

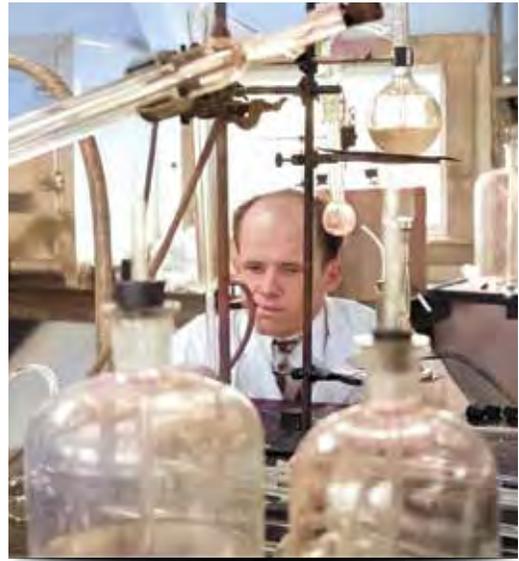
CELL BIOLOGY • MOLECULAR BIOLOGY • RESEARCH • BIOCHEMISTRY • BIOPROCESSING


Worthington
Biochemical Corporation
Primary Enzyme Producer

Sharing Over 75 Years of Enzyme Technology Expertise

From the early days of enzyme research during the 1940s to today's most challenging life sciences discoveries, the Worthington family and dedicated staff have been producing high quality products, providing personalized services and publishing extensive resources for a new generation of researchers and respected bulk/ OEM and bioprocessing business partners.

As an ISO9001 certified global primary enzyme producer, our goal is to serve customers with the most efficient methods for investigating and purchasing specialty enzymes for their research and bioprocessing applications.



The New Worthington-Biochem.com



Our new website is redesigned to provide you more options to connect with us across a wide range of devices.

- New and improved online ordering functionality provides a quick way to find Worthington products, download educational resources and review technical information.
- An interactive Bioz platform gives researchers access to a growing collection of peer-reviewed citations and allows customers to pivot between easy-to-use search and selection tools.
- Ongoing company updates and calendar for scientists to meet us in person to discuss techniques at annual scientific meetings and international conferences are also featured.

This 23rd catalog edition also lists a number of expanded product lines and new products for primary and stem cell isolation, DNA/RNA digestion and modification, and protein sequencing applications, including animal-free products.

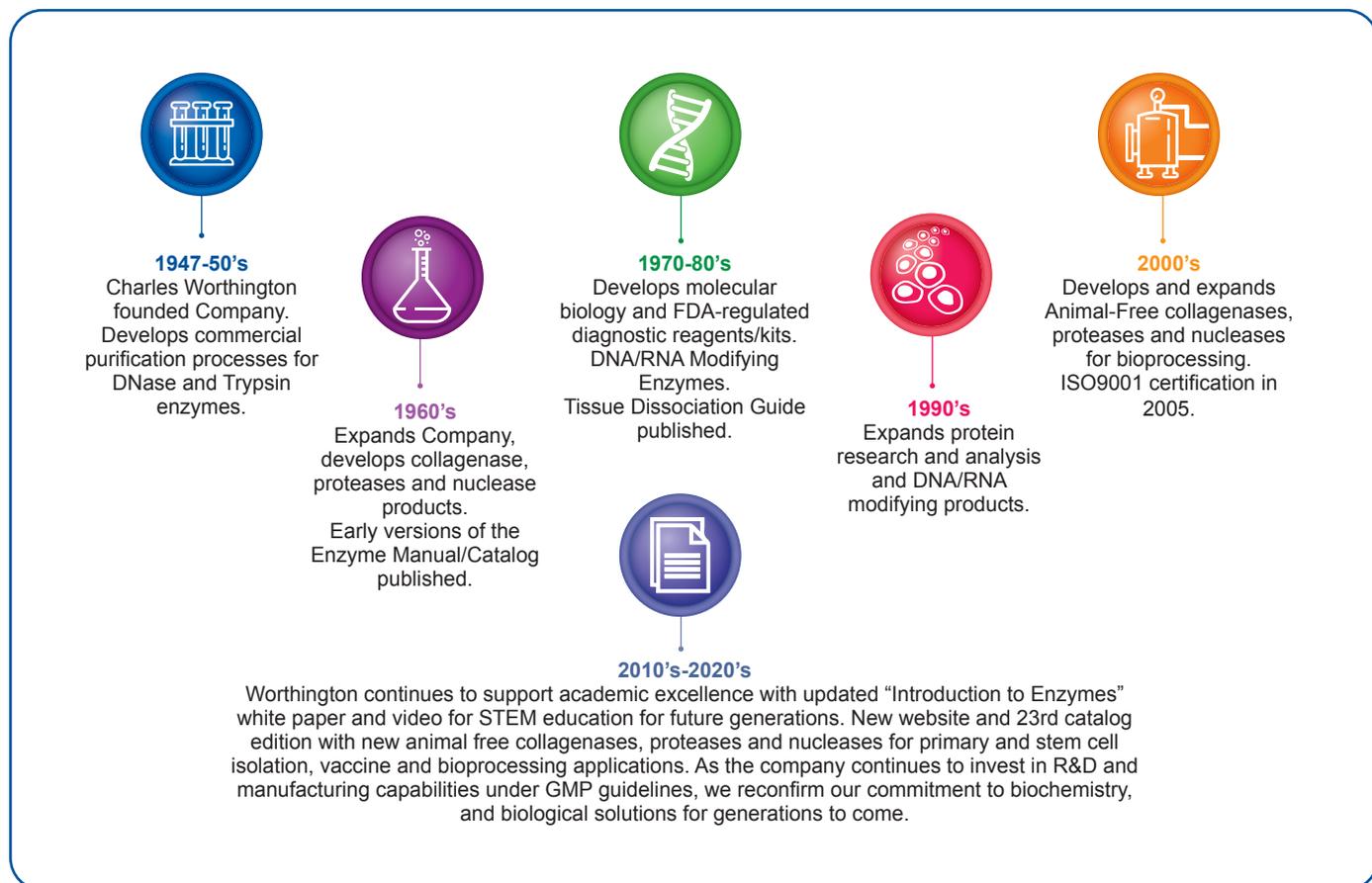
Working Together for Decades

Worthington wishes to thank our loyal customers for their continued support and feedback. Your comments and suggestions help us to expand our product lines, enhance educational materials and continually improve quality and service. We invite researchers to collaborate with employees and field support personnel to build our technical library by sharing data, photos, protocols, citations and articles referencing Worthington enzymes so we can share them with your colleagues.

Visit the new website for continued updates – a portal for improved access to product information and a superior source of enzyme application information. This new online resource, along with recently developed new products, is further evidence of our commitment to your life science research.

In closing, we would like to thank the dedicated staff at Worthington who have worked diligently to make 75 years a reality.

— The Worthington Family



Eliminate Many of the Quality and Regulatory Issues Associated with Animal Sourced Enzymes

Worthington Animal Free (AF) enzymes for pre-clinical, bioprocessing and biopharma applications are produced under ISO9001 certified GMP guidelines. Animal Free products allow you to meet the demand for safer enzymes and biopharmaceuticals, minimizing the potential risks of BSE/TSE and/ or mammalian virus contaminants.

Animal Free Collagenases



Types **AFA**, **AFB**, **AFC**, **AFD**, purified **AFP**, **STEMxyme**[®] **1** and **2** collagenase/neutral protease blends and neutral proteases are derived from cultures grown in medium completely devoid of animal based components and designed for bioprocessing applications where introduction of potential animal derived pathogens must be prevented.

- **CLSAFA** is the original AF grade designed to have collagenase and secondary proteases similar to Types 1 and 2 collagenase
- **CLSafb** contains higher collagenase and caseinase activities than CLSAFA
- **CLSAFC** has especially low tryptic activity similar to Type 4 collagenase
- **CLSAFD** contains two to three fold higher specific activity than CLSAFA
- **CLSAFP** purified collagenase, contains minimal secondary proteolytic activities along with high collagenase activity
- **STZ1** and **STZ2** 0.22µ filtered **STEMxyme**[®] **AF Collagenase/Neutral Protease (Dispase**[®]) blends for primary and stem cell isolation



Animal Free Nucleases



Deoxyribonucleases (DNases) recommended for removing DNA in molecular biological, biopharma and bioprocessing applications:

- **DR1 DNase I** recombinant, RNase and Protease Free, lyophilized
- **DR1S DNase I** recombinant, RNase and Protease Free, 1 mg/ml Solution
- **DR2 DNase I** recombinant, Bioprocess Grade, lyophilized

Ribonucleases (RNases) for the removal of RNA in molecular biological, biopharma and bioprocessing applications:

- **RRA1 RNase A** recombinant, RNase and Protease Free, lyophilized
- **RRA2 RNase A** recombinant, Bioprocess Grade, lyophilized
- **RT1S RNase T1** highly purified microbial RNase for RNA structure, sequencing and digestion, solution
- **RT1L RNase T1** highly purified microbial RNase for RNA structure, sequencing and digestion, lyophilized
- **RT2R RNase T2** recombinant, purified non-specific RNase for RNA digestion, 3' analysis and RNA protection assays

Animal Free Proteases and Inhibitors



Neutral Protease (Dispase®) used as a secondary enzyme in cell isolation and tissue dissociation applications:

- **NPRO** neutral protease, purified
- **NPRO2** neutral protease, partially purified

Trypsin Inhibitors recommended for protease inhibition in bioprocessing applications:

- **SI** soybean trypsin inhibitor, purified
- **SIC** soybean trypsin inhibitor, partially purified
- **LBI** lima bean trypsin inhibitor, purified

*For Your Convenience, Look for This Symbol
When Sourcing Animal Free Products*





Value Verified



*ISO9001 Certified Quality Management System
All Processes Fully Documented and Traceable
from Raw Materials through Final Shipment*



*Primary Producer For Biotech, Life Science Research,
Diagnostic, Biopharmaceutical and Bioprocessing
Respected Manufacturer of (High Quality,
Lot-to-Lot Consistent) Enzymes for Over 75 Years*



*Multi-Scale Extraction, Fermentation, Protein
Purification, Lyophilization and Packaging
Capabilities Produced Under GMP Guidelines
Internal Testing Capabilities include Enzyme, Protein,
and Related Biochemical Analysis and Characterization*



*Animal-Free Certified and USDA Approved Animal-
Sourced Products
Suitable for Worldwide Exportation*



*Flexible and Responsive Production Scheduling
Sample Lots and Bulk Inventories Available for
Immediate Shipment*



*Superior Customer Services and Technical Support -
Before, During and After Sale
Volume Purchases, Bulk Packaging, Standing Orders,
OEM/Supply Agreements, and Special Arrangements*



*Cited in Thousands of Respected Scientific Journals
Across the Globe; Online Citations and Technical
Library to Educate Your Staff and Support Your
Business Development Goals*

Experience Worthington Quality, Consistency, Enzymes...for over 75 Years!



