeia: DAB, BP, Ph Franc, Ph Helv, JP, Ph Eur, USP. |



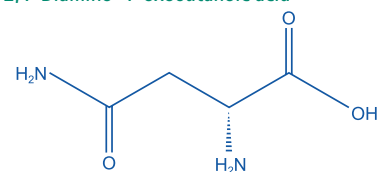
| Specification:   | Merck Cat. No. 1.01543<br>(for biochemistry)    | 1.01544<br>(extra pure Ph Eur, BP, USP)  |
|--|---|--|
| Assay (perchloric acid titration, calculated on dried substance)                     | ≥ 99.0 %  | 98.5 – 101.0 %   |
| Identity (IR-Spectrum)   | passes test                                     | passes test  |
| Appearance   | white, crystalline powder or colorless crystals | white, crystalline powder or colorless crystals                                      |
| Appearance of solution (1 mol/l, water)  | clear and colorless                             |  |
| Appearance of solution (50 g/l, water)   |   | clear and not more intense in color than reference solution BY <sub>6</sub> (Ph Eur) |
| Specific rotation (α 20/D, 50 g/l, hydrochloric acid 1 mol/l, calc. on dried subst.) | +21.0° to +22.0°                                |  |
| Specific rotation (α 20/D, 80 g/l, hydrochloric acid 250 g/l, calc. on dried subst.) |   | +21.0° to +23.5°   |
| Specific rotation (α 20/D, 80 g/l, hydrochloric acid 6 mol/l, calc. on dried subst.) |   | +21.4° to +23.6°   |
| UV-Absorption (260 nm; 1 mol/l; 1 cm; water)   | ≤ 0.1   |  |
| UV-Absorption (280 nm; 1 mol/l; 1 cm; water)   | ≤ 0.02  |  |
| Chloride (Cl) (argentometric)  |   | 16.5 – 17.1 %  |
| Sulphate (SO <sub>4</sub> )  | ≤ 0.01 %  | ≤ 0.03 %   |
| Heavy metals (as Pb)   | ≤ 0.001 %                                       | ≤ 0.001 %  |
| As (Arsenic)   | ≤ 0.0005%                                       |  |
| Ca (Calcium)   | ≤ 0.001 %                                       |  |
| Co (Cobalt)  | ≤ 0.0005 %                                      |  |
| Fe (Iron)  | ≤ 0.0005 %                                      | ≤ 0.001 %  |
| K (Potassium)  | ≤ 0.0005 %                                      |  |
| Mg (Magnesium)   | ≤ 0.0005 %                                      |  |
| Na (Sodium)  | ≤ 0.005 %                                       |  |
| NH <sub>4</sub> (Ammonium)   | ≤ 0.01 %  | ≤ 0.02 %   |
| Zn (Zinc)  | ≤ 0.0005 %                                      |  |
| Foreign amino acids  | ≤ 0.3 %   |  |
| Other ninhydrine positive substances   | ≤ 0.1 %   |  |
| Ninhydrine – positive substances (TLC)   |   | ≤ 0.5 %  |
| Residual solvents (Ph Eur/USP/ICH)   |   | excluded by manufacturing process  |
| Organic volatile impurities (acc. to USP)  |   | conforms   |
| Sulfated ash (600°C)   |   | ≤ 0.1 %  |
| Loss on drying (105 °C, 3h)  | ≤ 0.3 %   | ≤ 0.2 %  |
| Bacterial endotoxins   |   | ≤ 3.0 I.U./g   |
| Pharmacopoeias   |   | corresponds to Ph Eur, BP, USP   |

## L-Asparagine monohydrate

Merck Cat. No. 1.01566 (for biochemistry), 1.01565 (extra pure, Ph Eur)

|                         |  |
|-------------------------|--|
| CAS-No.                 | 5794-13-8  |
| Summation formula       | C <sub>4</sub> H <sub>8</sub> N <sub>2</sub> O <sub>3</sub> · H <sub>2</sub> O |
| Molar weight            | 150.14 g/mol; anhydrous 132.12 g/mol   |
| EINECS-No.              | 2007359  |
| Melting range           | 215 - 217°C  |
| Solubility              | Soluble in water, mineral acids and alkalis; insoluble in organic solvents.    |
| Storage                 | Well closed at room temperature (+15° to +25°C). Stable for at least 5 years.  |
| Applications/Literature | Merck Index 10, 850. Römpf 8, 293. Pharmacopoeia: DAB.                         |

2-Aminosuccinic acid-4-amide,  
L-β-Asparagine, α-Aminosuccinamic acid,  
Aspartic acid β-amide, Asn,  
(S)-2,4-Diamino-4-oxobutanoic acid



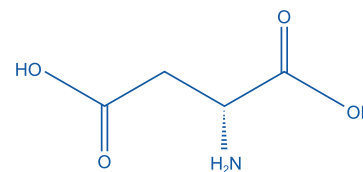
| Specification:   | Merck Cat. No. 1.01566<br>(for biochemistry)    | 1.01565<br>(extra pure, Ph Eur)                 |
|--|---|---|
| Assay (perchloric acid titration, calculated on anhydrous substance)                     | ≥ 99.0 %  |   |
| Assay (perchloric acid titration, calculated on dried substance)                         |   | 99.0 - 101.0 %                                  |
| Identity (IR-Spectrum)   | passes test                                     | passes test                                     |
| Appearance   | white, crystalline powder or colorless crystals | white, crystalline powder or colorless crystals |
| Appearance of solution (0.5 mol/l, hydrochloric acid 1 mol/l)                            | clear and colorless                             |   |
| Appearance of solution (20 g/l, water)   |   | clear and colorless                             |
| Specific rotation (α 20/D, 50 g/l, hydrochloric acid 3 mol/l, calc. on anhydrous subst.) | +34.1° to +35.6°                                |   |
| Specific rotation (α 20/D, 100 g/l, hydrochloric acid 3 mol/l, calc. on dried subst.)    |   | +33.7° to +36.0°                                |
| UV-Absorption (260 nm; 0.5 mol/l; 1 cm; hydrochloric acid 1 mol/l)                       | ≤ 0.05  |   |
| UV-Absorption (280 nm; 0.5 mol/l; 1 cm; hydrochloric acid 1 mol/l)                       | ≤ 0.05  |   |
| pH-value (20 g/l, CO <sub>2</sub> -free water)   |   | 4.0 - 6.0                                       |
| Chloride (Cl)  | ≤ 0.02 %  | ≤ 0.02 %  |
| Sulphate (SO <sub>4</sub> )  | ≤ 0.01 %  | ≤ 0.02 %  |
| Heavy metals (as Pb)   | ≤ 0.001 %                                       | ≤ 0.001 %                                       |
| As (Arsenic)   | ≤ 0.0005 %                                      |   |
| Ca (Calcium)   | ≤ 0.001 %                                       |   |
| Co (Cobalt)  | ≤ 0.0005 %                                      |   |
| Fe (Iron)  | ≤ 0.0005 %                                      | ≤ 0.001 %                                       |
| K (Potassium)  | ≤ 0.0005 %                                      |   |
| Mg (Magnesium)   | ≤ 0.0005 %                                      |   |
| Na (Sodium)  | ≤ 0.005 %                                       |   |
| NH <sub>4</sub> <sup>+</sup> (Ammonium)  | ≤ 0.01 %  | ≤ 0.1 %   |
| Zn (Zinc)  | ≤ 0.0005 %                                      |   |
| Aspartic acid  | ≤ 1.0 %   |   |
| Foreign amino acids  | ≤ 0.3 %   |   |
| Other ninhydrine positive substances   | ≤ 0.1 %   |   |
| Related substances (TLC)   |   | ≤ 0.5 %   |
| Residual solvents (Ph Eur/ICH)   |   | excluded by manufacturing process               |
| Sulfated ash (600°C)   |   | ≤ 0.1 %   |
| Loss on drying 130°C   |   | 10.5 - 12.5 %                                   |
| Water (according to Karl-Fischer)  | 11.5 - 12.5 %                                   |   |
| Bacterial endotoxins   |   | ≤ 3.0 I.U./g                                    |
| Pharmacopoeias   |   | corresponds to Ph Eur                           |

## L-Aspartic acid

Merck Cat. No. 1.00126 (for biochemistry), 1.00129 (extra pure, Ph Eur, BP, USP)

|                         |   |
|-------------------------|---|
| CAS-No.                 | 56-84-86  |
| Summation formula       | C <sub>4</sub> H <sub>7</sub> NO <sub>4</sub>   |
| Molar weight            | 133.10 g/mol  |
| EINECS-No.              | 2002916   |
| Melting range           | 265 – 271°C   |
| Solubility              | Soluble in water, acids, alkalis and organic solvents; insoluble in alcohol.          |
| Storage                 | Well closed at room temperature (+5° to +30°C). Stable for at least 5 years.          |
| Applications/Literature | Merck Index 11, 862, Römpf 8, 294. Pharmacopoeia: DAB, Ph Franc, Ph Helv, Ph Eur, BP. |

L- $\alpha$ -Amino succinic acid, Asparagic acid, Asp, Asparaginic acid, (S)-Aminobutanedioic acid, 1-Amino-1,2-carboxyethane

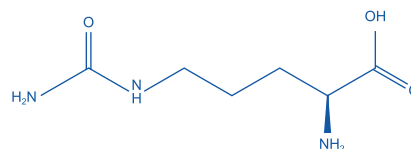


| Specification:  | Merck Cat. No. 1.00126<br>(for biochemistry)    | 1.00129<br>(extra pure, Ph Eur, BP, USP)   |
|---|---|--|
| Assay (acidimetric, calculated on dried substance)  | ≥ 99.0 %  | 98.5 – 101.5 %   |
| Identity (IR-Spectrum)  | passes test                                     | passes test  |
| Appearance  | white, crystalline powder or colorless crystals | white, crystalline powder or colorless crystals                                      |
| Appearance of solution (0.5 mol/l, hydrochloric acid 1 mol/l)                                   | clear and colorless                             |  |
| Appearance of solution (50 g/l, hydrochloric acid 1 mol/l)                                      |   | clear and not more intense in color than reference solution BY <sub>6</sub> (Ph Eur) |
| Specific rotation ( $\alpha$ 20/D, 50 g/l, hydrochloric acid 1 mol/l, calc. on dried substance) | +25.3° to +26.3°                                |  |
| Specific rotation ( $\alpha$ 20/D, 80 g/l, hydrochloric acid 250 g/l, calc. on dried substance) |   | +24.0° to +26.0°   |
| UV-Absorption (260 nm; 0.5 mol/l; 1 cm; hydrochloric acid 1 mol/l)                              | ≤ 0.2   |  |
| UV-Absorption (280 nm; 0.5 mol/l; 1 cm; hydrochloric acid 1 mol/l)                              | ≤ 0.2   |  |
| Chloride (Cl)   | ≤ 0.02 %  | ≤ 0.02 %   |
| Sulphate (SO <sub>4</sub> )   | ≤ 0.01 %  | ≤ 0.03 %   |
| Heavy metals (as Pb)  | ≤ 0.001 %                                       | ≤ 0.001 %  |
| As (Arsenic)  | ≤ 0.0005 %                                      |  |
| Ca (Calcium)  | ≤ 0.001 %                                       |  |
| Co (Cobalt)   | ≤ 0.0005 %                                      |  |
| Fe (Iron)   | ≤ 0.0005 %                                      | ≤ 0.001 %  |
| K (Potassium)   | ≤ 0.0005 %                                      |  |
| Mg (Magnesium)  | ≤ 0.0005 %                                      |  |
| Na (Sodium)   | ≤ 0.005 %                                       |  |
| NH <sub>4</sub> (Ammonium)  | ≤ 0.01 %  | ≤ 0.02 %   |
| Zn (Zinc)   | ≤ 0.0005 %                                      |  |
| Foreign amino acids   | ≤ 0.3 %   |  |
| Other ninhydrine positive substances  | ≤ 0.1 %   |  |
| Residual solvents (Ph Eur/USP/ICH)  |   | excluded by manufacturing process  |
| Organic volatile impurities (acc. to USP)   |   | conforms   |
| With Ninhydrine detectable substances (TLC)   |   | passes test  |
| Sulfated ash (600°C)  |   | ≤ 0.1 %  |
| Loss on drying (105°C, 3 h)   | ≤ 0.3 %   | ≤ 0.5 %  |
| Pharmacopoeias  |   | corresponds to Ph Eur, BP, USP   |

## L-Citrulline

Merck Cat. No. 1.12117 (for biochemistry)

|  |   |
|--|---|
| CAS-No.  | 372-75-8  |
| Summation formula  | C <sub>6</sub> H <sub>13</sub> N <sub>3</sub> O <sub>3</sub>                                  |
| Molar weight   | 175.19 g/mol  |
| EINECS-No.   | 206-759-6   |
| Melting range  | 108 – 110°C   |
| Description  | white, crystalline powder   |
| Solubility   | Soluble in water and mineral acids; insoluble in organic solvents.                            |
| Test solution  | Dissolve 1.0 g substance in DI water to make 20.0 ml.<br>The solution is clear and colorless. |
| Storage  | Well closed at room temperature (+5° to +30°C). Stable for at least 5 years.                  |
| Applications/Literature                                    | Pharmacopoeia: DAC.   |
| Specification:   | <b>Merck. Cat. No. 1.12117</b><br>(for biochemistry)  |
| Assay (perchloric acid titration)                          | ≥ 99 %  |
| Identity (IR-Spectrum)                                     | passes test   |
| Specific rotation (α 20/D, 2 %, hydrochloric acid 1 mol/l) | + 22° to + 23°  |
| Heavy metals (as Pb)                                       | ≤ 0.001 %   |
| NH <sub>4</sub> (Ammonium)                                 | ≤ 0.01 %  |
| Foreign amino acids  | ≤ 0.3 %   |
| Other ninhydrine-positive substances (as Glycine)          | ≤ 0.1 %   |