Worthington-Biochem.com

1.800.445.9603 • 1.732.942.1660

E-mail: custservice@Worthington-Biochem.com

techservice@Worthington-Biochem.com



Charles C. Worthington Freehold, NJ lab, 1947



Worthington Lakewood, NJ lab, today

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Ordering Information

Worthington provides various options to make ordering fast and convenient:

- **Call:** 1.800.445.9603 (8am – 5:30pm EST Mon. – Fri.)
1.732.942.1660
- **Fax:** 1.800.368.3108
1.732.942.9270 (24hr/day, 7 days/week)
- **E-mail:** custservice@Worthington-Biochem.com
techservice@Worthington-Biochem.com
- **Online/Website:** Worthington-Biochem.com
TissueDissociation.com
- **Write:** Worthington Biochemical Corporation
730 Vassar Avenue
Lakewood, New Jersey 08701 U.S.A
- **Pricing:** For current pricing go to Worthington-Biochem.com

Terms of Sale

Not responsible for typographical errors. Shipping charges will be prepaid and added to the invoice unless other arrangements are made at the time of ordering. Insurance will be charged for higher-value shipments at our discretion. An additional \$75.00 fee is charged for shipments requiring a USDA endorsed export certificate.

Payment terms are Net 30 Days, F.O.B. Origin, Lakewood, New Jersey USA, payable in US dollars. All checks must be drawn on a US bank or payment made by wire transfer. Past due accounts may be charged a 1.5% per month late payment fee.

Complete Standard Terms and Conditions of Sale are available on our website.

VISA, MasterCard & American Express are also accepted.



Discounts

Quantity Discounts

<i>Quantity</i>	<i>Price</i>
1 to 4	List Price
5 to 9	5% off list
10 to 19	10% off list
20 or more	15% off list
Bulk	Inquire

Standing Orders & Additional Discounts

For orders of greater than 25 packages, or orders of material packed in bulk, contact your representative or the Bulk Sales Office for special pricing consideration. Standing orders may also qualify for discounts. We welcome long-term use projections for which we can consider special rates. Large institutional buyers should contact their representative regarding special purchasing agreements.

Bulk, Contract/Custom & OEM Enzyme Purchasing

As a primary manufacturer, Worthington can supply products in a wide range of purity and activity specifications and in large-scale bulk quantities at substantial discounts. In addition, we welcome inquiries for contract and custom manufacturing, custom analysis, and special packaging for OEM applications. Several products are listed as Bulk Only in this catalog due to limited availability. Please contact Customer Service or our Bulk Sales Office to discuss your specific requirements at: **custservice@Worthington-Biochem.com**

Complete Standard Terms and Conditions of Sale are available on our website.

Technical Service

Available 8:00 AM to 5:00 PM Eastern Time Monday through Friday. We can be contacted 24 hours a day by fax, e-mail or through our website.

Worthington makes the products we sell and welcome your questions and suggestions. Because we are a primary manufacturer we have ready access to all production and quality control records of our products by lot number.

Our years of experience in enzyme purification put us in a position to assist individual researchers with special needs. We frequently do customized preparations of entirely new products. We can make modifications of a regular production procedure on a custom basis. Furthermore, our quality control department can do special testing if needed.



*Need help with protocols?
Ask a representative how we can help update you with our latest technical tools.*

Sampling Program Online

Our position as the principal manufacturer of research grade collagenase makes possible our Collagenase Sampling Program. Under the program, we provide 100 mg samples of up to three different lots of collagenase for evaluation in your own cell isolation systems. A period of 60 days is allowed for your evaluation of these samples. A minimum of 3 grams of each lot of collagenase will be placed on HOLD, reserved in your name. When you determine which lot performs best for you, specify the lot desired when ordering. The only requirement, once a suitable lot of collagenase is found, is that you purchase a minimum of 3 grams of the material. **There is no charge for participating in the Collagenase Sampling Program. Contact your representative or our Technical Service group for more information at techservice@Worthington-Biochem.com.**

Collagenase Lot Selection Tool

Worthington's Collagenase Lot Selection Tool is available online at our website. This feature was designed to help researchers select and evaluate current collagenase lots that match previous lots or desired activity profiles. Users may enter target values for collagenase, caseinase, clostripain, and tryptic activities or specify previous lot numbers. Each value can be weighted based on the relative level of importance to the application. After the search for matches is completed, a ranked list of collagenase lots currently available is generated. The selected lots can then be sampled simply by using the built-in link to the Free Collagenase Sampling Program. As always, Worthington Customer and Technical Service personnel are available via phone and e-mail to assist with collagenase or any other products.

ISO 9001 Certified Quality Management System

Worthington Biochemical Corporation is company-wide ISO9001 certified and operates according to GMP guidelines. Our initial ISO assessment audit was performed by ANAB-accredited SGS US Testing Company, Systems & Services Certification in 2005 with continuous successful re-certifications.

Product Use

All Worthington products are sold for manufacturing, research, and laboratory use only by properly trained and authorized personnel. Researchers and clinical laboratory personnel intending to use any of these products for medical investigation on humans are solely responsible for such use, and for compliance with the pertinent regulations of the United States Food & Drug Administration (USFDA) and other regulations. We do not assume liability for damages resulting from the use of these products or from their use in violation of patent or other rights.

U.S.D.A. Certified Raw Materials

All products from animal sources are produced from starting materials of United States Department of Agriculture (USDA) or equivalent approved origin, collected in USDA or equivalent approved facilities, inspected to be free of disease and suitable for exportation. Certificates of Origin are available upon request.

Animal Free Products

Several Animal Free (AF) nucleases, proteases and other products are also available to eliminate BSE/TSE and mammalian viral risks. Please inquire. All animal free products are designated with this symbol for ease of use.



Product Returns

Authorization for any product return must be obtained from Worthington Biochemical Corporation (Customer Service Department), or its authorized representative, prior to the return of product. This authorization is required to ensure the proper return of material and, if applicable, the correct issuance of credit. There is no provision for credit of misused, improperly stored or outdated material. Product(s) must be returned in the same condition as received within 30 days of the original shipment by Worthington Biochemical Corporation. A restocking fee may be charged.

Complete Standard Terms and Conditions of Sale are available on our website.

Enhanced Online Resources

New Customer-friendly Log In
Worthington Enzyme Manual, Tissue Dissociation Guide and Educational Video
Easy-to-Use Online Collagenase Sampling and Lot Selection Tool
Improved Online Product Catalog with Multi-Filtering Capabilities
Extensive Citations Powered by Bioz AI Search Engine

Additional Online Features

Product Catalog Pages are Simplified for Convenient Ordering
Access Current Collagenase Lot Activity Survey
Multiple Options for Quick Enzyme Selection
Simple Search by Application Area
International Distributor Listing with Website Links
Updated Announcements and Exhibit Schedules

Visit us at: [**facebook**](#) [**LinkedIn**](#)



*Addressing your individual needs, we value every customer interaction.
Let us know how we are doing.*

Working Together

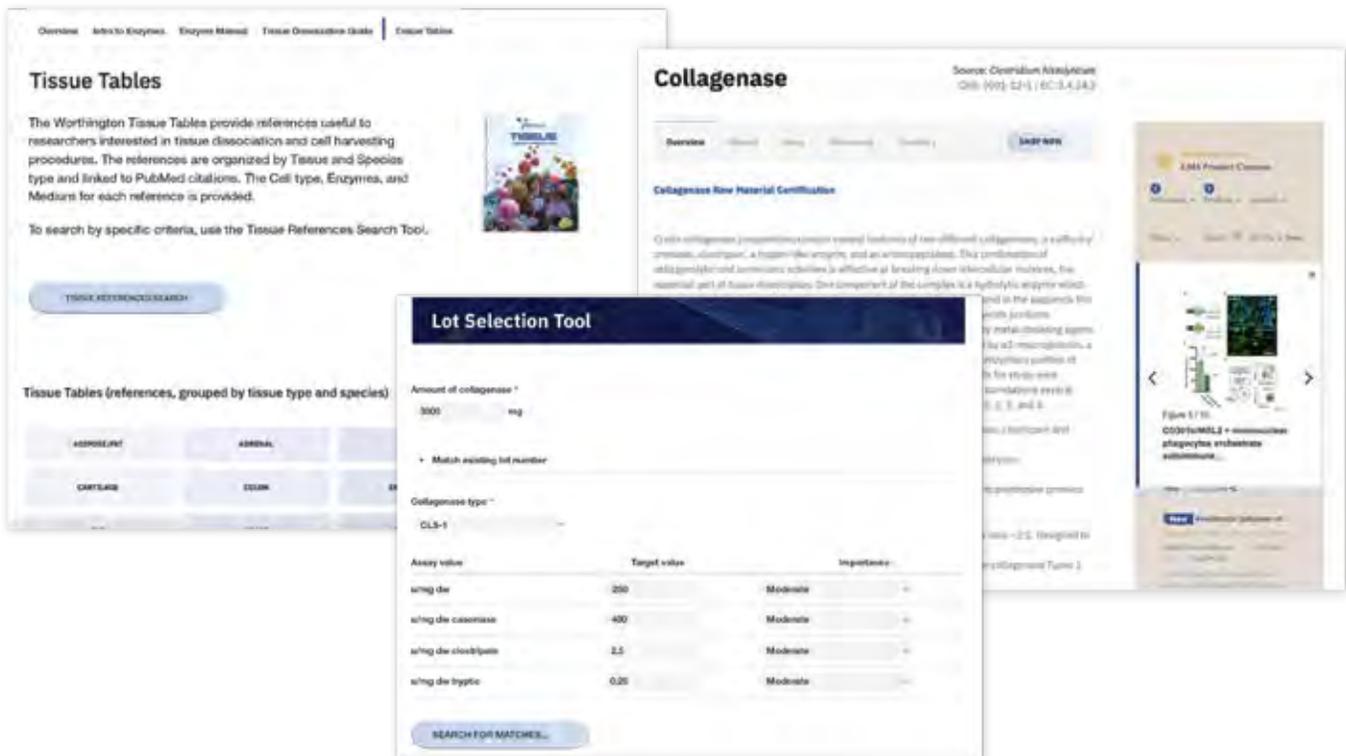
Opening the Potential for Stem Cell Research Innovation

Sharing our enzyme expertise is a top priority at Worthington, and we have done so for over 70 years. We author technical manuals and guides both in print and digital formats. Worthington products are cited in thousands of respected scientific journals across the globe.

To Support Your Research, We Provide Online Resources To Include:

- Advanced tissue search feature in the tissue dissociation guide section of our website
- Comprehensive citations listings at: Bioz.com by search for Worthington products to obtain article snippets with technique filtering capabilities
- Collagenase Sampling Program to pre-test a particular lot of enzyme you are planning to use in your experiment. This free service allows you to pre-sample several different lots of collagenase at a time and select the best of the group for the application.

We invite you to work with us hand-in-hand to enhance our stem cell research technical library by submitting Tissue protocols, citations and articles referencing Worthington enzymes that can be shared with your colleagues. For details on submissions, contact your local Worthington Account Manager or forward suggestions to: techservice@worthington-biochem.com.