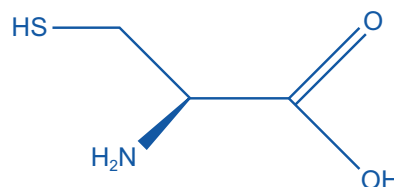


## L-Cysteine

Merck Cat. No. 1.02838 (for biochemistry)

|   |  |
|---|--|
| CAS-No.   | 52-90-4  |
| Summation formula   | C <sub>3</sub> H <sub>7</sub> NO <sub>2</sub> S  |
| Molar weight  | 121.16 g/mol   |
| EINECS-No.  | 2001582  |
| Solubility  | Soluble in water, alcohol and mineral acids; insoluble in organic solvents   |
| Storage   | Well closed at room temperature (+5° to 30° C). Stable for at least 5 years  |
| Applications/Literature   | In aqueous solutions L-Cysteine becomes easily oxidised to L-Cystine on contact with air at neutral or alkaline pH. More stable in acidic solutions.<br>pK <sub>1</sub> = 1.71; pK <sub>2</sub> = 8.33; pK <sub>3</sub> = 10.78. Merck Index 11, 2787.<br>Pharmacopoeia: DAB |
| Specification:  | <b>Merck. Cat. No. 1.02838</b><br>(for biochemistry)   |
| Assay (perchloric acid titration, calculated on dried substance)                        | ≥ 99.0 %   |
| Identity (IR-Spectrum)  | passes test  |
| Appearance  | white, crystalline powder or colorless crystals  |
| Appearance of solution (0.5 mol/l, hydrochloric acid 1 mol/l)                           | clear and colorless  |
| Specific rotation (α 20/D, 50 g/l, hydrochloric acid 1 mol/l, calc. on dried substance) | +8.0° to +9.0°   |
| UV-Absorbtion (280 nm; 0.5 mol/l, 1 cm; hydrochloric acid 1 mol/l)                      | ≤ 0.5  |
| Chloride (Cl)   | ≤ 0.02 %   |
| Sulphate (SO <sub>4</sub> )   | ≤ 0.01 %   |
| Heavy metals (as Pb)  | ≤ 0.001 %  |
| As (Arsenic)  | ≤ 0.0005 %   |
| Ca (Calcium)  | ≤ 0.001 %  |
| Co (Cobalt)   | ≤ 0.0005 %   |
| Fe (Iron)   | ≤ 0.0005 %   |
| K (Potassium)   | ≤ 0.0005 %   |

L-2-Amino-3-mercaptopropionic acid, Cys,  
β-Mercaptoalanine, Thioisoserine,  
α-Amino-β-thiolpropionic acid

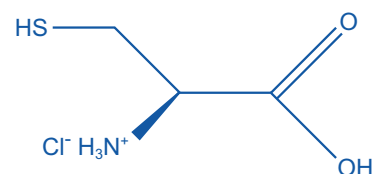


|                                      |  |
|--------------------------------------|--|
| Specification:                       | Merck Cat. No. 1.02838<br>(for biochemistry) |
| Mg (Magnesium)                       | ≤ 0.0005 %                                   |
| Na (Sodium)                          | ≤ 0.005 %                                    |
| NH <sub>4</sub> (Ammonium)           | ≤ 0.01 %                                     |
| Zn (Zinc)                            | ≤ 0.0005 %                                   |
| Foreign amino acids                  | ≤ 0.5 %                                      |
| Other ninhydrine positive substances | ≤ 0.1 %                                      |
| Loss on drying (105°C, 3 h)          | ≤ 0.3 %                                      |

## L-Cysteine hydrochloride monohydrate Merck Cat. No. 1.02839 (for biochemistry), 1.02735 (Ph Eur, USP)

|                   |  |
|-------------------|--|
| CAS-No.           | 7048-04-6  |
| Summation formula | C <sub>3</sub> H <sub>8</sub> ClNO <sub>2</sub> S · H <sub>2</sub> O   |
| Molar weight      | 175.64 g/mol; anhydrous 157.62 g/mol   |
| EINECS-No.        | 2001577  |
| Melting range     | 168-170°C (Decomposition)  |
| Storage           | Well closed at room temperature (+5° to +30°C). Stable for at least 5 years.   |
| Applications      | The hydrochloride is relatively stable, in aqueous solutions L-Cysteine becomes easily oxidised to L-Cystine on contact with air at neutral or alkaline pH. Merck Index 11, 2850. Pharmacopoeia DAB, BP, Ph Franc, Ph Helv, Ph Eur, USP. |

L-Cysteiniumchloride monohydrate;  
3-Mercapto-2-aminopropionic acid  
hydrochloride



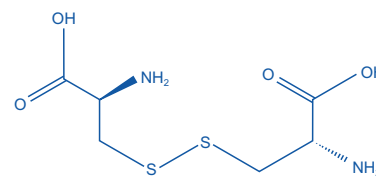
| Specification:   | Merck Cat. No. 1.02839<br>(for biochemistry)    | 1.02735<br>(Ph Eur, USP)   |
|--|---|--|
| Assay (iodometric, calculated on dried substance)                                    | ≥ 99.0 %  | 98.5 – 101.0 %   |
| Identity   |   |  |
| IR-Spectrum  | passes test                                     | passes test  |
| Chloride   |   | passes test  |
| Appearance   | white, crystalline powder or colorless crystals | white, crystalline powder or colorless crystals                                      |
| Appearance of solution (1 mol/l, water)  | clear and colorless                             |  |
| Appearance of solution (25 g/l; water)   |   | clear and not more intense in color than reference solution BY <sub>6</sub> (Ph Eur) |
| Specific rotation (α 20/D, 50 g/l, hydrochloric acid 1 mol/l, calc. on dried subst.) | +6.3° to +7.3°                                  |  |
| Specific rotation (α 20/D, 80 g/l, hydrochloric acid 250 g/l, calc. on dried subst.) |   | +5.5° to +7.0°   |
| Specific rotation (α 25/D, 80 g/l, hydrochloric acid 6 mol/l, calc. on dried subst.) |   | +5.7° to +6.8°   |
| UV-Absorption 280 nm; 1 mol/l, 1 cm; water   | ≤ 0.1   |  |
| Sulphate (SO <sub>4</sub> )  | ≤ 0.01 %  | ≤ 0.03 %   |
| Heavy metals (as Pb)   | ≤ 0.001 %                                       | ≤ 0.001 %  |
| As (Arsenic)   | ≤ 0.0005 %                                      |  |
| Ca (Calcium)   | ≤ 0.001 %                                       |  |
| Co (Cobalt)  | ≤ 0.0005 %                                      |  |
| Fe (Iron)  | ≤ 0.0005 %                                      | ≤ 0.002 %  |
| K (Potassium)  | ≤ 0.0005 %                                      |  |
| Mg (Magnesium)   | ≤ 0.0005 %                                      |  |
| Na (Sodium)  | ≤ 0.02 %  |  |
| NH <sub>4</sub> (Ammonium)   | ≤ 0.01 %  | ≤ 0.02 %   |
| Zn (Zinc)  | ≤ 0.0005 %                                      |  |
| Foreign amino acids  | ≤ 0.3 %   |  |
| Other ninhydrine positive substances (as Glycine)                                    | ≤ 0.1 %   |  |
| Ninhydrine – positive substances (TLC)   |   | ≤ 0.5 %  |
| Residual solvents (Ph Eur/USP/ICH)   |   | excluded by manufacturing process  |
| Organic volatile impurities (acc. to USP)  |   | conforms   |
| Sulfated ash (600°C)   |   | ≤ 0.1 %  |
| Loss on drying (vacuum < 0.7 kPa, P <sub>2</sub> O <sub>5</sub> , 24h)               | 9.0 – 11.5 %                                    | 8.0 – 12.0 %   |
| Pharmacopoeias   |   | corresponds to Ph Eur, USP   |

## L-Cystine

Merck Cat. No. 1.02837 (for biochemistry), 1.02737 (Ph Eur)

|                         |  |
|-------------------------|--|
| CAS-No.                 | 56-89-3  |
| Summation formula       | C <sub>3</sub> H <sub>12</sub> N <sub>2</sub> O <sub>4</sub> S <sub>2</sub>  |
| Molar weight            | 240.30 g/mol   |
| EINECS-No.              | 2002963  |
| Melting range           | 261-262°C (Decomposition)  |
| Storage                 | Well closed at room temperature (+5° to +30°C). Stable for at least 5 years.   |
| Applications/Literature | Quite soluble in aqueous solutions below pH 2 or above pH 8. pK <sub>1</sub> = 1; pK <sub>2</sub> = 2.1, pK <sub>3</sub> = 8.02 at 35°C. Merck Index 11, 2788. Römpf 8, 851. Pharmacopoeia: DAB, Ph Eur. |

3,3'-Dithiobis(2-aminopropionic acid),  
α-Diamino-β-dithiolactic acid,  
Bis(β-amino-β-carboxyethyl)disulfide



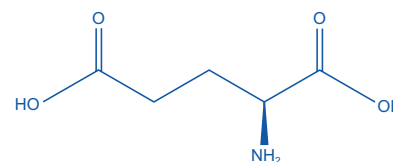
| Specification:   | Merck Cat. No. 1.02837 (for biochemistry)       | 1.02737 (Ph Eur)  |
|--|---|---|
| Assay (perchloric acid titration, calculated on dried substance)                     | ≥ 99.0 %  |   |
| Assay (bromatometric, calculated on dried substance)                                 |   | 98.5 – 101.0 %  |
| Identity (IR-Spectrum)   | passes test                                     | passes test   |
| Appearance   | white, crystalline powder or colorless crystals | white, fine, crystalline powder   |
| Appearance of solution (0.2 mol/l, hydrochloric acid 1 mol/l)                        | clear and colorless                             |   |
| Appearance of solution (100 g/l, hydrochloric acid 2 mol/l)                          |   | clear and not more intense in color than reference solution Y, (Ph Eur) |
| Specific rotation (α 20/D, 50 g/l, hydrochloric acid 1 mol/l, calc. on dried subst.) | -220.0° to -225.0°                              |   |
| Specific rotation (α 20/D, 20 g/l, hydrochloric acid 1 mol/l, calc. on dried subst.) |   | -218.0° to -224.0°  |
| Chloride (Cl)  | ≤ 0.02 %  | ≤ 0.02 %  |
| Sulphate (SO <sub>4</sub> )  | ≤ 0.01 %  | ≤ 0.03 %  |
| Heavy metals (as Pb)   | ≤ 0.001 %                                       | ≤ 0.001 %   |
| As (Arsenic)   | ≤ 0.0005 %                                      |   |
| Ca (Calcium)   | ≤ 0.001 %                                       |   |
| Co (Cobalt)  | ≤ 0.0005 %                                      |   |
| Fe (Iron)  | ≤ 0.0005 %                                      | ≤ 0.001 %   |
| K (Potassium)  | ≤ 0.0005 %                                      |   |
| Mg (Magnesium)   | ≤ 0.0005 %                                      |   |
| Na (Sodium)  | ≤ 0.005 %                                       |   |
| NH <sub>4</sub> (Ammonium)   | ≤ 0.01 %  | ≤ 0.02 %  |
| Zn (Zinc)  | ≤ 0.0005 %                                      |   |
| Foreign amino acids  | ≤ 0.3 %   |   |
| Other ninhydrine positive substances   | ≤ 0.1 %   |   |
| Ninhydrine – positives substances (TLC)  |   | ≤ 0.2 %   |
| Residual solvents (Ph Eur/ICH)   |   | excluded by manufacturing process                                       |
| Sulfated ash (600°C)   |   | ≤ 0.1 %   |
| Loss on drying (105°C, 3h)   | ≤ 0.3 %   | ≤ 0.5 %   |
| Pharmacopoeias   |   | corresponds to Ph Eur   |

## L-Glutamic acid

Merck Cat. No. 1.00291 (for biochemistry), 1.01791 (Ph Eur)

|                         |  |
|-------------------------|--|
| CAS-No.                 | 56-86-0  |
| Summation formula       | C <sub>5</sub> H <sub>9</sub> NO <sub>4</sub>  |
| Molar weight            | 147.13 g/mol   |
| EINECS-No.              | 2002937  |
| Melting point           | 160°C  |
| Solubility              | Soluble in mineral acids and water, insoluble in organic solvents.   |
| Storage                 | Well closed at room temperature (+5° to +30°C). Stable for at least 5 years.   |
| Applications/Literature | In aqueous solutions forms pyrrolidonecarboxylic acid slowly at room temperature, more rapidly at 100°C. Merck Index 11, 4363. Römpf 8, 1509. Pharmacopoeia: DAB, BP, Ph Franc, Ph Helv, OEAB, Ph Eur. |

L-α-Aminoglutaric acid, Glu, Glutamic acid,  
(S)-2-Aminopentanedioic acid,  
1-Aminopropane-1,3-dicarboxylic acid



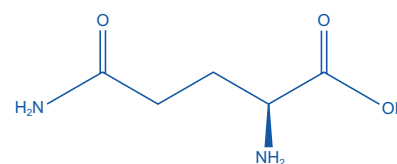
| Specification:   | Merck Cat. No. 1. 00291<br>(for biochemistry)   | 1. 01791<br>(Ph Eur)                            |
|--|---|---|
| Assay (acidimetric, calculated on dried substance)   | ≥ 99.0 %  | 98.5 – 100.5 %                                  |
| Identity (IR-Spectrum)   | passes test                                     | passes test                                     |
| Appearance   | white, crystalline powder or colorless crystals | white, crystalline powder or colorless crystals |
| Appearance of solution (0.5 mol/l, hydrochloric acid 1 mol/l)                                    | clear and colorless                             |   |
| Appearance of solution (100 g/l, hydrochloric acid 1 mol/l)                                      |   | clear and colorless                             |
| Specific rotation ( $\alpha$ 20/D, 50 g/l, hydrochloric acid 1 mol/l, calc. on dried substance)  | +31.5° to +32.5°                                |   |
| Specific rotation ( $\alpha$ 20/D, 100 g/l, hydrochloric acid 1 mol/l, calc. on dried substance) |   | +30.5° to +32.5°                                |
| UV-Absorption (260 nm; 0.5 mol/l; 1 cm; hydrochloric acid 1 mol/l)                               | ≤ 0.1   |   |
| UV-Absorption (280 nm; 0.5 mol/l; 1 cm; hydrochloric acid 1 mol/l)                               | ≤ 0.1   |   |
| Chloride (Cl)  | ≤ 0.02 %  | ≤ 0.02 %  |
| Sulphate (SO <sub>4</sub> )  | ≤ 0.01 %  | ≤ 0.03 %  |
| Heavy metals (as Pb)   | ≤ 0.001 %                                       | ≤ 0.001 %                                       |
| As (Arsenic)   | ≤ 0.0005 %                                      |   |
| Ca (Calcium)   | ≤ 0.001 %                                       |   |
| Co (Cobalt)  | ≤ 0.0005 %                                      |   |
| Fe (Iron)  | ≤ 0.0005 %                                      | ≤ 0.001 %                                       |
| K (Potassium)  | ≤ 0.0005 %                                      |   |
| Mg (Magnesium)   | ≤ 0.0005 %                                      |   |
| Na (Sodium)  | ≤ 0.01 %  |   |
| NH <sub>4</sub> (Ammonium)   | ≤ 0.01 %  | ≤ 0.02 %  |
| Zn (Zinc)  | ≤ 0.0005 %                                      |   |
| Foreign amino acids  | ≤ 0.3 %   |   |
| Other ninhydrine positive substances   | ≤ 0.1 %   |   |
| Ninhydrine – positives substances (TLC)  |   | ≤ 0.5 %   |
| Residual solvents (Ph Eur/ICH)   |   | excluded by manufacturing process               |
| Sulfated ash (600°C)   |   | ≤ 0.1 %   |
| Loss on drying (105°C, 3h)   | ≤ 0.3%  | ≤ 0.5%  |
| Pharmacopoeias   |   | corresponds to Ph Eur                           |

## L-Glutamine

Merck Cat. No. 1.00298 (for biochemistry), 1.00286 (Ph Eur)

|                         |  |
|-------------------------|--|
| CAS-No.                 | 56-85-9  |
| Summation formula       | C <sub>5</sub> H <sub>10</sub> N <sub>2</sub> O <sub>3</sub>   |
| Molar weight            | 146.15 g/mol   |
| EINECS-No.              | 2002921  |
| Melting range           | 185–186°C  |
| Solubility              | Soluble in mineral acids and water, insoluble in organic solvents  |
| Storage                 | Well closed at room temperature (+5° to +30°C). Stable for at least 5 years  |
| Applications/Literature | Rapidly converted in neutral or weakly acidic aqueous solutions to the ammonium salt of the pyrrolidonecarboxylic acid. pK <sub>1</sub> = 2.17, pK <sub>2</sub> = 9.13.<br>Merck Index 11, 4365. Pharmacopoeia: DAB, USP |

L-Glutamic acid-5-amine, Gln,  
2-Aminoglutaramic acid,  
(S)-2,5-Diamino-5-oxopentanoic acid



| Specification:  | Merck Cat. No. 1.00298<br>(for biochemistry)    | 1.00286<br>(DAB, USP)                           |
|---|---|---|
| Assay (perchloric acid titration, calculated on dried substance)                              | ≥ 99.0 %  | 99.0 – 101.0 %                                  |
| Identity (IR-Spectrum)  | passes test                                     | passes test                                     |
| Appearance  | white, crystalline powder or colorless crystals | white, crystalline powder or colorless crystals |
| Appearance of solution (1 mol/l, hydrochloric acid 1 mol/l)                                   | clear and colorless                             |   |
| Appearance of solution (25 g/l, water)  |   | clear and colorless                             |
| Specific rotation ( $\alpha$ 20/D, 50 g/l, hydrochloric acid 1 mol/l, calc. on dried subst.)  | +32.3° to +33.3°                                |   |
| Specific rotation ( $\alpha$ 20/D, 100 g/l, hydrochloric acid 2 mol/l, calc. on dried subst.) |   | +31.5° to +33.0°                                |
| Specific rotation ( $\alpha$ 20/D, 40 g/l, water, calc. on dried substance)                   |   | +6.3° to +7.3°                                  |
| UV-Absorption (260 nm; 1 mol/l; 1 cm; hydrochloric acid 1 mol/l)                              | ≤ 0.2   |   |
| UV-Absorption (280 nm; 1 mol/l; 1 cm; hydrochloric acid 1 mol/l)                              | ≤ 0.02  |   |
| pH-value (25 g/l; CO <sub>2</sub> -free water)  |   | 4.0 – 6.0                                       |
| Chloride (Cl)   | ≤ 0.02 %  | ≤ 0.02 %  |
| Sulphate (SO <sub>4</sub> )   | ≤ 0.01 %  | ≤ 0.02 %  |
| Heavy metals (as Pb)  | ≤ 0.001 %                                       | ≤ 0.001 %                                       |

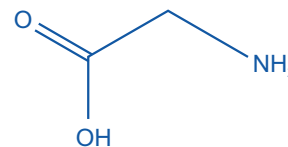
| Specification:                            | Merck Cat. No. 1. 00298<br>(for biochemistry) | 1. 00286<br>(DAB, USP)            |
|---|---|-----------------------------------|
| As (Arsenic)                              | ≤ 0.0005 %                                    |                                   |
| Ca (Calcium)                              | ≤ 0.001 %                                     |                                   |
| Co (Cobalt)                               | ≤ 0.0005 %                                    |                                   |
| Fe (Iron)                                 | ≤ 0.0005 %                                    | ≤ 0.001 %                         |
| K (Potassium)                             | ≤ 0.0005 %                                    |                                   |
| Mg (Magnesium)                            | ≤ 0.0005 %                                    |                                   |
| Na (Sodium)                               | ≤ 0.005 %                                     |                                   |
| NH <sub>4</sub> (Ammonium)                | ≤ 0.1 %                                       | ≤ 0.1 %                           |
| Zn (Zinc)                                 | ≤ 0.0005 %                                    |                                   |
| Foreign amino acids                       | ≤ 0.3 %                                       |                                   |
| Other ninhydrine positive substances      | ≤ 0.2 %                                       |                                   |
| Ninhydrine – positive substances (TLC)    |   | ≤ 0.5 %                           |
| Residual solvents (Ph Eur/USP/ICH)        |   | excluded by manufacturing process |
| Organic volatile impurities (acc. to USP) |   | conforms                          |
| Sulfated ash (600°C)                      |   | ≤ 0.1 %                           |
| Loss on drying (105°C, 3h)                | ≤ 0.3 %                                       | ≤ 0.3 %                           |
| Bacterial endotoxins                      |   | ≤ 2.0 I.U./g                      |
| Pharmacopoeias                            |   | corresponds to DAB, USP           |

## Glycine

Merck Cat. No. 1.04201 (for biochemistry), 5.00190 (cryst. Ph Eur, BP, USP)

|                   |  |
|-------------------|--|
| CAS-No.           | 56-40-6  |
| Summation formula | C <sub>2</sub> H <sub>5</sub> NO <sub>2</sub>  |
| Molar weight      | 75.07 g/mol  |
| EINECS-No.        | 2002722  |
| Melting range     | 232–236°C (Decomposition)  |
| Solubility        | Soluble in water, slightly soluble in ethanol. Insoluble in organic solvents.  |
| Storage           | Well closed at room temperature (+5° to +30°C). Stable for at least 5 years.   |
| Applications      | Suitable as buffer substance for general biochemical work (pKa=2.35 and 9.78).<br>Merck Index 11, 4500. Pharmacopoeia: DAB, BP, Ph Franc, Ph Helv, JP, Ph Eur, USP |

Aminoacetic acid, Glycocol, Soerensens buffer substances



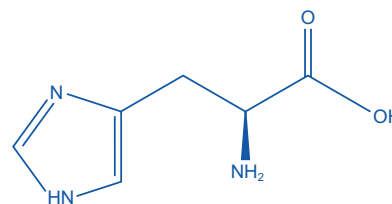
| Specification:   | Merck Cat. No. 1. 04201<br>(for biochemistry) | 5.00190<br>(cryst. Ph Eur, BP, USP)                                     |
|--|---|---|
| Assay (perchloric acid titration, calculated on dried substance) | ≥ 99.7 % (perchloric acid titration)          | 98.5 – 101.0 %  |
| Identity (IR-Spectrum)   | passes test                                   | passes test   |
| Appearance   |   | colorless, fine crystals or white crystalline powder                    |
| Appearance of solution (100 g/l, water)                          |   | clear and not more intense in color than reference solution Y, (Ph Eur) |
| pH-value (50 g/l, CO <sub>2</sub> -free water)                   | 5.9 – 6.3                                     | 5.9 – 6.4   |
| Chloride (Cl)  | ≤ 0.003 %                                     | ≤ 0.007 %   |
| Sulphate (SO <sub>4</sub> )                                      | ≤ 0.0025 %                                    | ≤ 0.0065 %  |
| Heavy metals (as Pb)   | ≤ 0.001 %                                     | ≤ 0.001 %   |
| Cu (Copper)  | ≤ 0.0001 %                                    |   |
| Fe (Iron)  | ≤ 0.0001 %                                    |   |
| Pb (Lead)  | ≤ 0.0001 %                                    |   |
| NH <sub>4</sub> (Ammonium)                                       | ≤ 0.02 %                                      |   |
| Foreign amino acids  | ≤ 0.1 %                                       |   |
| Other ninhydrine positive substances                             | ≤ 0.1 %                                       |   |
| In water insoluble matter  | ≤ 0.003 %                                     |   |
| Hydrolizable substances  |   | passes test   |
| Ninhydrine – positive substances (TLC)                           |   | ≤ 0.5 %   |
| Residual solvents (Ph Eur/USP/ICH) class2 (Methanol)             |   | ≤ 0.3 %   |
| Other residual solvents (Ph Eur/USP/ICH)                         |   | excluded by manufacturing process                                       |
| Organic volatile impurities (acc. to USP)                        |   | conforms  |
| Sulfated ash (600°C)   | ≤ 0.05 %                                      | ≤ 0.1 %   |
| Loss on drying (105°C)   |   | ≤ 0.2 %   |
| Bacterial endotoxins   |   | ≤ 3.0 % I.U./g  |
| Pharmacopoeias   |   | corresponds to Ph Eur, BP, USP  |

## L-Histidine

Merck Cat. No. 1.04351 (for biochemistry), 1.04352 (Ph Eur, USP)

|                         |   |
|-------------------------|---|
| CAS-No.                 | 71-00-1   |
| Summation formula       | C <sub>6</sub> H <sub>9</sub> N <sub>3</sub> O <sub>2</sub>   |
| Molar weight            | 155.16 g/mol  |
| EINECS-No.              | 2007453   |
| Melting point           | 272–273°C (Decomposition)   |
| Solubility              | Soluble in water, alcohol and mineral acids; insoluble in organic solvents.   |
| Storage                 | Well closed at room temperature (+5° to +30°C). Stable for at least 5 years.  |
| Applications/Literature | Losses occur during protein hydrolysis. Readily racemized on heating with H <sub>2</sub> SO <sub>4</sub> . Merck Index 11, 4758. Pharmacopoeia DAB, BP, Ph Franc, Ph Helv, Ph Eur, USP. |