Name	Activity	Catalog Number	Package	Code
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Actin

Source: Rabbit Muscle **CAS Number: 51005-14-2**

Actin is a protein involved in the conversion of chemical energy into mechanical work. ATP is an essential component of the molecule. Actin is a key component of muscle myofibrils that combines with the heavy meromyosin (HMM) portion of the myosin filament to form the highly viscous actomyosin. Actin is characterized by its super-precipitation with myosin, its activation of myosin ATPase (EC 3.6.1.3) at low ionic strength and its depolymerization, i.e., loss of viscosity, on adding ATP at high ionic strength. Actin is reversibly transformed into a viscous polymerized fibrous form, F-actin, by the addition of neutral salts at a neutral or slightly alkaline pH. The reaction which involves bound nucleotide is:



Stability/Storage: Stable 1-2 years at 2-8°C.

Actin

Prepared by modification of the procedure of Spudich and Watt, *J. Biol. Chem.*, 246, 4866 (1971). Purity checked by SDS-PAGE. A lyophilized powder. Store at 2-8°C.

N/A

LS001041

1 mg

LS001045

5 mg

LS001043

Bulk

ACT

Related Product: Deoxyribonuclease

Name	Activity	Catalog Number	Package	Code
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Adenosine Deaminase

Source: Calf Spleen

EC: 3.5.4.4

CAS Number: 9026-93-1

Adenosine deaminase is a purine catabolic enzyme ubiquitous in mammalian tissue that catalyzes the deamination of both adenosine and 2'-deoxyadenosine to inosine and 2'-deoxyinosine, respectively.

Stability/Storage: Stable ≥ 6 months when stored at 2-8°C.

Unit Definition: One Unit converts one micromole of adenosine to inosine per minute at 25°C, pH 7.4.

Adenosine Deaminase

A chromatographically purified, dialyzed, lyophilized powder. Prepared by a modification of the method of Pfrogner, *Arch. Biochim. Biophys.*, 119, 141 (1967). Store at 2-8°C.

≥ 15 Units per
mg dry weight

LS009043

250 un

LS009044

Bulk

ADA

Name	Activity	Catalog Number	Package	Code
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Albumin, Nuclease-Free

Source: Bovine Serum **CAS Number: 9048-46-8**

Non-acetylated BSA processed to remove exonuclease, endonuclease, ribonuclease, and protease activities. Some degradation of the albumin may occur during treatment. The Worthington product is useful as a stabilizing agent in reactions and dilutions, and as a ballast protein in precipitations where contaminating nucleases and proteases are a concern.

Albumin, Nuclease-Free

Prepared by a method developed at Worthington. Some degradation products may be present. ≥ 90% of the material is intact BSA as determined by SDS-PAGE. Tested for exonuclease, endonuclease, ribonuclease, and protease. An aqueous solution at neutral pH in 50% glycerol at 50 mg/ml. Store at 2-8°C.

N/A

LS000290

100 mg

LS000291

5 x 100 mg

LS000292

Bulk

BSANF

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Name	Activity	Catalog Number	Package	Code
Alcohol Dehydrogenase				
Source: Yeast				
EC: 1.1.1.1 CAS Number: 9031-72-5				
Alcohol dehydrogenase derived from yeast is a metalloenzyme containing four tightly bound zinc atoms per molecule (Vallee and Hoch, <i>Proc. Natl. Acad. Sci. USA</i> , 41, 327, 1955). The optimum pH for the enzymatic oxidation of ethanol is 8.6-9.0 and is closer to 7.0 for the reduction of acetaldehyde.				
Stability/Storage: Stable 4-5 months at 2-8°C.				
Unit Definition: One Unit reduces one micromole of NAD per minute at 25°C, pH 8.8.				
Alcohol Dehydrogenase, Suspension				
Two times crystallized. A suspension in 2.4 M ammonium sulfate containing 3% pyrophosphate and 0.1% glycine. Store at 2-8°C. SPECIAL SHIPPING: ICE PACK	≥ 300 Units per mg protein	LS001089	Bulk	ADHS
Alcohol Dehydrogenase, Lyophilized				
Two times crystallized. A lyophilized powder. Store at -20°C. SPECIAL SHIPPING: ICE PACK	≥ 300 Units per mg protein	LS001069 LS001070 LS001071	100 mg 1 gm Bulk	ADHL

Name	Activity	Catalog Number	Package	Code
Aldolase				
Source: Rabbit Muscle				
EC: 4.1.2.13 CAS Number: 9024-52-6				
Aldolase catalyzes the reversible conversion of fructose-1,6-bisphosphate to dihydroxyacetone phosphate + glyceraldehyde-3-phosphate and plays a key role in glycolysis and energy production.				
Stability/Storage: The enzyme is irreversibly denatured at pH values lower than 4.5. A crystalline suspension in ammonium sulfate solution, pH 7.6, is stable for at least six months at 2-8°C.				
Unit Definition: One unit causes an increase of 1.0 A ₂₄₀ per minute at 25°C, pH 7.5 with the hydrazine/3-phosphoglyceraldehyde assay (Jagannathan <i>et al.</i> , <i>Biochem. J.</i> , 63, 94, 1956).				
Aldolase, Suspension				
Two times crystallized. A suspension in 2.1 M ammonium sulfate, pH 7.8. Store at 2-8°C.	≥ 10 units per mg protein	LS001123 LS001125	100 mg Bulk	ALD
Aldolase, Lyophilized				
Chromatographically purified. A lyophilized powder containing 80% sucrose by weight. Purity checked by SDS PAGE. Useful as a chromatography size marker. Store at 2-8°C. PROTECT FROM MOISTURE.	N/A	LS001130 LS001128	100 mg Bulk	ALDC

Name	Activity	Catalog Number	Package	Code
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Amino Acid Oxidase, D-

Source: Porcine Kidney

EC: 1.4.3.3 **CAS Number:** 9000-88-8

D-amino acid oxidase is a flavoprotein. The enzyme is isolated as a stable crystalline complex with benzoate from which the holo- and apoenzyme may be prepared. The benzoate, is readily exchanged for a substrate. D-amino acid oxidase in the presence of molecular oxygen oxidatively deaminates D-amino acids to corresponding α -keto-acids:



Stability/Storage: The enzyme is stable for months at 2-8°C as a dry, lyophilized powder and in solution at high protein concentration at 2-8°C. 1.4×10^{-5} M FAD prevents loss of activity upon dilution (Dixon and Kleppe, *Biochim. Biophys. Acta*, 96, 368, 1965).

Store at 2-8°C.

Unit Definition: 1 Unit oxidizes 1 micromole of D-alanine per minute at 37°C, pH 8.3.

Amino Acid Oxidase, D-

DAOFF

Chromatographically purified. A lyophilized powder. Note: This enzyme is sensitive to physical denaturation and should be reconstituted and handled with care. Store at 2-8°C.	≥ 2 Units mg per dry weight	LS006310 LS006308 LS006311	5 mg 25 mg Bulk
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Name	Activity	Catalog Number	Package	Code
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Amino Acid Oxidase, L-

Source: *Crotalus adamanteus* Venom

EC: 1.4.3.2 **CAS Number:** 9000-89-9

L-Amino acid oxidase is an heterodimeric glycoprotein composed of two approximately 70 kDa subunits. Three electrophoretically different isozymes occur as different combinations of the two subunits. There are approximately two moles of FAD per mole of holo-enzyme. L-amino acid oxidase catalyzes the oxidative deamination of a number of L-amino acids. The enzyme is absolutely specific for L-isomers. The Worthington product is prepared according to Wellner and Meister, *J. Biol. Chem.*, 235, 2013 (1960) to the point just prior to crystallization.

Stability/Storage: The enzyme is stable in solution for 6-12 months at 2-8°C. The presence of substrate and the absence of oxygen stabilize the enzyme at elevated temperatures. The enzyme may be reversibly inactivated by incubation at 38°C in phosphate buffer, pH 7.5 (Wellner, *Biochemistry*, 5, 1586, 1966). Curti *et. al.* report reversible inactivation upon freezing (Curti *et. al.*, *J. Biol. Chem.*, 243, 2306, 1968). Store at 2-8°C. Do not freeze.

Unit Definition: One Unit oxidizes one micromole of L-leucine per minute at 25°C, pH 7.6.

Amino Acid Oxidase, L-

LAO

An aqueous solution with toluene added as a preservative. Store at 2-8°C. DO NOT FREEZE.	≥ 4 Units per mg protein	LS002763 LS002764 LS002766	2 mg 5 mg Bulk
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Name	Activity	Catalog Number	Package	Code
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Carbonic Anhydrase

Source: Bovine Erythrocytes

EC: 4.2.1.1 **CAS Number:** 9001-03-0

Carbonic anhydrase is useful in carboxy group transfers and reduction reactions.

Unit Definition: One unit is determined by the electrometric method of Wilbur and Anderson, *J. Biol. Chem.*, 176, 147 (1948), in which the time required (in seconds) for a saturated CO₂ solution to lower the pH of 0.02 M Tris-HCl buffer from 8.3 to 6.3, at 0-4°C is determined.

Carbonic Anhydrase

CA

A dialyzed, lyophilized powder.
Store at 2-8°C.

≥ 3,000 units	LS001260	50 mg
per mg dry	LS001263	250 mg
weight	LS001265	Bulk

Name	Activity	Catalog Number	Package	Code
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Carboxypeptidase B

Source: Porcine Pancreas

EC: 3.4.17.2 **CAS Number:** 9025-24-5

Carboxypeptidase B catalyzes hydrolysis of the basic amino acids lysine, arginine and ornithine from the C-terminal end of polypeptides. The molecular weight is 34.5 kDa and the pH optimum is 7.9. Carboxypeptidase B is competitively inhibited by arginine, lysine and ornithine. The enzyme is not inhibited by di-isopropylfluorophosphate (DFP), but it is inhibited by metal chelating agents such as 1,10-phenanthroline.

Unit Definition: One Unit hydrolyzes one micromole of hippuryl-L-arginine per minute at 25°C, pH 7.65.

Note: Carboxypeptidase product code COBPMS has been discontinued and superseded by product code COBC listed below.

Carboxypeptidase B

COBC

Chromatographically purified. A solution in 100 mM sodium chloride. Chymotrypsin and trypsin ≤ 0.02%.
Store at -20°C.

≥ 170 Units	LS005305	5 mg
per mg	LS005301	10 mg
protein	LS005304	50 mg
	LS005302	Bulk

REQUIRES SPECIAL SHIPPING: ICE PACK

Related Products: Carboxypeptidase Y • Chymotrypsin • Clostripain (Endoproteinase-Arg-C) Protease, *Staph aureus* (Endoproteinase Glu-C) • Trypsin

Name	Activity	Catalog Number	Package	Code
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Carboxypeptidase Y

Source: Yeast

EC: 3.4.16.5 **CAS Number: 9046-67-7**

Carboxypeptidase Y is a serine exopeptidase which cleaves amino acids from the carboxyl terminus of peptide chains. Carboxypeptidase Y has a broad amino acid specificity, including proline and amidated amino acid residues.