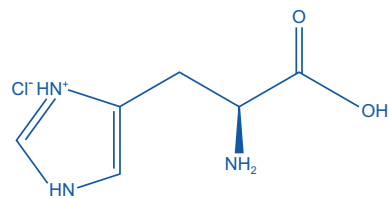
L-3-Imidazol-4-ylalanine, His,  
(S)-α-Amino-1H-imidazole-4-propionic acid,  
Glyoxaline-5-alanine



| Specification:  | Merck Cat. No. 1.04351<br>(for biochemistry)    | 1.04352<br>(Ph Eur, USP)   |
|---|---|--|
| Assay (acidimetric, calculated on dried substance)                                    | ≥ 99.0 %  | 98.5 – 101.0 %   |
| Identity (IR-Spectrum)  | passes test                                     | passes test  |
| Appearance  | white, crystalline powder or colorless crystals | white, crystalline powder or colorless crystals                                      |
| Appearance of solution (0.5 mol/l, hydrochloric acid 1 mol/l)                         | clear and colorless                             |  |
| Appearance of solution (50 g/l; water)  |   | clear and not more intense in color than reference solution BY <sub>7</sub> (Ph Eur) |
| Specific rotation (α 20/D, 50 g/l, hydrochloric acid 1 mol/l, calc. on dried subst.)  | +10.5° to +11.5°                                |  |
| Specific rotation (α 20/D, 110 g/l, hydrochloric acid 120 g/l, calc. on dried subst.) |   | +11.4° to +12.4°   |
| Specific rotation (α 25/D, 110 g/l, hydrochloric acid 6 mol/l, calc. on dried subst.) |   | +12.6° to +14.0°   |
| UV-Absorption (260 nm; 0.5 mol/l; 1 cm; hydrochloric acid 1 mol/l)                    | ≤ 0.07  |  |
| UV-Absorption (280 nm; 0.5 mol/l; 1 cm; hydrochloric acid 1 mol/l)                    | ≤ 0.07  |  |
| pH-value (20 g/l; CO <sub>2</sub> -free water)  |   | 7.0 – 8.5  |
| Chloride (Cl)   | ≤ 0.02 %  | ≤ 0.02 %   |
| Sulphate (SO <sub>4</sub> )   | ≤ 0.01 %  | ≤ 0.03 %   |
| Heavy metals (as Pb)  | ≤ 0.001 %                                       | ≤ 0.001 %  |
| As (Arsenic)  | ≤ 0.0005 %                                      |  |
| Ca (Calcium)  | ≤ 0.001 %                                       |  |
| Co (Cobalt)   | ≤ 0.0005 %                                      |  |
| Fe (Iron)   | ≤ 0.0005 %                                      | ≤ 0.001 %  |
| K (Potassium)   | ≤ 0.0005 %                                      |  |
| Mg (Magnesium)  | ≤ 0.0005 %                                      |  |
| Na (Sodium)   | ≤ 0.005 %                                       |  |
| NH <sub>4</sub> <sup>+</sup> (Ammonium)   | ≤ 0.01 %  | ≤ 0.02 %   |
| Zn (Zinc)   | ≤ 0.0005 %                                      |  |
| Foreign amino acids   | ≤ 0.3 %   |  |
| Other ninhydrine positive substances  | ≤ 0.1 %   |  |
| Ninhydrine – positive substances (TLC)  |   | ≤ 0.5 %  |
| Residual solvents (Ph Eur/USP/ICH)  |   | excluded by manufacturing process  |
| Sulfated ash (600°C)  |   | ≤ 0.1 %  |
| Loss on drying (105°C, 3h)  | ≤ 0.3%  | ≤ 0.2 %  |
| Bacterial endotoxins  |   | ≤ 2.0 I.U./g   |
| Pharmacopoeias  |   | corresponds to Ph Eur, USP   |

L-Histidine monohydrochloride monohydrate Merck Cat. No. 1.04350 (for biochemistry), 1.04354 (extra pure Ph Eur, BP)

|                         |   |
|-------------------------|---|
| CAS-No.                 | 5934-29-2   |
| Summation formula       | C <sub>6</sub> H <sub>10</sub> ClN <sub>3</sub> O <sub>2</sub> · H <sub>2</sub> O             |
| Molar weight            | 209.63 g/mol; anhydrous 191.62 g/mol  |
| EINECS-No.              | 2114389   |
| Melting point           | 259°C (Decomposition)   |
| Solubility              | Soluble in water and mineral acids; insoluble in organic solvents.                            |
| Storage                 | Well closed at room temperature (+5° to +30°C). Stable for at least 5 years.                  |
| Applications/Literature | Merck Index 10, 4617. Römpp 8, 1711. Pharmacopoeia: DAB, Ph Eur, BP, Ph Franc, Ph Helv, OEAB. |



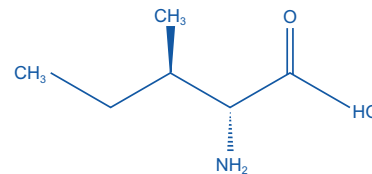
| Specification:   | Merck Cat. No. 1.04350<br>(for biochemistry)    | 1.04354<br>(extra pure Ph Eur, BP)   |
|--|---|--|
| Assay (acidimetric, calculated on anhydrous or dried substance)                                    | ≥ 99.0 % (anhydrous)                            | 98.5 – 101.0 % (dried)   |
| Identity (IR-Spectrum)   | passes test                                     | passes test  |
| Identity (chloride)  |   | passes test  |
| Appearance   | white, crystalline powder or colorless crystals | white, crystalline powder or colorless crystals                                      |
| Appearance of solution (0.5 mol/l, water)  | clear and colorless                             |  |
| Appearance of solution (50 g/l, water)   |   | clear and not more intense in color than reference solution BY <sub>6</sub> (Ph Eur) |
| Specific rotation (α <sub>D</sub> 20/D, 50 g/l, hydrochloric acid 1 mol/l, calc. on dried subst.)  | +8.5° to +10.5°                                 |  |
| Specific rotation (α <sub>D</sub> 20/D, 110 g/l, hydrochloric acid 120 g/l, calc. on dried subst.) |   | +9.2° to +10.6°  |
| UV-Absorption (260 nm; 0.5 mol/l; 1 cm; water)   | ≤ 0.05  |  |
| UV-Absorption (280 nm; 0.5 mol/l; 1 cm; water)   | ≤ 0.05  |  |
| pH-value (50 g/l, water)   |   | 3.0 – 5.0  |
| Sulphate (SO <sub>4</sub> )  | ≤ 0.01 %  | ≤ 0.03 %   |
| Heavy metals (as Pb)   | ≤ 0.001 %                                       | ≤ 0.001 %  |
| As (Arsenic)   | ≤ 0.0005 %                                      |  |
| Ca (Calcium)   | ≤ 0.001 %                                       |  |
| Co (Cobalt)  | ≤ 0.0005 %                                      |  |
| Fe (Iron)  | ≤ 0.0005 %                                      | ≤ 0.001 %  |
| K (Potassium)  | ≤ 0.0005 %                                      |  |
| Mg (Magnesium)   | ≤ 0.0005 %                                      |  |
| Na (Sodium)  | ≤ 0.005 %                                       |  |
| NH <sub>4</sub> (Ammonium)   | ≤ 0.01 %  | ≤ 0.02 %   |
| Zn (Zinc)  | ≤ 0.0005 %                                      |  |
| Foreign amino acids  | ≤ 0.3 %   |  |
| Other ninhydrine positive substances   | ≤ 0.1 %   |  |
| Ninhydrine – positive substances (TLC)   |   | passes test  |
| Residual solvents (Ph Eur/ICH)   |   | excluded by manufacturing process  |
| Sulfated ash (600°C)   |   | ≤ 0.1 %  |
| Water (according to Karl Fischer)  | 8.0 – 9.0 %                                     |  |
| Loss on drying (105°C)   |   | 7.0 – 10.0 %   |
| Pharmacopoeias   |   | corresponds to Ph Eur, BP  |

## L-Isoleucine

Merck Cat. No. 1.05362 (for biochemistry), 1.05357 (Ph Eur, USP)

|                         |   |
|-------------------------|---|
| CAS-No.                 | 73-32-5   |
| Summation formula       | C <sub>6</sub> H <sub>13</sub> NO <sub>2</sub>                                    |
| Molar weight            | 131.18 g/mol  |
| EINECS-No.              | 2007982   |
| Melting range           | 279-280°C   |
| Solubility              | Soluble in water and mineral acids; insoluble in organic solvents.                |
| Storage                 | Well closed at room temperature (+5° to +30°C). Stable for at least 5 years.      |
| Applications/Literature | Merck Index 11, 5064. Pharmacopoeia: DAB, BP, Ph Franc, Ph Helv, JP, Ph Eur, USP. |

iso-Leucine, Ile, 2-Amino-3-methylvaleric acid

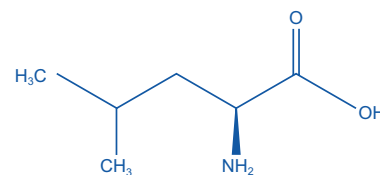


| Specification:   | Merck Cat. No. 1.05362<br>(for biochemistry) | 1.05357<br>(Ph Eur, USP)   |
|--|--|--|
| Assay (perchloric acid titration, calculated on dried substance)                             | ≥ 99.0 %                                     | 98.5 – 101.0 %   |
| Identity (IR-Spectrum)   | passes test                                  | passes test  |
| Appearance   | white, crystalline powder or brightly flakes | white, crystalline powder or brightly flakes   |
| Appearance of solution (1 mol/l, hydrochloric acid 1 mol/l)                                  | clear and colorless                          |  |
| Appearance of solution (50 g/l, hydrochloric acid 1 mol/l)                                   |  | clear and not more intense in color than reference solution BY <sub>6</sub> (Ph Eur) |
| Specific rotation ( $\alpha$ 20/D, 50 g/l, hydrochloric acid 1 mol/l, calc. on dried subst.) | +36.2° to +37.2°                             |  |
| Specific rotation ( $\alpha$ 20/D, 40 g/l, hydrochloric acid 250 g/l, calc. on dried subst.) |  | +40.0° to +43.0°   |
| Specific rotation ( $\alpha$ 25/D, 40 g/l, hydrochloric acid 6 mol/l, calc. on dried subst.) |  | +38.9° to +41.8°   |
| UV-Absorption (260 nm; 1 mol/l; 1 cm; hydrochloric acid 1 mol/l)                             | ≤ 0.10                                       |  |
| UV-Absorption (280 nm; 1 mol/l; 1 cm; hydrochloric acid 1 mol/l)                             | ≤ 0.10                                       |  |
| pH-value (10 g/l, CO <sub>2</sub> -free water)   |  | 5.5 – 7.0  |
| Chloride (Cl)  | ≤ 0.02 %                                     | ≤ 0.02 %   |
| Sulphate (SO <sub>4</sub> )  | ≤ 0.01 %                                     | ≤ 0.03 %   |
| Heavy metals (as Pb)   | ≤ 0.001 %                                    | ≤ 0.001 %  |
| As (Arsenic)   | ≤ 0.0005 %                                   |  |
| Ca (Calcium)   | ≤ 0.001 %                                    |  |
| Co (Cobalt)  | ≤ 0.0005 %                                   |  |
| Fe (Iron)  | ≤ 0.0005 %                                   | ≤ 0.001 %  |
| K (Potassium)  | ≤ 0.0005 %                                   |  |
| Mg (Magnesium)   | ≤ 0.0005 %                                   |  |
| Na (Sodium)  | ≤ 0.005 %                                    |  |
| NH <sub>4</sub> (Ammonium)   | ≤ 0.01 %                                     | ≤ 0.02 %   |
| Zn (Zinc)  | ≤ 0.0005 %                                   |  |
| Foreign amino acids  | ≤ 0.5 %                                      |  |
| Other ninhydrine positive substances   | ≤ 0.1 %                                      |  |
| Ninhydrine – positive substances (TLC)   |  | ≤ 0.5 %  |
| Residual solvents (Ph Eur/USP/ICH) class 2 (methanol)  |  | ≤ 0.3%   |
| Other residual solvents (Ph Eur/USP/ICH)   |  | excluded by manufacturing process  |
| Organic volatile impurities (acc. to USP)  |  | conforms   |
| Sulfated ash (600°C)   |  | ≤ 0.1 %  |
| Loss on drying (105°C, 3h)   | ≤ 0.3 %                                      | ≤ 0.3 %  |
| Pharmacopoeias   |  | conforms to Ph Eur, USP  |

## L-Leucine

Merck Cat. No. 1.05360 (for biochemistry), 1.05020 (Ph Eur, USP)

|                         |   |
|-------------------------|---|
| CAS-No.                 | 61-90-5   |
| Summation formula       | C <sub>6</sub> H <sub>13</sub> NO <sub>2</sub>                                |
| Molar weight            | 131.18 g/mol  |
| EINECS-No.              | 2005220   |
| Melting range           | 300°C (Decomposition)   |
| Solubility              | Soluble in hot water and mineral acids; insoluble in ethanol and ether.       |
| Storage                 | Well closed at room temperature (+5° to +30°C). Stable for at least 5 years.  |
| Applications/Literature | Merck Index 11, 5331. Pharmacopoeia: DAB, BP, Ph Franc, Ph Helv, Ph Eur, USP. |

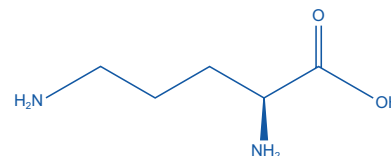
2-Amino-4-methylvaleric acid, Leu,  
α-Aminoisocaproic acid

| Specification:   | Merck Cat. No. 1.05360<br>(for biochemistry) | 1.05020<br>(Ph Eur, USP)   |
|--|--|--|
| Assay (perchloric acid titration, calculated on dried substance)                     | ≥ 99.0 %                                     | 98.5 – 101.0 %   |
| Identity (IR-Spectrum)   | passes test                                  | passes test  |
| Appearance   | white, crystalline powder or shiny crystals  | white, crystalline powder or shiny crystals  |
| Appearance of solution (0.5 mol/l, hydrochloric acid 1 mol/l)                        | clear and colorless                          |  |
| Appearance of solution (50 g/l, hydrochloric acid 1 mol/l)                           |  | clear and not more intense in color than reference solution BY <sub>6</sub> (Ph Eur) |
| Specific rotation (α 20/D, 50 g/l, hydrochloric acid 1 mol/l, calc. on dried subst.) | +12.2° to +13.2°                             |  |
| Specific rotation (α 20/D, 40 g/l, hydrochloric acid 250 g/l, calc. on dried subst.) |  | +14.5° to +16.5°   |
| Specific rotation (α 25/D, 40 g/l, hydrochloric acid 6 mol/l, calc. on dried subst.) |  | +14.9° to +17.3°   |
| UV-Absorption (260 nm; 0.5 mol/l; 1 cm; hydrochloric acid 1 mol/l)                   | ≤ 0.05                                       |  |
| UV-Absorption (280 nm; 0.5 mol/l; 1 cm; hydrochloric acid 1 mol/l)                   | ≤ 0.02                                       |  |
| pH-value (10 g/l, CO <sub>2</sub> -free water)                                       |  | 5.5 – 7.0  |
| Chloride (Cl)  | ≤ 0.02 %                                     | ≤ 0.02 %   |
| Sulphate (SO <sub>4</sub> )  | ≤ 0.01 %                                     | ≤ 0.03 %   |
| Heavy metals (as Pb)   | ≤ 0.001 %                                    | ≤ 0.001 %  |
| As (Arsenic)   | ≤ 0.0005 %                                   |  |
| Ca (Calcium)   | ≤ 0.001 %                                    |  |
| Co (Cobalt)  | ≤ 0.0005 %                                   |  |
| Fe (Iron)  | ≤ 0.0005 %                                   | ≤ 0.001 %  |
| K (Potassium)  | ≤ 0.0005 %                                   |  |
| Mg (Magnesium)   | ≤ 0.0005 %                                   |  |
| Na (Sodium)  | ≤ 0.005 %                                    |  |
| NH <sub>4</sub> (Ammonium)   | ≤ 0.01 %                                     | ≤ 0.02 %   |
| Zn (Zinc)  | ≤ 0.0005 %                                   |  |
| Isoleucine   | < 1.0 %                                      |  |
| Other foreign amino acids  | ≤ 0.3 %                                      |  |
| Other ninhydrine positive substances   | ≤ 0.1 %                                      |  |
| Ninhydrine – positive substances (TLC)   |  | ≤ 0.5 %  |
| Residual solvents (Ph Eur/USP/ICH)   |  | excluded by manufacturing process  |
| Organic volatile impurities (acc. to USP)  |  | conforms   |
| Sulfated ash (600°C)   |  | ≤ 0.1 %  |
| Loss on drying (105°C, 3h)   | ≤ 0.3 %                                      | ≤ 0.2 %  |
| Bacterial endotoxins   |  | ≤ 3.0 I.U./g   |
| Pharmacopoeias   |  | corresponds to Ph Eur, USP   |

## L-Lysine monohydrate Merck Cat. No. 1.12233 (for biochemistry)

|   |  |
|---|--|
| CAS-No.   | 39665-12-8   |
| Summation formula   | C <sub>6</sub> H <sub>14</sub> N <sub>2</sub> O <sub>2</sub> · H <sub>2</sub> O                |
| Molar weight  | 164.21 g/mol; anhydrous 146.20 g/mol   |
| EINECS-No.  | 2002942  |
| Melting range   | 225°C  |
| Description   | White, crystalline powder.   |
| Solubility  | Soluble in water and mineral acids; insoluble in organic solvents.                             |
| Test solution   | Dissolve 1.0 g substance in DI water to make 10.0 ml.<br>The solution is clear and colourless. |
| Storage   | Well closed in refrigerator at +2° to +8°C. Stable for at least 5 years.                       |
| Applications/Literature   | Pharmacopoeia: DAB.  |
| Specification:  | <b>Merck Cat. No. 1.12233<br/>(for biochemistry)</b>   |
| Assay (perchloric acid titration, calculated on anhydrous substance)      | ≥ 99.0 %   |
| Identity (IR-Spectrum)  | passes test  |
| Appearance  | white, crystalline powder<br>or colorless crystals<br>with characteristic odor                 |
| Appearance of solution (100 g/l, water)                                   | clear and colorless  |
| Specific rotation (α 20/D; 50 g/l; HCl 1 mol/l, calc. on dried substance) | + 25.5° to +26.5°  |
| Heavy metals (as Pb)  | ≤ 0.001 %  |
| NH <sub>4</sub> <sup>+</sup> (Ammonium)                                   | ≤ 0.01 %   |
| Foreign amino acids   | ≤ 0.3 %  |
| Other ninhydrine-positive substances                                      | ≤ 0.1 %  |
| Water (acc. to Karl-Fischer)  | 10.0 – 12.0 %  |

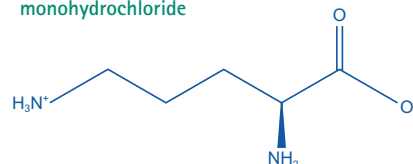
2,6-Diaminohexanoic acid, Lys



## L-Lysine monohydrochloride Merck Cat. No. 1.05700 (for biochemistry), 1.05701 (extra pure Ph Eur, BP, USP)

|                         |  |
|-------------------------|--|
| CAS-No.                 | 657-27-2   |
| Summation formula       | C <sub>6</sub> H <sub>13</sub> ClN <sub>2</sub> O <sub>2</sub>                         |
| Molar weight            | 182.65 g/mol   |
| EINECS-No.              | 2115199  |
| Melting range           | 263–264°C  |
| Solubility              | Soluble in water and mineral acids; insoluble in organic solvents.                     |
| Storage                 | Well closed at room temperature at +5° to +30°C. Stable for at least 5 years.          |
| Applications/Literature | Merck Index 11, 5509. Römpf 8, 2428. Pharmacopoeia: DAB, BP, Ph Helv, JP, Ph Eur, USP. |

L-(+)-2,6-Diamino-N-caproic acid monohydrochloride



|  |  |   |
|--|--|---|
| Specification:   | <b>Merck Cat. No. 1.05700<br/>(for biochemistry)</b> | <b>1.05701<br/>(extra pure Ph Eur, BP, USP)</b>                                   |
| Assay (perchloric acid titration, calculated on dried substance)                     | ≥ 99.0 %   | 98.5 – 101.0 %  |
| Identity (IR-Spectrum)   | passes test  | passes test   |
| Appearance   | white, crystalline powder or<br>colorless crystals   | white, crystalline powder or colorless<br>crystals                                |
| Appearance of solution (1 mol/l, water)  | clear and colorless                                  |   |
| Appearance of solution (100 g/l, water)  |  | clear and note more intense in color<br>than reference solution B, or GY, (PhEur) |
| Specific rotation (α 20/D, 50 g/l, hydrochloric acid 1 mol/l, calc. on dried subst.) | +20.3° to +21.3°                                     |   |
| Specific rotation (α 20/D, 80 g/l, hydrochloric acid 250 g/l, calc. on dried subst.) |  | +21.0° to +22.5°  |
| Specific rotation (α 20/D, 80 g/l, hydrochloric acid 6 mol/l, calc. on dried subst.) |  | +20.4° to +21.4°  |
| UV-Absorption (260 nm; 1 mol/l; 1 cm; water)   | ≤ 0.05   |   |
| UV-Absorption (280 nm; 1 mol/l; 1 cm; water)   | ≤ 0.05   |   |
| Chloride (Cl) (argentometric)  |  | 19.0 – 19.6 %   |
| Sulphate (SO <sub>4</sub> )  | ≤ 0.01 %   | ≤ 0.03 %  |
| Heavy metals (as Pb)   | ≤ 0.001 %  | ≤ 0.001 %   |
| As (Arsenic)   | ≤ 0.0005 %   |   |
| Ca (Calcium)   | ≤ 0.001 %  |   |

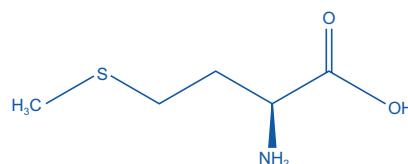
| Specification:                            | Merck Cat. No. 1.05700<br>(for biochemistry) | 1.05701<br>(extra pure Ph Eur, BP, USP) |
|---|--|---|
| Co (Cobalt)                               | ≤ 0.0005 %                                   |   |
| Fe (Iron)                                 | ≤ 0.0005 %                                   | ≤ 0.003 %                               |
| K (Potassium)                             | ≤ 0.001 %                                    |   |
| Mg (Magnesium)                            | ≤ 0.0005 %                                   |   |
| Na (Sodium)                               | ≤ 0.005 %                                    |   |
| NH <sub>4</sub> (Ammonium)                | ≤ 0.01 %                                     | ≤ 0.02 %                                |
| Zn (Zinc)                                 | ≤ 0.0005 %                                   |   |
| Foreign amino acids                       | ≤ 0.3 %                                      |   |
| Other ninhydrine positive substances      | ≤ 0.1 %                                      |   |
| Ninhydrine – positive substances (TLC)    |  | passes test                             |
| Residual solvents (Ph Eur/USP/ICH)        |  | excluded by manufacturing process       |
| Organic volatile impurities (acc. to USP) |  | conforms                                |
| Sulfated ash (600°C)                      |  | ≤ 0.1 %                                 |
| Loss on drying (105°C, 3h)                | ≤ 0.4 %                                      | ≤ 0.4 %                                 |
| Bacterial endotoxins                      |  | ≤ 3.0 I.U./g                            |
| Pharmacopoeias                            |  | corresponds to Ph Eur, BP, USP          |

## L-Methionine

Merck Cat. No. 1.05707 (for biochemistry)

|                         |   |
|-------------------------|---|
| CAS-No.                 | 63-68-3   |
| Summation formula       | C <sub>5</sub> H <sub>11</sub> NO <sub>2</sub> S                              |
| Molar weight            | 149.21 g/mol  |
| EINECS-No.              | 2005629   |
| Melting range           | 280-285°C   |
| Solubility              | Soluble in water and mineral acids; insoluble in organic solvents.            |
| Storage                 | Well closed at room temperature at +5° to +30°C. Stable for at least 5 years. |
| Applications/Literature | Merck Index 11, 5896. Pharmacopoeia DAB, JP, Ph Eur, USP.                     |

2-Amino-4-(methylthio)butyric acid, Met,  
(S)-2-Amino-4-(methylthio)butanoic acid

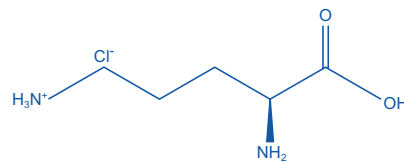


| Specification:   | Merck Cat. No. 1.05707<br>(for biochemistry)    |
|--|---|
| Assay (perchloric acid titration, calculated on dried substance)                             | ≥ 99.0 %  |
| Identity (IR-Spectrum)   | passes test                                     |
| Appearance   | white, crystalline powder or colorless crystals |
| Appearance of solution (0.5 mol/l, hydrochloric acid 1 mol/l)                                | clear and colorless                             |
| Specific rotation ( $\alpha$ 20/D, 50 g/l, hydrochloric acid 1 mol/l, calc. on dried subst.) | +22.5° to +23.5°                                |
| UV-Absorption (260 nm; 0.5 mol/l; 1 cm; hydrochloric acid 1 mol/l)                           | ≤ 0.5   |
| UV-Absorption (280 nm; 0.5 mol/l; 1 cm; hydrochloric acid 1 mol/l)                           | ≤ 0.2   |
| Chloride (Cl)  | ≤ 0.02 %  |
| Sulphate (SO <sub>4</sub> )  | ≤ 0.01 %  |
| Heavy metals (as Pb)   | ≤ 0.001 %                                       |
| As (Arsenic)   | ≤ 0.0005 %                                      |
| Ca (Calcium)   | ≤ 0.001 %                                       |
| Co (Cobalt)  | ≤ 0.0005 %                                      |
| Fe (Iron)  | ≤ 0.0005 %                                      |
| K (Potassium)  | ≤ 0.0005 %                                      |
| Mg (Magnesium)   | ≤ 0.0005 %                                      |
| Na (Sodium)  | ≤ 0.005 %                                       |
| NH <sub>4</sub> (Ammonium)   | ≤ 0.01 %  |
| Zn (Zinc)  | ≤ 0.0005 %                                      |
| Foreign amino acids  | ≤ 0.3 %   |
| Other ninhydrine positive substances   | ≤ 0.1 %   |
| Loss on drying (105°C, 3 h)  | ≤ 0.3 %   |

## L-Ornithine monohydrochloride Merck Cat. No. 1.06906 (for biochemistry)

|  |   |
|--|---|
| CAS-No.  | 3184-13-2   |
| Summation formula  | C <sub>5</sub> H <sub>13</sub> ClN <sub>2</sub> O <sub>2</sub>                |
| Molar weight   | 168.62 g/mol  |
| EINECS-No.   | 2216786   |
| Melting range  | 245°C   |
| Solubility   | Soluble in water and mineral acids; insoluble in organic solvents.            |
| Storage  | Well closed at room temperature at +5° to +30°C. Stable for at least 5 years. |
| Applications/Literature  | Merck Index 11, 7002. Pharmacopoeia: DAB.                                     |
| Specification:   | Merck Cat. No. 1.06906<br>(for biochemistry)                                  |
| Assay (perchloric acid titration, calculated on dried substance)                     | ≥ 99.0 %  |
| Identity (IR-Spectrum)   | passes test   |
| Appearance   | white, crystalline powder or colorless crystals                               |
| Appearance of solution (1 mol/l, water)  | clear and colorless   |
| Specific rotation (α 20/D, 50 g/l, hydrochloric acid 1 mol/l, calc. on dried subst.) | +21.7° to +22.7°  |
| UV-Absorption (260 nm; 1 mol/l; 1 cm; water)   | ≤ 0.2   |
| UV-Absorption (280 nm; 1 mol/l; 1 cm; water)   | ≤ 0.2   |
| Sulphate (SO <sub>4</sub> )  | ≤ 0.01 %  |
| Heavy metals (as Pb)   | ≤ 0.001 %   |
| As (Arsenic)   | ≤ 0.0005 %  |
| Ca (Calcium)   | ≤ 0.01 %  |
| Co (Cobalt)  | ≤ 0.0005 %  |
| Fe (Iron)  | ≤ 0.0005 %  |
| K (Potassium)  | ≤ 0.002 %   |
| Mg (Magnesium)   | ≤ 0.001 %   |
| Na (Sodium)  | ≤ 0.005 %   |
| NH <sub>4</sub> <sup>+</sup> (Ammonium)  | ≤ 0.01 %  |
| Zn (Zinc)  | ≤ 0.0005 %  |
| Foreign amino acids  | ≤ 0.3 %   |
| Other ninhydrine positive substances   | ≤ 0.1 %   |
| Loss on drying (105°C, 3 h)  | ≤ 0.3 %   |