Unit Definition: One Unit hydrolyzes 1 micromole of benzyl-oxy-carbonyl-L-phenylalanyl-L-leucine per minute at 25°C, pH 6.5.

Carboxypeptidase Y

COY

A highly purified preparation supplied as a lyophilized powder. Store at -20°C.	≥ 50 Units per mg protein	LS009070 LS009068 LS009071	1 mg 5 mg Bulk
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Related Products: Carboxypeptidase B • Chymotrypsin • Clostripain (Endoproteinase-Arg-C) Protease, *Staph aureus* (Endoproteinase Glu-C) • Trypsin

Name	Activity	Catalog Number	Package	Code
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Catalase

Source: Bovine Liver

EC: 1.11.1.6 **CAS Number: 9001-05-2**

Catalase is a tetrameric hemoprotein that decomposes hydrogen peroxide to water and O₂.

Technical Notes: To remove thymol from Product Code: CTR, measure desired amount of mixed suspension, centrifuge to collect enzyme crystals, remove supernatant. Resuspend crystals in one-half initial volume of water, respin. Discard wash supernatant in an appropriate manner and dissolve crystals in buffer of choice.

Stability/Storage: All preparations are stable for 12 months at 2-8°C. Lyophilized preparations should be protected from moisture. In addition, the Worthington Product Code: CTR should not be stored in plastic.

Unit Definition: One Unit decomposes one micromole of hydrogen peroxide per minute at 25°C, pH 7.0.

Catalase, Suspension

CTR

A crystalline aqueous suspension of approximately 6 mg/ml containing thymol as a preservative. Store at 2-8°C. DO NOT STORE IN PLASTIC: CONTAINS THYMOL	≥ 20,000 Units per mg protein	LS001872 LS001873 LS001874	10 ml 100 ml Bulk
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Catalase, Filtered

CTS

Supplied as an aqueous solution of 2X crystallized catalase (Code: CTR without thymol) filtered through a 0.22 micron membrane. Minimum of 30,000 units/ml; 10 ml/vial. Store at 2-8°C. DO NOT FREEZE.	≥ 40,000 Units per mg protein	LS001896 LS001898	10 ml 10x10 ml
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Catalase, Lyophilized

CTL

A partially purified, lyophilized powder. Store at -20°C. PROTECT FROM MOISTURE.	≥ 3,000 Units per mg protein	LS001847 LS001849 LS001851	2 gm 10 gm Bulk
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Name	Activity	Catalog Number	Package	Code
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Celase® GMP Collagenase Blend

Source: *Cl. histolyticum* Collagenase/*Bacillus* Neutral Protease

EC: 3.4.24.3/3.4.24.28

CAS Number: 42613-33-2

Celase® GMP is a proprietary, blended proteolytic enzyme designed for efficient, gentle and reproducible *in vitro* dissociation of nucleated cells from adipose tissue.

Convenience In Your Lab

- A single, sterile, ready-to-use vial containing both collagenase and a neutral protease can digest up to 280 gm of adipose tissue
- Best-in-class shelf life of up to 72 months

Clarity In Your Approach

- Research protocols are available from Cytori for dissociating canine, equine, human, ovine, porcine, rabbit and rodent adipose tissue
- Technical dossier is available from Cytori to ease the transition from research to clinical applications

Confidence In Your Result

- Included in IDE applications approved by U.S. FDA for alopecia, chronic heart failure, hamstring injuries, osteoarthritis of the knee, and hand manifestations of scleroderma
- Produced using avian and mammalian tissue-free raw materials, aseptic processes and sterile filtration under GMP guidelines to assure the lowest levels of impurities



Ask about our animal free products for a wide range of biomedical research and bulk bioprocessing applications.

Name	Activity	Catalog Number	Package	Code
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Celase® GMP Collagenase Blend (Continued)

Total Protein 34.4 - 51.6 mg/vial

Endotoxin < 50 EU / mg

Stability Lyophilized: 72 months at -25 to -15°C
Reconstituted: 6 months at -25 to -15°C and up to 2 freeze-thaw cycles

Appearance White lyophilizate

Celase®

A single, sterile, ready-to-use vial containing both collagenase and a neutral protease which can digest up to 280 gm of adipose tissue. Stable up to 72 months at -20°C. REQUIRES SPECIAL SHIPPING AND PACKAGING: DRY ICE.

Digests ≥ 280 gm of adipose tissue

1235-01

1 vial, 35 mg

CLAS

235-PKG

1 ea

CLAS-PKG

Related Products: Cell Isolation Optimizing System • Collagen • Deoxyribonuclease I • Elastase • Hepatocyte Isolation System
Hyaluronidase • Neonatal Cardiomyocyte Isolation System • Neutral Protease (Dispase®) • Papain • Papain Dissociation System
STEMxyme® 1 • STEMxyme® 2 • Trypsin • Trypsin Inhibitors

Next Level Research



Celase® GMP

- Same formulation, now available without Cellution
- Foundational and versatile for all research programs
- Eliminates time consuming, costly bridging studies

Expanding our commitment to convenience, clarity and confidence with the Celase® enzyme blend for pre-clinical applications.

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Cell Isolation Optimizing System

A complete method development kit containing an assortment of enzymes most frequently used in enzymatic tissue dissociation and cell isolation procedures. Includes instructions, references, and strategies for the handling, use and optimization of enzymatic cell isolation methods for maximum yield of viable cells. It also contains the **Cell Isolation Guide** which describes the tissue types commonly used, the mode of action of the various enzymes, tissue culture techniques, and protocol optimization guidelines (with cell- and tissue-specific references for getting started in enzymatic cell isolation).

Tissue dissociation and cell harvesting are two principal applications for enzymes in tissue culture research and cell biology studies. Despite the widespread use of enzymes for these applications over the years, their mechanisms of action in dissociation and harvesting are not well understood. As a result, the choice of one technique over another is often arbitrary and based more on past experience than on an understanding of why the method works and what modifications could lead to even better results.

Investigators searching the scientific literature for information on the ideal enzymes and optimal conditions for tissue dissociation are often confronted with conflicting data. Much of the variation stems from the complex and dynamic nature of the extracellular matrix and from the historical use of relatively crude, undefined enzyme preparations for cell isolation applications. The extracellular matrix is composed of a wide variety of proteins, glycoproteins, lipids and glycolipids, all of which can differ in abundance from species to species, tissue to tissue and with developmental stage. The Worthington Cell Isolation Optimizing System provides an assortment of the widely used enzymes in purified form for establishing an optimized cell isolation procedure on a cost-efficient basis.

Kit Contents:

- Collagenase Type 1, CLS-1, 500 mgdw
- Collagenase Type 2, CLS-2, 500 mgdw
- Collagenase Type 3, CLS-3, 500 mgdw
- Collagenase Type 4, CLS-4, 500 mgdw
- Trypsin, TRL, 500 mgdw
- Neutral Protease (Dispase®), NPRO, 10 mgdw
- Hyaluronidase, HSE, 50,000 un
- Elastase, ESL, 100 mgP
- Papain, PAPL, 100 mgP
- Deoxyribonuclease I, DP, 25 mgdw
- Trypsin Inhibitor, SIC, 100 mgdw

Cell Isolation Optimizing System

A complete method development kit containing an assortment of enzymes most frequently used in tissue dissociation and cell isolation procedures. Includes instructions, references, and strategies or the handling, use and optimization of enzymatic cell isolation methods to achieve maximum yield of viable cells. Kit includes 500 mg of each of four types of collagenase, 500 mg trypsin, 50 ku hyaluronidase, 100 mg elastase, 100 mg papain, 25 mg DNase I, 10 mg neutral protease (Dispase®) and 100 mg trypsin inhibitor. Store at 2-8°C.

N/A LK003200 1 bx

CIT

Related Products: Collagenase • Deoxyribonuclease I • Elastase • Hepatocyte Isolation System
Hyaluronidase • *STEMxyme*® 1 & 2 • Neonatal Cardiomyocyte Isolation System • Neutral Protease (Dispase®)
Papain • Papain Dissociation System • Trypsin • Trypsin Inhibitor

Name	Activity	Catalog Number	Package	Code
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Cellulase

Source: *Trichoderma reesei* ATCC #26921 (previously *T. viride*)

EC: 3.2.1.4 **CAS Number:** 9012-54-8

Cellulase refers to a family of enzymes which act in concert to hydrolyze cellulose. *Trichoderma reesei* has an extensively studied cellulase enzyme complex. This complex converts crystalline, amorphous, and chemically derived celluloses quantitatively to glucose.

Unit Definition: One unit releases 0.01 milligrams of glucose per hour from microcrystalline cellulose at 37°C, pH 5.0.

Cellulase

Purified complex containing exo- and endoglucanase activities. A diafiltered, lyophilized powder. Tested for lipase, protease, and nuclease. Store at 2-8°C.

≥ 45 units per
mg dry weight

LS002598
LS002601
LS002603
LS002600

250 mg
1 gm
10 gm
Bulk

CEL

Cellulase

A partially purified, lyophilized powder. Store at 2-8°C.

≥ 25 units
mg dry weight

LS002610
LS002611
LS002609

1 gm
10 gm
Bulk

CELLF

Related Product: Pectinase



From application specific kits to bulk quantities, our researchers take pride in our quality assurance procedures.

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Cholinesterase, Butyryl

Source: Horse Serum

EC: 3.1.1.8 **CAS Number: 9001-08-5**

Butyryl cholinesterase catalyzes the hydrolysis of a number of choline esters according to the following reaction:



It is a homotetrameric glycoprotein, each subunit having a molecular weight of 110 kDa. Butyryl cholinesterase hydrolyzes butyrylcholine four times more rapidly than acetylcholine. Unlike acetyl cholinesterase, it does not hydrolyze D-beta-methyl acetylcholine. It is inhibited by 10µM physostigmine, numerous organophosphate esters, the carbamate derivatives and quaternary ammonium salts.

Stability/Storage: Stable for 3 years at 2-8°C. Store at 2-8°C.

Unit Definition: 1 Unit hydrolyzes 1 micromole of acetylcholine per minute at 25°C, pH 7.4.

Cholinesterase, Butyryl

A partially purified lyophilized powder.
Store at 2-8°C.

≥ 4 Units per
mg dry weight

LS001628
LS001632
LS001636

500 un
4 ku
Bulk

CHE

Name	Activity	Catalog Number	Package	Code
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Chymotrypsin

Source: Bovine Pancreas

EC: 3.4.21.1 **CAS Number: 9004-07-3**

Chymotrypsin is a serine endopeptidase that preferentially catalyzes the hydrolysis of peptide bonds involving L-isomers of tyrosine, phenylalanine and tryptophan. It also readily acts upon amides and esters of susceptible amino acids. Chymotrypsin catalyzes the hydrolysis of bonds of leucyl, methionyl, asparaginyl and glutamyl residues.

Stability/Storage: The enzyme is stable for days in solution at pH 3.0 and for years as a dry powder at 2-8°C. Protect from moisture.

Unit Definition: One Unit hydrolyzes one micromole of benzoyl-L-tyrosine ethyl ester per minute at 25°C, pH 7.8 in the presence of calcium. An activity of 45 Units per mg using the above definition, is the equivalent of 10,000 optical density or 1330 N.F. units per mg using ATEE as a substrate.

1 BTEE unit = 29.5 USP/NF units.

Chymotrypsin, Alpha, TLCK Treated, Sequencing Grade

Three times crystallized and treated with 1-chloro-3-tosylamido-7-amino-2-heptanone (TLCK) to inhibit trypsin activity (Shaw, *et al.*, *Biochemistry*, 4, 2219, 1965). Dialyzed against 1 mM HCl to remove autolysis products and low molecular weight contaminants. Supplied lyophilized in 25 ug and 100 ug high-recovery vials. Store at 2-8°C.

≥ 45 Units per
mg protein

LS02130
LS02132

4 x 25 ug
4 x 100 ug

CDSEQ

Related Products: Endo-Arg-C • Endo-Glu-C • Endo-Lys-C • Trypsin, Modified • Trypsin

Name	Activity	Catalog Number	Package	Code
Chymotrypsin (Continued)				
Chymotrypsin, Alpha, TLCK Treated Three times crystallized and treated with 1-chloro-3-tosylamido-7-amino-2-heptanone (TLCK) to inhibit trypsin activity (Shaw, <i>et al.</i> , <i>Biochemistry</i> , 4, 2219 1965). Dialyzed against 1 mM HCl to remove autolysis products and low molecular weight contaminants. Supplied as a dialyzed, lyophilized powder. Store at 2-8°C.	≥ 45 Units per mg protein	LS001430	25 mg	CDTLCK
		LS001432	100 mg	
		LS001434	1 gm	
		LS001438	Bulk	
Chymotrypsin, Alpha, Purified Chromatographically prepared by the procedure of Yapel <i>et al.</i> , <i>J. Amer. Chem. Soc.</i> , 88, 2573 (1966). A lyophilized powder. Store at 2-8°C.	≥ 45 Units per mg protein	LS001475	100 mg	CDS
		LS001479	1 gm	
		LS001477	Bulk	
Chymotrypsin, Alpha, 3X Three times crystallized alpha chymotrypsin, which is an activation product of a three times crystallized zymogen. Dialyzed against 1 mM HCl and lyophilized. Store at 2-8°C.	≥ 45 Units per mg protein	LS001448	250 mg	CDI
		LS001450	1 gm	
		LS001451	10 gm	
		LS001453	Bulk	
Chymotrypsin, Alpha, Crystallized Crystallized as zymogen and activated. Dialyzed against 1 mM HCl and lyophilized. Store at 2-8°C.	≥ 35 Units per mg protein	LS001333	1 gm	CDAG
		LS001334	10 gm	
		LS001332	Bulk	

Related Products: Carboxypeptidase B • Carboxypeptidase Y • Collagenase • Endo-Arg-C • Endo-Lys-C Elastase • Hyaluronidase • Neutral Protease (Dispase®) Papain • Pepsin • Protease, *Staph aureus* (Endoproteinase Glu-C) Proteinase K • Trypsin • Trypsin Inhibitors

Name	Activity	Catalog Number	Package	Code
Chymotrypsinogen A				
Source: Bovine Pancreas CAS Number: 9035-75-0				
The zymogen form of chymotrypsin that is activated by trypsin. Chymotrypsin preferentially catalyzes the hydrolysis of peptide bonds involving L-isomers of tyrosine, phenylalanine and tryptophan. It also readily acts upon amides and esters of susceptible amino acids. Chymotrypsin catalyzes the hydrolysis of bonds of leucyl, methionyl, asparaginyl and glutamyl residues.				
Unit Definition: One Unit hydrolyzes one micromole of benzoyl-L-tyrosine ethyl ester per minute at 25°C, pH 7.8 in the presence of calcium. An activity of 45 Units per mg using the above definition, is the equivalent of 10,000 optical density or 1330 N.F. Units per mg using ATEE as a substrate.				
1 BTEE unit = 29.5 USP/NF Units.				
Chymotrypsinogen A, Purified Five times crystallized, electrophoretically homogeneous. Supplied as a dialyzed, lyophilized powder. Intrinsic activity ≤ 0.55 %. Store at 2-8°C.	Activates to ≥ 45 Units per mg protein	LS005630	1 gm	CGC
		LS005623	5 gm	
		LS005622	Bulk	

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Clostripain (Endoproteinase-Arg-C)

Source: *Clostridium histolyticum*

EC: 3.4.22.8 CAS Number: 9028-00-6

Clostripain (Endoproteinase-Arg-C) is a two chain cysteine proteinase associated with collagenase and isolated from *Clostridium histolyticum*. It is highly specific for the carboxyl peptide bond of arginine. Clostripain is activated by dithiothreitol, cysteine, or other sulfhydryl containing reagents. The presence of calcium ions is essential. The enzyme is inhibited by oxidizing agents, divalent cations such as Co²⁺, Cu²⁺, Cd²⁺, and heavy metal ions. Citrate, borate, and Tris anions are less inhibitory.

Unit Definition: One Unit hydrolyzes one micromole of N-benzoyl-L-arginine ethyl ester per minute at 25°C, pH 7.6, in the presence of dithiothreitol.

Clostripain (Endoproteinase-Arg-C)

CPSEQ

Sequencing Grade

Chromatographically purified. A dialyzed, pre-activated, lyophilized powder. Supplied in 10 µg high recovery vials. Store at 2-8°C.	≥ 50 Units per mg protein	LS02135 LS02139	10 ug Bulk
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Clostripain (Endoproteinase-Arg-C)

CP

Chromatographically purified. A dialyzed, pre-activated, lyophilized powder. Store at 2-8°C.	≥ 50 Units per mg dry weight	LS001641	1 mg
		LS001643	5 x 1 mg
		LS001646	10 mg
		LS001647	Bulk

Related Products: Collagenase • Chymotrypsin • Deoxyribonuclease I • Elastase • Endo-Glu-C • Endo-Lys-C
Hepatocyte Isolation System • Hyaluronidase • Neonatal Cardiomyocyte Isolation System • Neutral Protease (Dispase®) • Papain
Papain Dissociation System • Trypsin • Trypsin Inhibitor • Trypsin, Modified

Name	Activity	Catalog Number	Package	Code
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Collagen

CAS Number: 9007-34-5

Collagen is an inert, rigid protein found predominantly in skin, ligaments, bones and teeth. Its most distinctive characteristic in its role as a transmitter of mechanical force is its inelasticity. The fundamental structural unit is a tropo-collagen, a molecular rod about 2600 Å in length and 15 Å in diameter with a molecular weight of 300 kDa. In tendons, these macromolecules, grouped as collagen fibrils, run parallel to the axis; in skin the fibrils are interlaced and branched. Collagen fibers with limited cross-linkages (i.e., unaged) will dissolve to some extent in dilute acid or concentrated neutral salt solutions.

Collagen

CL

Source: Bovine Achilles Tendon

Type I collagen prepared by the method of Einbinder and Schubert, <i>J. Biol. Chem.</i> , 188, 335 (1951). Supplied as a shredded, lyophilized, insoluble preparation. Store at 2-8°C.	Suitable as substrate	LS001654 LS001652 LS001656 LS001658	1 gm 5 gm 10 gm Bulk
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Collagen, Soluble

CLCS

Source: Calf Skin

Type I collagen supplied as a 6mg/ml liquid preparation in 75 mM sodium citrate, pH 3.6 - 4.0, containing 0.01% thimerosal as a preservative. Store at 2-8°C	≤ 20 minutes gel time	LS001663	Bulk
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REQUIRES SPECIAL SHIPPING: ICE PACK

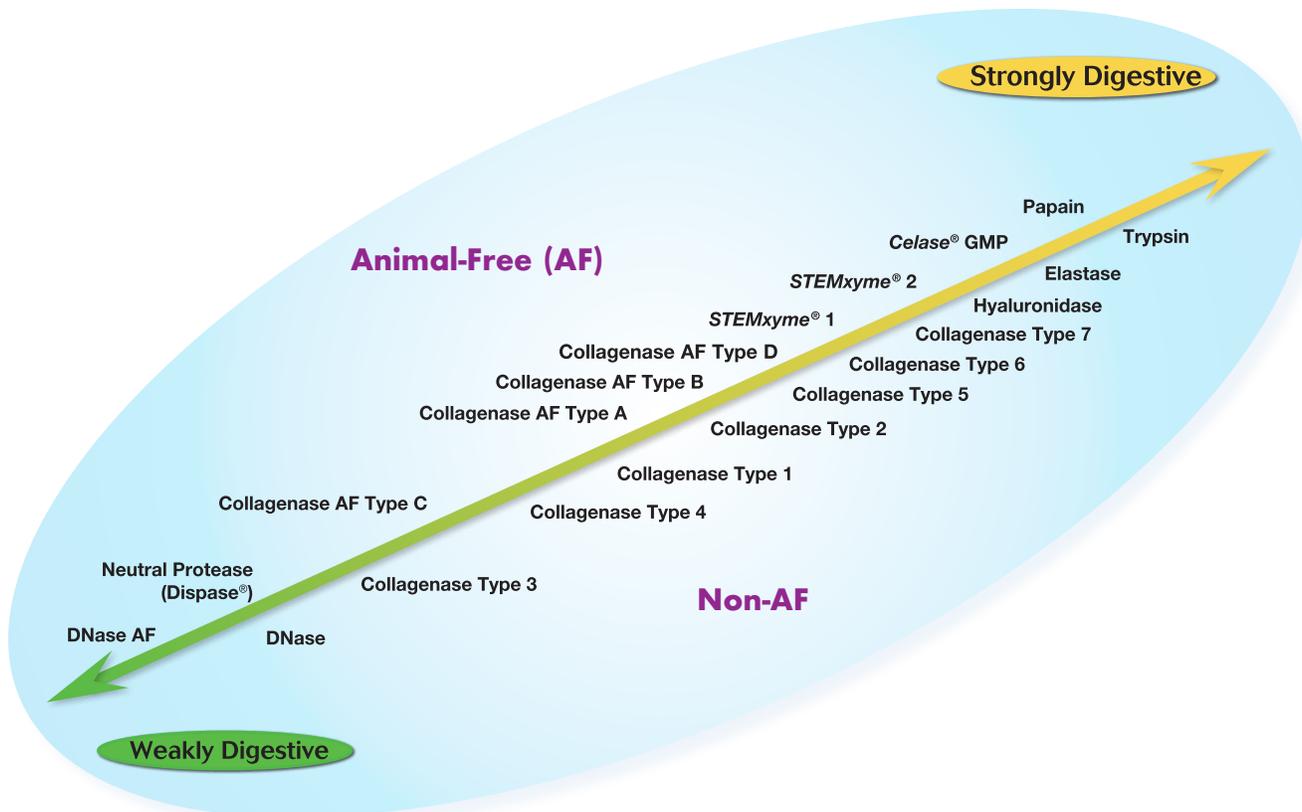
Note: Contains thimerosal as a preservative; proper handling and disposal required.