L-(+)-2,5-Diamino valeric acid hydrochloride

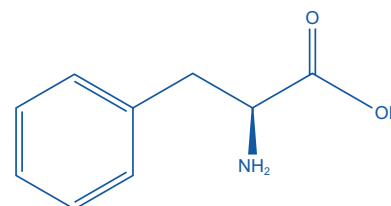


## L-Phenylalanine

## Merck Cat. No. 1.07256 (for biochemistry), 1.07267 (Ph Eur, USP)

|                         |  |
|-------------------------|--|
| CAS-No.                 | 63-91-2  |
| Summation formula       | C <sub>9</sub> H <sub>9</sub> NO <sub>2</sub>  |
| Molar weight            | 165.19 g/mol   |
| EINECS-No.              | 2005681  |
| Melting range           | 275-283°C (Decomposition)  |
| Solubility              | Soluble in water and mineral acids; insoluble in organic solvents.   |
| Storage                 | Well closed at room temperature at +5° to +30°C. Stable for at least 5 years.  |
| Applications/Literature | Unstable in alkalis. Absorption maximum at 257.5 nm in 0.1 mol HCl.<br>Merck Index 11, 7242. Pharmacopoeia: DAB, BP, Ph Franc, Ph Helv, JP, Ph Eur, USP. |

α-Aminohydrocinnamic acid, Phe,  
(S)-2-Amino-3-phenylpropanoic acid



| Specification:   | Merck Cat. No. 1.07256<br>(for biochemistry)    | 1.07267<br>(Ph Eur, USP)   |
|--|---|--|
| Assay (perchloric acid titration, calculated on dried substance)                     | ≥ 99.0 %  | 98.5 – 101.0 %   |
| Identity (IR-Spectrum)   | passes test                                     | passes test  |
| Appearance   | white, crystalline powder or colorless crystals | white, crystalline powder  |
| Appearance of solution (0.5 mol/l, hydrochloric acid 1 mol/l)                        | clear and colorless                             |  |
| Appearance of solution (50 g/l, hydrochloric acid 1 mol/l)                           |   | clear and not more intense in color than reference solution BY <sub>6</sub> (Ph Eur) |
| Specific rotation (α 20/D, 50 g/l, hydrochloric acid 1 mol/l, calc. on dried subst.) | -9.5° to -10.5°                                 |  |

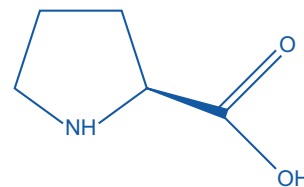
| Specification:  | Merck Cat. No. 1.07256<br>(for biochemistry) | 1.07267<br>(Ph Eur, USP)          |
|---|--|-----------------------------------|
| Specific rotation ( $\alpha$ 20/D, 20 g/l, water, calc. on dried substance) |  | -33.0° to -33.5°                  |
| Specific rotation ( $\alpha$ 25/D, 20 g/l, water, calc. on dried substance) |  | -32.7° to -34.7°                  |
| pH-value (10 g/l, CO <sub>2</sub> -free water)                              |  | 5.4 – 6.0                         |
| Chloride (Cl)   | ≤ 0.02 %                                     | ≤ 0.02 %                          |
| Sulphate (SO <sub>4</sub> )   | ≤ 0.01 %                                     | ≤ 0.03 %                          |
| Heavy metals (as Pb)  | ≤ 0.001 %                                    | ≤ 0.001 %                         |
| As (Arsenic)  | ≤ 0.0005 %                                   |                                   |
| Ca (Calcium)  | ≤ 0.001 %                                    |                                   |
| Co (Cobalt)   | ≤ 0.0005 %                                   |                                   |
| Fe (Iron)   | ≤ 0.0005 %                                   | ≤ 0.001 %                         |
| K (Potassium)   | ≤ 0.0005 %                                   |                                   |
| Mg (Magnesium)  | ≤ 0.0005 %                                   |                                   |
| Na (Sodium)   | ≤ 0.005 %                                    |                                   |
| NH <sub>4</sub> (Ammonium)  | ≤ 0.01 %                                     | ≤ 0.02 %                          |
| Zn (Zinc)   | ≤ 0.0005 %                                   |                                   |
| Foreign amino acids   | ≤ 0.3 %                                      |                                   |
| Other ninhydrine positive substances  | ≤ 0.1 %                                      |                                   |
| Ninhydrine – positive substances (TLC)                                      |  | ≤ 0.5 %                           |
| Residual solvents (Ph Eur/USP/ICH) class 2 (methanol)                       |  | ≤ 0.3 %                           |
| Other residual solvents (Ph Eur/ICH)  |  | excluded by manufacturing process |
| Organic volatile impurities (acc. to USP)                                   |  | conforms                          |
| Sulfated ash (600°C)  |  | ≤ 0.1 %                           |
| Loss on drying (105°C, 3 h)   | ≤ 0.3 %                                      | ≤ 0.3 %                           |
| Bacterial endotoxins  |  | ≤ 3.0 I.U./g                      |
| Pharmacopoeias  |  | corresponds to Ph Eur, USP        |

## L-Proline

Merck Cat. No. 1.07434 (for biochemistry), 1.07430 (Ph Eur, USP)

|                         |  |
|-------------------------|--|
| CAS-No.                 | 147-85-3   |
| Summation formula       | C <sub>5</sub> H <sub>9</sub> NO <sub>2</sub>  |
| Molar weight            | 115.13 g/mol   |
| EINECS-No.              | 2057022  |
| Melting range           | 220-222°C  |
| Solubility              | Soluble in water and mineral acids; insoluble in organic solvents.                           |
| Storage                 | Well closed at room temperature at +5° to +30°C. Stable for at least 5 years.                |
| Applications/Literature | Merck Index 11, 7790. Römpp 8, 3360. Pharmacopoeia: DAB, BP, Ph Franc, Ph Helv, Ph Eur, USP. |

2-Pyrrolidinecarboxylic acid, Pro



| Specification:  | Merck Cat. No. 1.07434<br>(for biochemistry)    | 1.07430<br>(Ph Eur, USP)                        |
|---|---|---|
| Assay (perchloric acid titration, calculated on dried substance)                                | ≥ 99.0 %  | 98.5 – 101.0 %                                  |
| Identity (IR-Spectrum)  | passes test                                     | passes test                                     |
| Appearance  | white, crystalline powder or colorless crystals | white, crystalline powder or colorless crystals |
| Appearance of solution (1 mol/l, water)   | clear and colorless                             |   |
| Appearance of solution (50 g/l, water)  |   | clear and colorless                             |
| Specific rotation ( $\alpha$ 20/D, 50 g/l, hydrochloric acid 1 mol/l, calc. on dried substance) | -50.5° to -52.0°                                |   |
| Specific rotation ( $\alpha$ 20/D, 40 g/l, water, calc. on dried substance)                     |   | -84.0° to -86.0°                                |
| Specific rotation ( $\alpha$ 25/D, 40 g/l, water, calc. on dried substance)                     |   | -84.3° to -86.3°                                |
| UV-Absorption (260 nm, 1 mol/l, 1 cm, water)  | ≤ 0.05  |   |
| UV-Absorption (280 nm, 1 mol/l, 1 cm, water)  | ≤ 0.05  |   |
| Chloride (Cl)   | ≤ 0.02 %  | ≤ 0.02 %  |
| Sulphate (SO <sub>4</sub> )   | ≤ 0.01 %  | ≤ 0.03 %  |
| Heavy metals (as Pb)  | ≤ 0.001 %                                       | ≤ 0.001 %                                       |
| As (Arsenic)  | ≤ 0.0005 %                                      |   |
| Ca (Calcium)  | ≤ 0.001 %                                       |   |
| Co (Cobalt)   | ≤ 0.0005 %                                      |   |

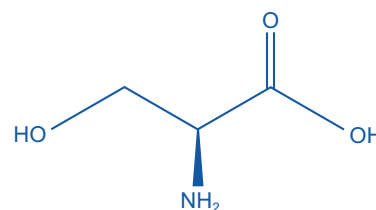
| Specification:                            | Merck Cat. No. 1.07434<br>(for biochemistry) | 1.07430<br>(Ph Eur, USP)          |
|---|--|-----------------------------------|
| Fe (Iron)                                 | ≤ 0.0005 %                                   | ≤ 0.001 %                         |
| K (Potassium)                             | ≤ 0.0005 %                                   |                                   |
| Mg (Magnesium)                            | ≤ 0.0005 %                                   |                                   |
| Na (Sodium)                               | ≤ 0.005 %                                    |                                   |
| NH <sub>4</sub> (Ammonium)                | ≤ 0.01 %                                     | ≤ 0.02 %                          |
| Zn (Zinc)                                 | ≤ 0.0005 %                                   |                                   |
| Foreign amino acids                       | ≤ 0.3 %                                      |                                   |
| Other ninhydrine positive substances      | ≤ 0.1 %                                      |                                   |
| Ninhydrine – positive substances (TLC)    |  | ≤ 0.5 %                           |
| Residual solvents (Ph Eur/USP/ICH)        |  | excluded by manufacturing process |
| Organic volatile impurities (acc. to USP) |  | conforms                          |
| Sulfated ash (600°C)                      |  | ≤ 0.1 %                           |
| Loss on drying (105°C, 3h)                | ≤ 0.3 %                                      | ≤ 0.4 %                           |
| Pharmacopoeias                            |  | corresponds to Ph Eur, USP        |

## L-Serine

Merck Cat. No. 1.07769 (for biochemistry), 1.07647 (Ph Eur, USP)

|                         |  |
|-------------------------|--|
| CAS-No.                 | 56-45-1  |
| Summation formula       | C <sub>3</sub> H <sub>7</sub> NO <sub>3</sub>  |
| Molar weight            | 105.09 g/mol   |
| EINECS-No.              | 2002743  |
| Melting point           | 215–225°C  |
| Solubility              | Soluble in water and mineral acids; insoluble in organic solvents.   |
| Storage                 | Well closed at room temperature at +5° to +30°C. Stable for at least 5 years.  |
| Applications/Literature | Unstable in hot alkalis. L-Serine racemizes in aqueous solutions at pH 9.<br>Merck Index 11, 8411. Pharmacopoeia: DAB, BP, Ph Franc, Ph Helv, Ph Eur, USP. |

3-Hydroxy-L-alanine, Ser,  
2-Amino-3-hydroxypropionic acid



| Specification:  | Merck Cat. No. 1.07769<br>(for biochemistry)    | 1.07647<br>(Ph Eur, USP)   |
|---|---|--|
| Assay (perchloric acid titration, calculated on dried substance)                      | ≥ 99.0 %  | 98.5 – 101.0 %   |
| Identity (IR-Spectrum)  | passes test                                     | passes test  |
| Appearance  | white, crystalline powder or colorless crystals | white, crystalline powder or colorless crystals                                      |
| Appearance of solution (1 mol/l, water)   | clear and colorless                             |  |
| Appearance of solution (50 g/l, water)  |   | clear and not more intense in color than reference solution BY <sub>1</sub> (Ph Eur) |
| Specific rotation (α 20/D, 50 g/l, hydrochloric acid 1 mol/l, calc. on dried subst.)  | +14.3° to +15.8°                                |  |
| Specific rotation (α 20/D, 100 g/l, hydrochloric acid 2 mol/l, calc. on dried subst.) |   | +14.0° to +16.0°   |
| Specific rotation (α 25/D, 100 g/l, hydrochloric acid 2 mol/l, calc. on dried subst.) |   | +14.0° to +15.6°   |
| UV-Absorption (260 nm, 1 mol/l, 1 cm, water)  | ≤ 0.05  |  |
| UV-Absorption (280 nm, 1 mol/l, 1 cm, water)  | ≤ 0.02  |  |
| Chloride (Cl)   | ≤ 0.02 %  | ≤ 0.02 %   |
| Sulphate (SO <sub>4</sub> )   | ≤ 0.01 %  | ≤ 0.03 %   |
| Heavy metals (as Pb)  | ≤ 0.001 %                                       | ≤ 0.001 %  |
| As (Arsenic)  | ≤ 0.0005 %                                      |  |
| Ca (Calcium)  | ≤ 0.001 %                                       |  |
| Co (Cobalt)   | ≤ 0.0005 %                                      |  |
| Fe (Iron)   | ≤ 0.0005 %                                      | ≤ 0.001 %  |
| K (Potassium)   | ≤ 0.0005 %                                      |  |
| Mg (Magnesium)  | ≤ 0.0005 %                                      |  |
| Na (Sodium)   | ≤ 0.005 %                                       |  |
| NH <sub>4</sub> (Ammonium)  | ≤ 0.01 %  | ≤ 0.02 %   |
| Zn (Zinc)   | ≤ 0.0005 %                                      |  |
| Foreign amino acids   | ≤ 0.3 %   |  |
| Other ninhydrine positive substances  | ≤ 0.1 %   |  |
| Ninhydrine – positive substances (TLC)  |   | ≤ 0.5 %  |