Related Product: Collagenase

Phone: 800.445.9603 • 732.942.1660 • Fax: 800.368.3108 • 732.942.9270

Worthington-Biochem.com
ISO9001 Certified

Worthington Primary Cell Isolation Enzyme Digestion Scale



Tissue dissociation/primary cell isolation and cell harvesting are principal applications for enzymes in tissue culture, stem cell research and cell biology studies. The goal of a cell isolation procedure is to maximize the yield of functionally viable, dissociated cells. There are many parameters which may affect the outcome. The choice of enzyme is an important parameter. Worthington's Tissue Dissociation Guide summarizes our knowledge of how these enzymes accomplish the "routine" operations of tissue dissociation and primary cell harvesting. This technical guide describes standard lab procedures; offers a logical experimental approach for establishing a cell isolation protocol; and lists many tissue specific references to aid development of an effective method. For more information, go to: TissueDissociation.com

Worthington Collagenase Products, Specifications and Applications Table

Product Code	Collagenase	Caseinase	Clostripain	Tryptic	Comments/Applications*
	CDU/mgdw	u/mgdw	u/mgdw	u/mgdw	
Partially Purified					
CLS-1	≥125	≥200	≤4.0	≤0.5	Balanced activities/Adipose, Adrenal, Epithelial, Liver, Lung
CLS-2	≥125	≥200	≥3.5	≥0.1	Higher proteolytic activities/Bone, Heart, Liver, Thymus
CLS-3	≥100	≥50	≤3.0	≤0.3	Lower proteolytic activities/Mammary
CLS-4	≥160	≥100	≤3.0	≤0.1	Lower tryptic activity/Pancreatic Islets
CLS-5	≥450	≥450	≤4.0	≤0.3	Higher collagenase and caseinase activities
CLS-6	≥400	≥1,000	≤4.0	≤0.5	Higher activity with caseinase to collagenase ratio ~2:1, designated to be enriched for Type II (<i>col H</i>) collagenase relative to Type I (<i>col G</i>)
CLS-7	≥1,000	≥2,000	≤8.0	≤0.5	Contains collagenase and caseinase activities 4X higher than collagenase Types 1 and 2
CLSS-1	≥125	≥200	≤4.0	≤0.5	0.22μ Filtered CLS-1 in 50mg & 1gm Vials
CLSS-2	≥125	≥200	≥3.5	≥0.1	0.22μ Filtered CLS-2 in 50mg & 1gm Vials
CLSS-3	≥100	≥50	≤3.0	≤0.3	0.22μ Filtered CLS-3 in 50mg Vials
CLSS-4	≥160	≥100	≤3.0	≤0.1	0.22μ Filtered CLS-4 in 50mg & 1gm Vials
CLSS-5	≥450	≥450	≤4.0	≤0.3	Higher collagenase and caseinase activities
CLSH	≥125	≥200	≤4.0	≤0.5	0.22μ Filtered, ≥22,500U CLS-1 & 30U ESL component of HIS kit
Animal Free					
CLSAFP	≥1,500	≤50	≤2.0	≤0.25	Chromatographically purified, Low Protease/Collagen Studies, Tissue Digestion combined with other proteases
CLSAFA	≥150	≥150	≤8.0	≥0.1	Balanced Activities/AF Stem Cell & Tissue Bioprocessing
CLSAFB	≥300	≥300	≤5.0	≤0.5	Higher Activities/AF Stem Cell & Tissue Bioprocessing
CLSAFC	≥200	≥150	≤3.0	≤0.1	Lower Protease Activities/AF Stem Cell & Tissue Bioprocessing
CLSAFD	≥600	≥600	≤5.0	≤0.5	High Activity CLS/CAS AF Stem Cell & Bioprocessing
CLSAFAS	≥150	≥150	≤8.0	≥0.1	0.22μ Filtered AF CLSAFA in 50mg vials
CLSAFBS	≥300	≥300	≤5.0	≤0.5	0.22μ Filtered AF CLSAFB in 50mg vials
CLSAFCS	≥200	≥150	≤3.0	≤0.1	0.22μ Filtered AF CLSAFC in 50mg vials
STEMxyme® Animal Free Blends of Collagenase and Neutral Protease					
STZ1	≥250	≥1,000	≤5.0	≤0.5	0.22μ Filtered CLSAFB & NPRO/AF Stem Cell & Tissue Bioprocessing
STZ2	≥250	≥2,000	≤5.0	≤0.5	0.22μ Filtered CLSAFB & NPRO/AF Stem Cell & Tissue Bioprocessing
Chromatographically Purified					
CLSPA	≥500	≤50	≤2.0	≤0.25	Chromatographically purified, Low Protease/Collagen Studies, Tissue Digestion combined with other proteases
CLSPANK	≥500	≤50	≤2.0	≤0.25	0.22μ Filtered, ≥1,500U CLSPA component of NCIS kit

*Correlations between type and effectiveness with different tissues have been good, but not perfect, and may be dependent partly on parameters of use and objectives as well as lot-to-lot variations. For more information see the Collagenase Sampling Program information.

Name	Activity	Catalog Number	Package	Code
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Collagenase

Source: *Clostridium histolyticum*

EC: 3.4.24.3 **CAS Number:** 9001-12-1

Clostridium histolyticum contains two distinct but related genes for collagenase. The *col G* gene codes for a 936 amino acid protein designated Collagenase Type 1 and the *col H* gene codes for a 1021 amino acid protein designated Collagenase Type II. Partially purified preparations contain several isoforms of both these gene products, a sulfhydryl protease, clostripain, a trypsin-like enzyme, and an aminopeptidase. This combination of collagenolytic and proteolytic activities is effective at breaking down intercellular matrices, the essential part of tissue dissociation. One component of the complex is a hydrolytic enzyme that degrades the helical regions in native collagen preferentially at the Y-Gly bond in the sequence Pro-Y-Gly-Pro, where Y is most frequently a neutral amino acid. This cleavage yields products susceptible to further peptidase digestion. Partially purified collagenase is inhibited by metal chelating agents such as cysteine, EDTA or o-phenanthroline but not DFP. It is also inhibited by alpha-2-macroglobulin, a large plasma glycoprotein. Ca²⁺ is required for enzyme activity. Particular enzymatic profiles of each collagenase have been correlated with the tissues from which the cells for study were obtained (or with the uses to which the cells are put). As a result of the correlations, several types of partially purified collagenases have been established by Worthington: Types 1, 2, 3, 4, 5, 6 and 7.

- **Type 1** partially purified collagenase has the original balance of collagenase, caseinase, clostripain and tryptic activities.
- **Type 2** contains higher relative levels of protease activity, particularly clostripain.
- **Type 3** contains lowest levels of secondary proteases.
- **Type 4** is designed to be especially low in tryptic activity to limit damage to membrane proteins and receptors.
- **Type 5** contains higher collagenase and caseinase values.
- **Type 6** contains high collagenase activity with a caseinase to collagenase ratio ~2:1. Designed to be enriched for Type II (*col H*) collagenase relative to Type I (*col G*).
- **Type 7** contains collagenase and caseinase activities four-fold higher than collagenase Types 1 and 2.
- Purified collagenase, Codes: **CLSPA/CLSPANK**, contain minimal secondary proteolytic activities along with high collagenase activity.

Animal Free Types AFA, AFB, AFC, AFD, AFP, STZ1 and STZ2 collagenases are derived from cultures grown in medium completely devoid of animal based components and designed for bioprocessing applications where introduction of potential animal derived pathogens must be prevented.

- **CLSAFA** is the original AF grade designed to have collagenase and secondary proteases similar to Types 1 and 2 collagenase.
- **CLSAFB** contains higher collagenase and caseinase activities than CLSAFA.
- **CLSAFC** has especially low tryptic activity similar to Type 4 collagenase.
- **CLSAFD** contains two to three fold higher specific activity than CLSAFA.
- Purified collagenase, Code: **CLSAFP** contains minimal secondary proteolytic activities along with high collagenase activity.
- **STZ1 & STZ2**, 0.22µ filtered **STEMxyme**[®] AF Collagenase/Neutral Protease (Dispase[®]) blends for primary and stem cell isolation. Worthington also offers 0.22 micron filtered preparations of many types in 50 mg/vial pre-packaged form for direct reconstitution and use in all isolation procedures.

The collagenase assay is a modification of Mandl wherein collagenase is incubated for five hours with native collagen and the extent of collagen breakdown is determined using the Moore and Stein, *J. Biol. Chem.*, 176, 367 (1948) colorimetric ninhydrin method. Amino acids released are expressed as micromoles leucine per milligram collagenase.

Uses: Partially purified collagenases are widely used in enzymatic primary cell isolation and tissue dissociation procedures. Most researchers employ either partially purified collagenase preparations or chromatographically purified collagenase which is usually combined with secondary enzymes such as elastase, hyaluronidase, etc. For best results, the precise mixture of proteolytic activities must be tailored to the tissue to be dissociated. Correlations between type and effectiveness with different tissues have been good, but not perfect, and may be dependent partly on parameters of use and objectives, as well as lot-to-lot variations. For more information see the Collagenase Sampling Program information on page iii of this catalog. Worthington also publishes a Tissue Dissociation Guide, which provides additional information regarding the enzymes used for these applications and specific references for numerous cell and tissue types.

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Name	Activity	Catalog Number	Package	Code
Collagenase (Continued)				
Unit Definition: One unit releases one micromole of L-leucine equivalents from collagen in 5 hours at 37°C, pH 7.5.				
Collagenase, Purified CLSPA				
Chromatographically purified. ≤ 50 caseinase units per milligram. Supplied as a lyophilized powder. Store at 2-8°C.	≥ 500 units per	LS005275	4 ku	
	mg dry weight	LS005273	10 ku	
		LS005277	Bulk	
Collagenase Vial, NCIS CLSPANK				
A component of the NCIS kit. This material is 0.22 micron membrane filtered and lyophilized in autoclaved vials. A vial reconstituted with 5 ml of HBSS or equivalent yields a solution of 300 units/ml of collagenase, Code: CLSPA. Suitable for cell isolation and culture applications. Store at 2-8°C.	≥ 1500 units	LK003240	1 vi	
	per vial	LK003245	5 vi	
Collagenase, Type 1 CLS-1				
The original balance of enzymatic activities. Each lot assayed for collagenase, caseinase, clostripain and tryptic activities. Suggested for epithelial, liver, lung and adrenal primary cell isolations. A dialyzed, lyophilized powder. Store at 2-8°C.	≥ 125 units per	LS004194	100 mg	
	mg dry weight	LS004196	1 gm	
		LS004197	5 gm	
		LS004200	Bulk	
Collagenase, Type 2 CLS-2				
Prepared to contain higher clostripain activity. Suggested for bone, heart, liver, thyroid and salivary primary cell isolation. Supplied as a dialyzed, lyophilized powder. Store at 2-8°C.	≥ 125 units per	LS004174	100 mg	
	mg dry weight	LS004176	1 gm	
		LS004177	5 gm	
		LS004179	Bulk	
Collagenase, Type 3 CLS-3				
Lower in secondary proteolytic contaminant activities but with typical collagenase activity. Suggested for mammary primary cell isolation. A dialyzed, lyophilized powder. Store at 2-8°C.	≥ 100 units per	LS004180	100 mg	
	mg dry weight	LS004182	1 gm	
		LS004183	5 gm	
		LS004185	Bulk	
Collagenase, Type 4 CLS-4				
Prepared to contain lower tryptic activity levels to limit damage to membrane proteins and receptors but with normal to above normal collagenase activity. Suggested for pancreatic islet primary isolation. A dialyzed, lyophilized powder. Store at 2-8°C.	≥ 160 units per	LS004186	100 mg	
	mg dry weight	LS004188	1 gm	
		LS004189	5 gm	
		LS004191	Bulk	
Collagenase, Type 5 CLS-5				
Prepared to contain higher collagenase and caseinase activities. A dialyzed, lyophilized powder. Store at 2-8°C.	≥ 450 units per	LS005280	100 mg	
	mg dry weight	LS005282	1 gm	
		LS005283	5 gm	
		LS005284	Bulk	

Name	Activity	Catalog Number	Package	Code
Collagenase (Continued)				
Collagenase, Type 6				CLS-6
Prepared to contain high collagenase activity with a caseinase to collagenase ratio ~2:1. Designed to be enriched for Type II (col H) collagenase relative to Type I (col G). A dialyzed, lyophilized powder. Store at 2-8°C.	≥ 400 units per mg dry weight	LS005318	100 mg	
		LS005319	500 mg	
		LS005321	2.5 gm	
		LS005323	Bulk	
Collagenase, Type 7				CLS-7
Prepared to contain collagenase and caseinase activities four-fold higher than collagenase Type 1/2. A dialyzed, lyophilized powder. Store at 2-8°C.	≥ 1,000 units per mg dry weight	LS005332	100 mg	
		LS005333	500 mg	
		LS005335	2.5 gm	
		LS005337	Bulk	
Collagenase, Type 1, 0.22µ Filtered				CLSS-1
Collagenase, Type 1 (Code: CLS-1), which is filtered through a 0.22 micron membrane and lyophilized in vials. Store at 2-8°C.	≥ 125 units per mg dry weight	LS004214	50 mg	
		LS004216	5 x 50 mg	
		LS004217	1 gm	
Collagenase, Type 2, 0.22µ Filtered				CLSS-2
Collagenase, Type 2 (Code: CLS-2), which is filtered through a 0.22 micron membrane and lyophilized in vials. Store at 2-8°C.	≥ 125 units per mg dry weight	LS004202	50 mg	
		LS004204	5 x 50 mg	
		LS004205	1 gm	
Collagenase, Type 3, 0.22µ Filtered				CLSS-3
Collagenase, Type 3 (Code: CLS-3), which is filtered through a 0.22 micron membrane and lyophilized in vials to contain ≥ 50 milligrams per vial. Store at 2-8°C.	≥ 100 units per mg dry weight	LS004206	50 mg	
		LS004208	5 x 50 mg	
Collagenase, Type 4, 0.22µ Filtered				CLSS-4
Collagenase, Type 4 (Code: CLS-4), which is filtered through a 0.22 micron membrane and lyophilized in vials. Store at 2-8°C.	≥ 160 units per mg dry weight	LS004210	50 mg	
		LS004212	5 x 50 mg	
		LS004209	1 gm	
Collagenase, Type 5, 0.22µ Filtered				CLSS-5
Collagenase, Type 5 (Code: CLS-5), which is filtered through a 0.22 micron membrane and lyophilized in vials. Store at 2-8°C.	≥ 450 units per mg dry weight	LS005286	50 mg	
		LS005287	5 x 50 mg	
		LS005288	1 gm	
Collagenase/Elastase Vial, HIS Kit				CLSH
Worthington collagenase (Code: CLS-1) and elastase (Code: ESL), filtered through 0.22 µm pore size membrane, and lyophilized. A component of the HIS kit also contains 30 u/vial elastase. Store unconstituted vials at 2-8°C.	≥ 20,000 units per vial	LK002066	1 vi	
		LK002067	5 vi	

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Name	Activity	Catalog Number	Package	Code
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STEMxyme® Collagenase/Neutral Protease Blends, Animal Free

STEMxyme®1, Collagenase/Neutral Protease (Dispase®), 0.22 Filtered, Animal Free

STZ1

A specialized combination of Animal Free <i>Clostridium histolyticum</i> collagenase and Animal Free <i>Bacillus polymyxa</i> neutral protease with a minimum of 250 CLS units and 1,000 caseinase units per mg dry weight. Designed for stem cell and other primary cell isolations and bioprocessing applications where introduction of potential animal derived pathogens must be prevented. Store at 2-8°C	≥ 250 collagenase units per mg dry weight	LS004106	50 mg	
	≥ 1,000 caseinase units per mg dry weight	LS004107	5 x 50 mg	

STEMxyme®2, Collagenase/Neutral Protease (Dispase®), 0.22 Filtered, Animal Free

STZ2

A specialized combination of Animal Free <i>Clostridium histolyticum</i> collagenase and Animal Free <i>Bacillus polymyxa</i> neutral protease with a minimum of 250 CLS units and 2,000 caseinase units per mg dry weight. Designed for stem cell and other primary cell isolations and bioprocessing applications where introduction of potential animal derived pathogens must be prevented. Store at 2-8°C.	≥ 250 collagenase units per mg dry weight	LS004112	50 mg	
	≥ 2,000 caseinase unit per mg dry weight	LS004113	5 x 50 mg	

Name	Activity	Catalog Number	Package	Code
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Collagenases, Animal Free

Collagenase, Purified, Animal Free

CLSAFP

Prepared from cultures grown in medium completely devoid of animal based components and designed for bioprocessing applications where introduction of animal derived pathogens must be prevented. Chromatographically purified. ≤ 50 caseinase units per milligram. Supplied as a lyophilized powder.	≥ 1,500 units per mg dry weight	LS005290	4 ku	
		LS005292	10 ku	
		LS005294	Bulk	

Collagenase, Type A, Animal Free

CLSAFA

Collagenase derived from cultures grown in animal free medium. Suitable for applications needing to avoid introduction of animal derived pathogens into bioprocessing procedures. Store at 2-8°C.	≥ 150 units per mg dry weight	LS004152	100 mg	
		LS004154	1 gm	
		LS004156	5 gm	
		LS004158	Bulk	

Name	Activity	Catalog Number	Package	Code
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Collagenases, Animal Free (Continued)

Collagenase, Type A, 0.22 Filtered, Animal Free

Collagenase, Type A which is filtered through a 0.22 micron membrane and lyophilized in vials. Store at 2-8°C.

LS004118 50 mg
LS004119 5 x 50 mg

CLSAFAS



Collagenase, Type B, Animal Free

Prepared from cultures grown in medium completely devoid of animal based components and designed for bioprocessing applications where introduction of animal derived pathogens must be prevented. Store at 2-8°C.

LS004145 100 mg
LS004147 1 gm
LS004148 5 gm
LS004150 Bulk

CLSAFB



Collagenase, Type B, 0.22 Filtered, Animal Free

Collagenase, Type B which is filtered through a 0.22 micron membrane and lyophilized in vials. Store at 2-8°C.

LS004124 50 mg
LS004125 5 x 50 mg

CLSAFBS



Collagenase, Type C, Animal Free

Prepared from cultures grown in medium completely devoid of animal based components and designed for bioprocessing applications where introduction of animal derived pathogens must be prevented. Store at 2-8°C.

LS004138 100 mg
LS004140 1 gm
LS004141 5 gm
LS004143 Bulk

CLSAFC



Collagenase, Type C, 0.22 Filtered, Animal Free

Collagenase, Type C which is filtered through a 0.22 micron membrane and lyophilized in vials. Store at 2-8°C.

LS004130 50 mg
LS004131 5 x 50 mg

CLSAFCS



Collagenase, Type D, Animal Free

Prepared from cultures grown in medium completely devoid of animal based components and designed for bioprocessing applications where introduction of animal derived pathogens must be prevented. Store at 2-8°C.

LS004160 100 mg
LS004162 500 mg
LS004163 2500 mg
LS004165 Bulk

CLSAFD



Related Products: Cell Isolation Optimizing System • Collagen • Deoxyribonuclease I • Elastase • Hepatocyte Isolation System
Hyaluronidase • Neonatal Cardiomyocyte Isolation System • Neutral Protease (Dispase®) • Papain • Papain (Neural) Dissociation System
STEMxyme® 1 & 2 Collagenase/Neutral Protease Blends • Trypsin • Trypsin Inhibitors

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Name	Activity	Catalog Number	Package	Code
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Deoxyribonuclease I

Source: Bovine Pancreas

EC: 3.1.21.1

CAS Number: 9003-98-9

Bovine pancreatic deoxyribonuclease is an endonuclease that splits phosphodiester linkages, preferentially adjacent to a pyrimidine nucleotide, yielding polynucleotides with free hydroxyl group at the 3' position and a phosphate group at the 5' position. The average chain length of a limit digest is a tetranucleotide.

Uses: Worthington offers DNase at different levels of purity for different applications. Product Codes: DPRF and DPRFS are both especially designed for Molecular Biology applications and contain the lowest levels of RNase and protease activity. They are both suitable for use in techniques requiring digestion of DNA in the recovery of intact RNA or where the integrity of structural proteins or enzymes must be maintained. Applications have included nick translation, DNA mapping, isolation of nuclear RNA and protein, RNA polymerase synthesis of RNA probes and RT-PCR. DNase is also used in tissue culture work to digest DNA from damaged cells thereby reducing viscosity, and removing membrane bound DNA fragments. Worthington Codes: DP and DCLS are suitable for these applications.

Stability/Storage: When properly stored, all grades of Worthington deoxyribonuclease are stable for 2-3 years. Product code DPRFS may be stored at -20°C. For long term storage in solution, Product Codes D and DPFF may be dissolved in 5 mM acetate, 1 mM calcium, pH 4.5 and stored in single use aliquots at -20°C or -70°C for up to one year. Only freeze and thaw once; thawed aliquots are stable refrigerated at least several weeks. Addition of 50% glycerol will maintain a liquid state at -20°C without affecting stability. Material in 50% glycerol can be removed and returned to -20°C repeatedly. DPRF is unusually stable due to the absence of protease. For long term storage of DPRF after reconstitution, use water or any buffer pH 4.0 to 9.0 except phosphate; add 50% glycerol for storage as liquid at -20°C; avoid calcium chelators. Aliquot in single use containers; only freeze and thaw once; thawed aliquots are stable refrigerated at least several weeks.