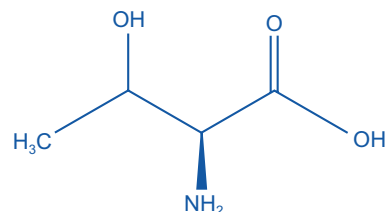
|  |  |                                   |
|--|--|-----------------------------------|
| Specification:   | Merck Cat. No. 1.07769<br>(for biochemistry) | 1.07647<br>(Ph Eur, USP)          |
| Residual solvents ( Ph Eur/USP/ICH) class 2 (Methanol) |  | ≤ 0.3 %                           |
| Other residual solvents (Ph Eur/USP/ICH)               |  | excluded by manufacturing process |
| Organic volatile impurities (acc. to USP)              |  | conforms                          |
| Sulfated ash (600°C)                                   |  | ≤ 0.1 %                           |
| Loss on drying (105°C, 3h)                             | ≤ 0.3 %                                      | ≤ 0.2 %                           |
| Bacterial endotoxins                                   |  | ≤ 2.0 I.U./g                      |
| Pharmacopoeias   |  | corresponds to Ph Eur, USP        |

## L-Threonine

Merck Cat. No. 1.08411 (for biochemistry)

|   |   |
|---|---|
| CAS-No.   | 72-19-5   |
| Summation formula   | C <sub>4</sub> H <sub>9</sub> NO <sub>3</sub>                                 |
| Molar weight  | 119.12 g/mol  |
| EINECS-No.  | 2007741   |
| Melting point   | 265–270°C (Decomposition)   |
| Solubility  | Soluble in water and mineral acids; insoluble in organic solvents.            |
| Storage   | Well closed at room temperature at +5° to +30°C. Stable for at least 5 years. |
| Applications/Literature                                       | Unstable in hot alkalies. Merck Index 11, 9316. Pharmacopoeia: JP, USP.       |
| Specification:  | Merck Cat. No. 1.08411<br>(for biochemistry)                                  |
| Assay (perchloric acid titration)                             | ≥ 99.0 %  |
| Identity (IR-Spectrum)  | passes test   |
| Appearance  | white, crystalline powder or colorless crystals                               |
| Appearance of solution (100 g/l, water)                       | clear and colorless   |
| Specific rotation (α 20/D, 50 g/l, hydrochloric acid 1 mol/l) | -15.4° to -16.4°  |
| Heavy metals (as Pb)  | ≤ 0.001 %   |
| NH <sub>4</sub> (Ammonium)                                    | ≤ 0.01 %  |
| Foreign amino acids   | ≤ 0.3 %   |
| Other ninhydrine positive substances                          | ≤ 0.1 %   |

2-Amino-3-hydroxybutyric acid, Thr

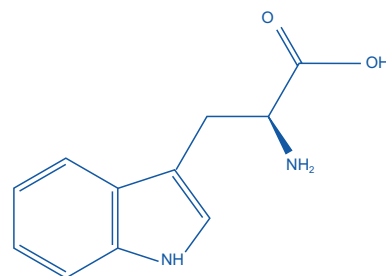


## L-Tryptophan

Merck Cat. No. 1.08374 (for biochemistry), 1.08396 (extra pure Ph Eur, BP, USP)

|                         |  |
|-------------------------|--|
| CAS-No.                 | 73-22-3  |
| Summation formula       | C <sub>11</sub> H <sub>12</sub> N <sub>2</sub> O <sub>2</sub>  |
| Molar weight            | 204.23 g/mol   |
| EINECS-No.              | 2007956  |
| Melting point           | 290°C (Decomposition)  |
| Solubility              | Soluble in water and mineral acids; hardly soluble in water; insoluble in organic solvents.  |
| Storage                 | Well closed and protected from light at room temperature at +5° to +30°C. Stable for at least 5 years.                               |
| Applications/Literature | Absorption maximum at 278 nm on 0.1 mol HCl. Merck Index 11, 9707. Römpf 8, 4383. Pharmacopoeia: DAB, BP, Ph Franc, JP, Ph Eur, USP. |

(S)-α-Amino-1H-indole-3-propanoic acid, Trp, 1-α-Aminoindole-3-propionic acid



|  |   |  |
|--|---|--|
| Specification:   | Merck Cat. No. 1.08374<br>(for biochemistry)    | 1.08396<br>(extra pure Ph Eur, BP, USP)  |
| Assay (perchloric acid titration, calculated on dried substance)                     | ≥ 99.0 %  | 98.5 – 101.0 %   |
| Identity (IR-Spectrum)   | passes test                                     | passes test  |
| Appearance   | white, crystalline powder or colorless crystals | white to yellowish-white crystalline powder or colorless crystals                    |
| Appearance of solution (10 g/l, hydrochloric acid 1 mol/l)                           |   | clear and not more intense in color than reference solution BY <sub>6</sub> (Ph Eur) |
| Specific rotation (α 20/D, 50 g/l, hydrochloric acid 1 mol/l, calc. on dried subst.) | +1.5° to +2.5°                                  |  |
| Specific rotation (α 20/D, 10 g/l, water, calc. on dried substance)                  |   | -30.0° to -33.0°   |
| Specific rotation (α 25/D, 10 g/l, water, calc. on dried substance)                  |   | -29.4° to -32.8°   |

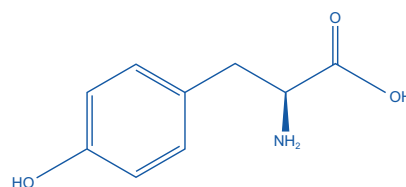
| Specification:                                 | Merck Cat. No. 1.08374<br>(for biochemistry) | 1.08396<br>(extra pure Ph Eur, BP, USP) |
|--|--|---|
| pH-value (10 g/l, CO <sub>2</sub> -free water) |  | 5.5. – 7.0                              |
| Chloride (Cl)                                  | ≤ 0.02 %                                     | ≤ 0.02 %                                |
| Sulphate (SO <sub>4</sub> )                    | ≤ 0.01 %                                     | ≤ 0.03 %                                |
| Heavy metals (as Pb)                           | ≤ 0.001 %                                    | ≤ 0.001 %                               |
| As (Arsenic)                                   | ≤ 0.0005 %                                   |   |
| Ca (Calcium)                                   | ≤ 0.001 %                                    |   |
| Co (Cobalt)                                    | ≤ 0.0005 %                                   |   |
| Fe (Iron)                                      | ≤ 0.0005 %                                   | ≤ 0.002 %                               |
| K (Potassium)                                  | ≤ 0.0005 %                                   |   |
| Mg (Magnesium)                                 | ≤ 0.0005 %                                   |   |
| Na (Sodium)                                    | ≤ 0.01 %                                     |   |
| NH <sub>4</sub> (Ammonium)                     | ≤ 0.01 %                                     | ≤ 0.02 %                                |
| Zn (Zinc)                                      | ≤ 0.0005 %                                   |   |
| Foreign amino acids                            | ≤ 0.3 %                                      |   |
| Other ninhydrine positive substances           | ≤ 0.1 %                                      |   |
| Ninhydrine – positive substances (TLC)         |  | passes test                             |
| Related substances (HPLC)                      |  | passes test                             |
| 1,1'-Ethylenedibistryptophan (Peak E)          |  | ≤ 10 ppm                                |
| Residual solvents (Ph Eur/USP/ICH)             |  | excluded by manufacturing process       |
| Organic volatile impurities (acc. to USP)      |  | conforms                                |
| Sulfated ash (600°C)                           |  | ≤ 0.1 %                                 |
| Loss on drying (105°C, 3 h)                    | ≤ 0.3 %                                      | ≤ 0.3 %                                 |
| Bacterial endotoxins                           |  | ≤ 10.0 I.U./g                           |
| Pharmacopoeias                                 |  | corresponds to Ph Eur, BP, USP          |

## L-Tyrosine

Merck Cat. No. 1.08371 (for biochemistry), 1.08378 (Ph Eur, USP)

|                         |  |
|-------------------------|--|
| CAS-No.                 | 60-18-4  |
| Summation formula       | C <sub>9</sub> H <sub>9</sub> NO <sub>3</sub>  |
| Molar weight            | 181.19 g/mol   |
| EINECS-No.              | 2004604  |
| Melting range           | 297-298°C (Decomposition)  |
| Solubility              | Soluble in mineral acids; hardly soluble in water; insoluble in organic solvents.                          |
| Storage                 | Well closed at room temperature at +5° to +30°C. Stable for at least 5 years.                              |
| Applications/Literature | Absorption maximum at 274.5 nm in 0.1 mol/l HCl. Merck Index 11, 9747.<br>Pharmacopoeia: DAB, Ph Eur, USP. |

4-Hydroxyphenylalanine, Tyr, β-(p-Hydroxy-phenyl)alanine, α-Amino-p-hydrocinnamic acid



| Specification:  | Merck Cat. No. 1.08371<br>(for biochemistry)    | 1.08378<br>(Ph Eur, USP)   |
|---|---|--|
| Assay (perchloric acid titration, calculated on dried substance)                        | ≥ 99.0 %  | 99.0 – 101.0 %   |
| Identity (IR-Spectrum)  | passes test                                     | passes test  |
| Appearance  | white, crystalline powder or colorless crystals | white, crystalline powder or colorless crystals                          |
| Appearance of solution ( 25 g/l, hydrochloric acid 2 mol/l)                             |   | clear and not more intense in colour than reference solution Y, (Ph Eur) |
| Specific rotation (α 20/D, 50 g/l, hydrochloric acid 1 mol/l, calc. on dried substance) | -11.0° to -12.3°                                | -11.0° to -12.3°   |
| Specific rotation (α 25/D, 50 g/l, hydrochloric acid 1 mol/l, calc. on dried substance) |   | -9.8° to -11.2°  |
| Chloride (Cl)   | ≤ 0.02 %  | ≤ 0.02 %   |
| Sulphate (SO <sub>4</sub> )   | ≤ 0.01 %  | ≤ 0.03 %   |
| Heavy metals (as Pb)  | ≤ 0.001 %                                       | ≤ 0.001 %  |
| As (Arsenic)  | ≤ 0.0005 %                                      |  |
| Ca (Calcium)  | ≤ 0.001 %                                       |  |
| Co (Cobalt)   | ≤ 0.0005 %                                      |  |
| Fe (Iron)   | ≤ 0.0005 %                                      | ≤ 0.001 %  |
| K (Potassium)   | ≤ 0.0005 %                                      |  |

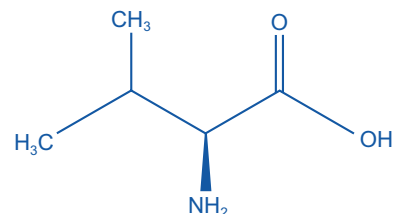
| Specification:                            | Merck Cat. No. 1. 08371<br>(for biochemistry) | 1. 08378<br>(Ph Eur, USP)         |
|---|---|-----------------------------------|
| Mg (Magnesium)                            | ≤ 0.0005 %                                    |                                   |
| Na (Sodium)                               | ≤ 0.01 %                                      |                                   |
| NH <sub>4</sub> (Ammonium)                | ≤ 0.01 %                                      | ≤ 0.02 %                          |
| Zn (Zinc)                                 | ≤ 0.0005 %                                    |                                   |
| Foreign amino acids                       | ≤ 0.3 %                                       |                                   |
| Other ninhydrine positive substances      | ≤ 0.1 %                                       |                                   |
| Ninhydrine – positive substances (TLC)    |   | ≤ 0.5 %                           |
| Residual solvents (Ph Eur/USP/ICH)        |   | excluded by manufacturing process |
| Organic volatile impurities (acc. to USP) |   | conforms                          |
| Sulfated ash (600°C)                      |   | ≤ 0.1 %                           |
| Loss on drying (105°C, 3 h)               | ≤ 0.3 %                                       | ≤ 0.3 %                           |
| Pharmacopoeias                            |   | corresponds to Ph Eur, USP        |

## L-Valine

Merck Cat. No. 1.08495 (for biochemistry)

|                         |   |
|-------------------------|---|
| CAS-No.                 | 72-18-4   |
| Summation formula       | C <sub>5</sub> H <sub>11</sub> NO <sub>2</sub>                                    |
| Molar weight            | 117.15 g/mol  |
| EINECS-No.              | 2007736   |
| Melting range           | 315°C (Decomposition)   |
| Solubility              | Soluble mineral acids and water; insoluble in organic solvents.                   |
| Storage                 | Well closed at room temperature at +5° to +30°C. Stable for at least 5 years.     |
| Applications/Literature | Merck Index 11, 9818. Pharmacopoeia: DAB, BP, Ph Franc, Ph Helv, JP, Ph Eur, USP. |

4-Hydroxyphenylalanine, Val, 2-Aminoisovaleric acid, 2-Amino-3-methylbutyric acid



| Specification:  | Merck Cat. No. 1.08495<br>(for biochemistry)    |
|---|---|
| Assay (perchloric acid titration)                                     | ≥ 99.0 %  |
| Identity (IR-Spectrum)  | passes test                                     |
| Appearance  | white, crystalline powder or colorless crystals |
| Appearance of solution (50 g/l, water)                                | clear and colorless                             |
| Specific rotation ( $\alpha$ 20/D, 50 g/l, hydrochloric acid 1 mol/l) | +23.8° to +24.8°                                |
| Heavy metals (as Pb)  | ≤ 0.001 %                                       |
| NH <sub>4</sub> (Ammonium)  | ≤ 0.01 %  |
| Foreign amino acids   | ≤ 0.3 %   |
| Other ninhydrine positive substances                                  | ≤ 0.1 %   |

# Ordering information



| Product   | Cat.-No.     | Pack size |
|---|--------------|-----------|
| A, B<br>N-Acetyl-L-cysteine for biochemistry                    | 1.12422.0025 | 25 g      |
|   | 1.12422.0100 | 100 g     |
|   | 1.12422.1000 | 1 kg      |
|   | 1.12422.9010 | 10 kg     |
| N-Acetyl-DL-tryptophan extra pure low in endotoxins, Ph Eur, BP | 1.12488.1000 | 1 kg      |
|   | 1.12488.9025 | 25 kg     |
| N-Acetyl-DL-tryptophan for biochemistry                         | 1.12423.0025 | 25 g      |
| B-Alanine for biochemistry                                      | 1.01008.0250 | 250 g     |
|   | 1.01008.1000 | 1 kg      |
|   | 1.01008.9025 | 25 kg     |
| DL-Alanine for biochemistry                                     | 1.00963.0100 | 100 g     |
|   | 1.00963.1000 | 1 kg      |
|   | 1.00963.9025 | 25 kg     |
| L-Alanine Ph Eur, USP   | 1.01700.0100 | 100 g     |
|   | 1.01700.1000 | 1 kg      |
|   | 1.01700.9010 | 10 kg     |
| L-Alanine for biochemistry                                      | 1.01007.0025 | 25 g      |
|   | 1.01007.0100 | 100 g     |
|   | 1.01007.1000 | 1 kg      |
|   | 1.01007.9010 | 10 kg     |
| 4-Aminohippuric acid for biochemistry                           | 1.00084.0025 | 25 g      |
|   | 1.00084.0100 | 100 g     |
|   | 1.00084.1000 | 1 kg      |
| 5-Aminolevulinic acid hydrochloride for biochemistry            | 1.24802.0500 | 500 mg    |
|   | 1.24802.2500 | 2.5 g     |
| L-Arginine Ph Eur, USP  | 1.01587.0100 | 100 g     |
|   | 1.01587.1000 | 1 kg      |
|   | 1.01587.9010 | 10 kg     |
| L-Arginine for biochemistry                                     | 1.01542.0100 | 100 g     |
|   | 1.01542.1000 | 1 kg      |
|   | 1.01542.9010 | 10 kg     |
| L-Arginine monohydrochloride extra pure Ph Eur, BP, USP         | 1.01544.0250 | 250 g     |
|   | 1.01544.1000 | 1 kg      |
|   | 1.01544.5000 | 5 kg      |
|   | 1.01544.9010 | 10 kg     |
| L-Arginine monohydrochloride for biochemistry                   | 1.01543.0050 | 50 g      |
|   | 1.01543.0250 | 250 g     |
|   | 1.01543.1000 | 1 kg      |
|   | 1.01543.5000 | 5 kg      |
|   | 1.01543.9010 | 10 kg     |
| L-Asparagine monohydrate extra pure DAB                         | 1.01565.0100 | 100 g     |
|   | 1.01565.1000 | 1 kg      |
|   | 1.01565.5000 | 5 kg      |
|   | 1.01565.9010 | 10 kg     |
| L-Asparagine monohydrate for biochemistry                       | 1.01566.0100 | 100 g     |
|   | 1.01566.1000 | 1 kg      |
|   | 1.01566.9010 | 10 kg     |
| L-Aspartic acid extra pure Ph Eur, BP, USP                      | 1.00129.0100 | 100 g     |
|   | 1.00129.1000 | 1 kg      |
|   | 1.00129.5000 | 5 kg      |
|   | 1.00129.9025 | 25 kg     |
| L-Aspartic acid for biochemistry                                | 1.00126.0100 | 100 g     |
|   | 1.00126.1000 | 1 kg      |
|   | 1.00126.9010 | 10 kg     |
| L-Aspartic acid Monosodium salt for biochemistry                | 1.00142.0100 | 100 g     |
|   | 1.00142.1000 | 1 kg      |
| C-F<br>L-Citrulline for biochemistry                            | 1.12117.0050 | 50 g      |
|   | 1.12117.0250 | 250 g     |
| L-Cysteine for biochemistry                                     | 1.02838.0025 | 25 g      |
|   | 1.02838.0100 | 100 g     |
|   | 1.02838.1000 | 1 kg      |
|   | 1.02838.9010 | 10 kg     |
| L-Cysteine hydrochloride monohydrate Ph Eur, USP                | 1.02735.0100 | 100 g     |
|   | 1.02735.1000 | 1 kg      |
|   | 1.02735.9010 | 10 kg     |
| L-Cysteine hydrochloride monohydrate for biochemistry           | 1.02839.0025 | 25 g      |
|   | 1.02839.0100 | 100 g     |
|   | 1.02839.1000 | 1 kg      |
|   | 1.02839.9010 | 10 kg     |

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| Product   | Cat.-No.      | Pack size |
|---|---------------|-----------|
| L-Cystine Ph Eur                                      | 1.02737.0100  | 100 g     |
|   | 1.02737.1000  | 1 kg      |
|   | 1.02737.9010  | 10 kg     |
| L-Cystine for biochemistry                            | 1.02837.0025  | 25 g      |
|   | 1.02837.0100  | 100 g     |
|   | 1.02837.1000  | 1 kg      |
|   | 1.02837.9010  | 10 kg     |
| <b>G</b>  |               |           |
| L-Glutamic acid Ph Eur                                | 1.01791.0100  | 100 g     |
|   | 1.01791.1000  | 1 kg      |
|   | 1.01791.9010  | 10 kg     |
| L-Glutamic acid for biochemistry                      | 1.00291.0250  | 250 g     |
|   | 1.00291.1000  | 1 kg      |
|   | 1.00291.5000  | 5 kg      |
|   | 1.00291.9010  | 10 kg     |
| L-Glutamine DAB, USP                                  | 1.00286.0100  | 100 g     |
|   | 1.00286.1000  | 1 kg      |
|   | 1.00286.9010  | 10 kg     |
| L-Glutamine for biochemistry                          | 1.00289.0025  | 25 g      |
|   | 1.00289.0100  | 100 g     |
|   | 1.00289.1000  | 1 kg      |
|   | 1.00289.9010  | 10 kg     |
| Glycine cryst. Ph Eur, BP, USP                        | 5.00190.1000  | 1 kg      |
|   | 5.00190.5000  | 5 kg      |
|   | 5.00190.9025  | 25 kg     |
| Glycine GR for analysis                               | 1.04201.0100  | 100 g     |
|   | 1.04201.0250  | 250 g     |
|   | 1.04201.1000  | 1 kg      |
|   | 1.04201.5000  | 5 kg      |
| <b>H</b>  |               |           |
| Hippuric acid LAB                                     | 1.00296.0500  | 500 g     |
|   | 1.00296.2500  | 2.5 kg    |
| L-Histidine Ph Eur, USP                               | 1.04352.0100  | 100 g     |
|   | 1.04352.1000  | 1 kg      |
|   | 1.04352.9010  | 10 kg     |
| L-Histidine for biochemistry                          | 1.04351.0025  | 25 g      |
|   | 1.04351.0100  | 100 g     |
|   | 1.04351.1000  | 1 kg      |
|   | 1.04351.5000  | 5 kg      |
|   | 1.04351.9010  | 10 kg     |
| L-Histidine monohydrochloride extra pure Ph Eur, BP   | 1.04354.0500  | 500 g     |
|   | 1.04354.5000  | 5 kg      |
| L-Histidine monohydrochloride for biochemistry        | 1.04350.0025  | 25 g      |
|   | 1.04350.0100  | 100 g     |
|   | 1.04350.0500  | 500 g     |
|   | 1.04350.9010  | 10 kg     |
| L-Hydroxyproline for biochemistry                     | 1.04506.0010  | 10 g      |
|   | 1.04506.0100  | 100 g     |
| <b>I-K</b>  |               |           |
| L-Isoleucine Ph Eur, USP                              | 1.05357.0100  | 100 g     |
|   | 1.05357.1000  | 1 kg      |
|   | 1.05357.9010  | 10 kg     |
| L-Isoleucine for biochemistry                         | 1.05362.0025  | 25 g      |
|   | 1.05362.0100  | 100 g     |
|   | 1.05362.0500  | 500 g     |
|   | 1.05362.9010  | 10 kg     |
| <b>L</b>  |               |           |
| L-Leucine Ph Eur, USP                                 | 1.05020.0100  | 100 g     |
|   | 1.05020.1000  | 1 kg      |
|   | 1.050250.9010 | 10 kg     |
| L-Leucine for biochemistry                            | 1.05360.0025  | 25 g      |
|   | 1.05360.0250  | 250 g     |
|   | 1.05360.9010  | 10 kg     |
| L-Lysine monohydrate for biochemistry                 | 1.12233.0100  | 100 g     |
|   | 1.12233.1000  | 1 kg      |
| L-Lysine monohydrochloride extra pure Ph Eur, BP, USP | 1.05701.1000  | 1 kg      |
|   | 1.05701.5000  | 5 kg      |
|   | 1.05701.9025  | 25 kg     |
| L-Lysine monohydrochloride for biochemistry           | 1.05700.0100  | 100 g     |
|   | 1.05700.1000  | 1 kg      |
|   | 1.05700.9010  | 10 kg     |
|   | 1.05700.9025  | 25 kg     |

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| Product  | Cat.-No.     | Pack size |
|--|--------------|-----------|
| <b>M</b>                                       |              |           |
| L-Methionine for biochemistry                  | 1.05707.0025 | 25 g      |
|  | 1.05707.0100 | 100 g     |
|  | 1.05707.1000 | 1 kg      |
|  | 1.05707.9010 | 10 kg     |
| <b>N</b>                                       |              |           |
| L-Norleucine for biochemistry                  | 1.24560.0250 | 250 mg    |
| <b>O</b>                                       |              |           |
| L-Ornithine monohydrochloride for biochemistry | 1.06906.0025 | 25 g      |
|  | 1.06906.0100 | 100 g     |
|  | 1.06906.1000 | 1 kg      |
|  | 1.06906.9010 | 10 kg     |
| <b>P-R</b>                                     |              |           |
| DL-Phenylalanine for biochemistry              | 1.07257.0025 | 25 g      |
|  | 1.07257.0100 | 100 g     |
| L-Phenylalanine Ph Eur, USP                    | 1.07267.0100 | 100 g     |
|  | 1.07267.1000 | 1 kg      |
|  | 1.07267.9010 | 10 kg     |
| L-Phenylalanine for biochemistry               | 1.07256.0025 | 25 g      |
|  | 1.07256.0100 | 100 g     |
|  | 1.07256.1000 | 1 kg      |
|  | 1.07256.9010 | 10 kg     |
| L-Proline Ph Eur, USP                          | 1.07430.0100 | 100 g     |
|  | 1.07430.1000 | 1 kg      |
|  | 1.07430.9010 | 10 kg     |
| L-Proline for biochemistry                     | 1.07434.0010 | 10 g      |
|  | 1.07434.0100 | 100 g     |
|  | 1.07434.0500 | 500 g     |
|  | 1.07434.9010 | 10 kg     |
| <b>S</b>                                       |              |           |
| L-Serine Ph Eur, USP                           | 1.07647.0100 | 100 g     |
|  | 1.07647.1000 | 1 kg      |
|  | 1.07647.9010 | 10 kg     |
| L-Serine for biochemistry                      | 1.07769.0010 | 10 g      |
|  | 1.07769.0100 | 100 g     |
|  | 1.07769.1000 | 1 kg      |
|  | 1.07769.9010 | 10 kg     |
| <b>T, U</b>                                    |              |           |
| L-Threonine for biochemistry                   | 1.08411.0010 | 10 g      |
|  | 1.08411.0100 | 100 g     |
|  | 1.08411.1000 | 1 kg      |
|  | 1.08411.9010 | 10 kg     |
| DL-Tryptophane for biochemistry                | 1.08375.0025 | 25 g      |
|  | 1.08375.0100 | 100 g     |
| L-Tryptophane extra pure Ph Eur, BP, USP       | 1.08396.0100 | 100 g     |
|  | 1.08396.1000 | 1 kg      |
|  | 1.08396.5000 | 5 kg      |
| L-Tryptophane for biochemistry                 | 1.08374.0010 | 10 g      |
|  | 1.08374.0100 | 100 g     |
|  | 1.08374.0500 | 500 g     |
|  | 1.08374.9010 | 10 kg     |
|  | 1.08374.9025 | 25 kg     |
| L-Tyrosine Ph Eur, USP                         | 1.08378.0100 | 100 g     |
|  | 1.08378.1000 | 1 kg      |
|  | 1.08378.9010 | 10 kg     |
| L-Tyrosine for biochemistry                    | 1.08371.0025 | 25 g      |
|  | 1.08371.0100 | 100 g     |
|  | 1.08371.1000 | 1 kg      |
|  | 1.08371.9010 | 10 kg     |
| <b>V-Z</b>                                     |              |           |
| L-Valine for biochemistry                      | 1.08495.0025 | 25 g      |
|  | 1.08495.0100 | 100 g     |
|  | 1.08495.1000 | 1 kg      |
|  | 1.08495.9010 | 10 kg     |


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## Abbreviations

|           |   |
|-----------|---|
| BP:       | British Pharmacopoeia                                 |
| CAS No.:  | Chemical Abstracts Service<br>Registry Number         |
| DAB:      | German Pharmacopoeia                                  |
| EINECS:   | European Inventory of<br>Existing Chemical Substances |
| Ph Eur:   | European Pharmacopoeia                                |
| Ph Franc: | French Pharmacopoeia                                  |
| Ph Helv:  | Swiss Pharmacopoeia                                   |
| JP:       | The Pharmacopoeia of Japan                            |
| OEAB:     | Austrian Pharmacopoeia                                |
| USP:      | The United States Pharmacopoeia                       |



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