Unit Definition: 1 unit causes an increase in absorbance at 260 nm of 0.001 per minute per ml at 25°C when acting upon highly polymerized DNA at pH 5.0. **Note:** Kunitz units as reported by other suppliers can be 2 to 4 times higher than Kunitz units as measured at Worthington. As measured at Worthington, one Kunitz unit digests 1 µg of calf thymus DNA in 10 minutes at 37°C in 50 mM Tris, 1 mM Mg²⁺, 1 mM Ca²⁺, pH 7.8. Correlation of digestion units with Kunitz units is different for other DNA and buffer systems.

Technical Note: Product Code DPRF: Each vial contains approximately 2 mg glycine and 2 µmoles calcium per 10,000 units of DNase I. Dissolving the entire 10 ku vial in 5 ml provides the equivalent of a 1 mg/ml solution.



*From research and development to manufacturing,
continuous quality improvement is everyone's job.*

Name	Activity	Catalog Number	Package	Code
Deoxyribonuclease I (Continued)				
Deoxyribonuclease I, Ribonuclease & Protease Free, Solution				DPRFS
Molecular Biology Grade.	≥ 2,000 Kunitz	LS006342	100 un	
Chromatographically purified to remove RNase and protease.	units per ml	LS006344	500 un	
Supplied as a solution at approximately 2 Kunitz units per microliter approximately 1 mg/ml containing 50% glycerol and 1 mM calcium chloride.		LS006348	Bulk	
Store at 2-8°C or -20°C.				
Deoxyribonuclease I, Ribonuclease & Protease Free				DPRF
Molecular Biology Grade.	≥ 2,000 Kunitz	LS006331	2500 un	
Chromatographically purified to remove RNase and protease. Lyophilized in vials.	units per mg dry weight	LS006333	10 ku	
Each 10,000 unit vial contains 2 mg glycine, 2 μmoles calcium, and ≥ 10,000 units of DNase I. Each 2,500 unit vial contains 0.5 mg glycine, 0.5 μmoles calcium, and ≥ 2,500 units of DNase I. Dissolving the entire 10,000 unit vial in 5 ml, or the entire 2,500 unit vial in 1.25 ml, provides the equivalent of a 1 mg/ml solution. (ku = 1000 un).		LS006343	50 ku	
Store at 2-8°C.		LS006334	Bulk	
PROTECT FROM MOISTURE.				
Deoxyribonuclease I				DPFF
Chromatographically purified. A lyophilized powder containing glycine as a stabilizer. Protease Free.	≥ 2,000 Kunitz units per mg dry weight	LS006330	25 ku	
Contains ≤ 0.0005% RNase.		LS006328	125 ku	
Store at 2-8°C.		LS006332	Bulk	
PROTECT FROM MOISTURE.				
Deoxyribonuclease I				D
Chromatographically purified. A lyophilized powder with glycine as a stabilizer.	≥ 2,000 Kunitz units per mg dry weight	LS002004	5 mg	
Store at 2-8°C.		LS002006	20 mg	
PROTECT FROM MOISTURE.		LS002007	100 mg	
		LS002009	Bulk	
Deoxyribonuclease I, Filtered				DCLS
Code D, filtered through a 0.22 micron membrane and lyophilized in vials.	≥ 2,000 Kunitz units per mg dry weight	LS002058	11 mg	
Store at 2-8°C.		LS002060	25 mg	
PROTECT FROM MOISTURE.				
Deoxyribonuclease I, Standard Vial				DSV
Lyophilized in vials for assay standardization. Labeled to show established activity. Not suitable for assays at neutral pH.	~2,000 Kunitz units per vial	LS002173	2 ku	
Store at 2-8°C.		LS002172	5x2 ku	
PROTECT FROM MOISTURE.				

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Name	Activity	Catalog Number	Package	Code
Deoxyribonuclease I (Continued)				
PDS Kit, DNase Vial				D2
A component of the Papain Dissociation System. This material is 0.22 micron membrane filtered and lyophilized in autoclaved vials. A vial reconstituted with 0.5 ml of EBSS or equivalent yields a solution of 2000 units/ml of deoxyribonuclease (1 mg/ml). Store at 2-8°C. PROTECT FROM MOISTURE.	≥ 1,000 units per vial	LK003170 LK003172	1 vi 5 vi	
Deoxyribonuclease I				DP
Partially purified. A lyophilized powder. Store at 2-8°C. PROTECT FROM MOISTURE.	≥ 2,000 Kunitz units per mg dry weight	LS002138 LS002139 LS002140 LS002141	25 mg 100 mg 1 gm Bulk	
Deoxyribonuclease I				DPB
Partially purified. A lyophilized powder. Store at 2-8°C. PROTECT FROM MOISTURE.	≥ 1,250 Kunitz units per mg dry weight	LS002145 LS002147 LS002149	100 mg 1 gm Bulk	

Related Products: Actin • Albumin, Nuclease-Free • Deoxyribonuclease II • Deoxyribonucleic Acid and Related Products
Histones • Lysozyme • Nuclease, Micrococcal • Nuclease, S1 • Phosphatase, Alkaline • Phosphodiesterase I • Phosphodiesterase II
Proteinase K • Recombinant Deoxyribonuclease • Reverse Transcriptase, Recombinant HIV • Ribonuclease • Ribonuclease T1
Ribonuclease T2 • Ribonucleic Acid



Our customer centric approach follows every order from start to finish to ensure your satisfaction.

Name	Activity	Catalog Number	Package	Code
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Deoxyribonuclease I, Recombinant Bovine Pancreatic, Animal Free

Source: *Pichia pastoris*

EC: 3.1.21.1 CAS Number: 9003-98-9

Bovine pancreatic deoxyribonuclease I produced recombinantly in yeast, *Pichia pastoris*, to decrease levels of contaminating RNase and proteases and eliminate potential pathogens associated with animal based materials.

Bovine pancreas is a rich source of RNase A which is often found in many commercial DNase preparations. Producing DNase I by recombinant means greatly facilitates purification of an enzyme with undetectable levels of RNase. The processes involved in the production and isolation of recombinant DNase I are completely devoid of animal based components, eliminating the possibility of introducing animal derived pathogens into bioprocessing procedures.

Recombinant DNase I is suitable for applications such as:

- Removing genomic DNA from RNA preparations prior to RT-PCR
- Degradation of DNA templates after transcription reactions
- Removing unwanted DNA from samples prior to Northern blotting
- Removing DNA during biopharma and bioprocessing procedures

Unit Definition: One unit causes an increase in absorbance at 260 nm of 0.001 per minute at 25°C when acting upon highly polymerized DNA at pH 5.0, which is the same as other Worthington DNase I products.

Note: Kunitz units as reported by other suppliers can be 2 to 4 times higher than Kunitz units as measured at Worthington. As measured at Worthington, one Kunitz unit digests 1 µg of calf thymus (or pUC19 or λ-phage) DNA in 10 minutes at 37°C in 50 mM Tris, 1 mM Mg²⁺, 1 mM Ca²⁺, pH 7.8. Correlation of digestion units with Kunitz units may be different in other buffer systems.

Storage Buffer (DR1S): 5 mM calcium acetate, 4 mg/ml glycine, pH 5.0 and 50% glycerol.

DNase I Reaction Buffer (10X): 500 mM Tris-HCl, 10 mM MgSO₄, 1 mM CaCl₂, pH 7.8, provided.

DNase I, Recombinant, Ribonuclease & Protease Free, Animal Free

Molecular Biology Grade.

Free of RNase and protease. Chromatographically purified and lyophilized powder containing glycine and calcium as a stabilizer. Store at 2-8°C. PROTECT FROM MOISTURE.

≥ 5,000 Kunitz units	LS006361	10 ku
per mg protein	LS006362	50 ku
	LS006360	Bulk



DNase I, Recombinant, Ribonuclease & Protease Free Solution, Animal Free

Molecular Biology Grade.

Chromatographically purified to remove RNase and protease. Supplied as a ready-to-use solution at 2 ≥ Kunitz u/µl in 5 mM calcium acetate, 4 mg/ml glycine, pH 5.0 and 50% glycerol. Includes 10X reaction buffer. Store at -20°C. REQUIRES ICE PACK.

≥ 2 Kunitz units	LS006353	2 ku
per microliter	LS006355	5 x 2 ku
	LS006357	Bulk



DNase I, Recombinant, Bioprocess Grade, Animal Free

Chromatographically purified AF bioprocessing grade. Supplied as a lyophilized powder containing glycine and calcium as a stabilizer. For the removal of DNA in bioprocessing and primary stem cell isolation applications. May contain protease and RNase. Store at 2-8°C. PROTECT FROM MOISTURE.

≥ 2,000 Kunitz units	LS006320	25 ku
per mg dry weight	LS006322	100 ku
	LS006323	500 ku
	LS006325	Bulk



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Name	Activity	Catalog Number	Package	Code
Deoxyribonuclease II				
Source: Porcine Spleen				
EC: 3.1.22.1 CAS Number: 9025-64-3				
Deoxyribonuclease II from porcine spleen has a molecular weight of 38 kDa. The enzyme is a glycoprotein endonuclease with trimeric structure. Optimum pH range is 4.5-5.0 at ionic strength 0.15 M. Deoxyribonuclease II (Acid DNase) hydrolyzes deoxyribonucleotide linkages in native and denatured DNA yielding products with 3'-phosphates. It also acts on <i>p</i> -nitrophenylphosphodiester at pH 5.6-5.9. Bernardi, <i>Biochem. Biophys. Res. Comm.</i> , 17, 573 (1971) describes a three stage degradation of native DNA by DNase II.				
Unit Definition: One unit causes an increase in absorbance at 260 nm of 0.001 per minute at 25°C, pH 4.6 using highly polymerized DNA as substrate.				
Deoxyribonuclease II				
A dialyzed, lyophilized powder.	≥ 800 units per	LS002425	80 ku	HDA
Store at 2-8°C.	mg dry weight	LS002427	Bulk	
Deoxyribonuclease II, Purified				
Chromatographically purified in a modification of the procedure of Bernardi, <i>et al.</i> , <i>Biochim. Biophys. Acta</i> , 129, 1 (1966).	≥ 12,000 units	LS005410	20 ku	HDAC
A dialyzed, lyophilized powder.	per mg protein	LS005411	Bulk	
Store at -20°C. REQUIRES SPECIAL SHIPPING: ICE PACK				
Deoxyribonuclease II, Purified, Solution				
Chromatographically prepared.	≥ 12,000 units	LS005416	2 ku	HDACS
A solution in 50% glycerol.	per mg protein	LS005418	5 ku	
Store at -20°C.		LS005420	Bulk	
REQUIRES SPECIAL SHIPPING: ICE PACK				

Related Products: Albumin, Nuclease-Free • Deoxyribonuclease I • Deoxyribonucleic Acid and Related Products
Histones • Lysozyme • Nuclease, Micrococcal • Nuclease, S1 • Phosphatase, Alkaline • Phosphodiesterase II • Proteinase K
Reverse Transcriptase, Recombinant HIV • Ribonuclease • Ribonuclease T1 • Ribonuclease T2 • Ribonucleic Acid

Name	Activity	Catalog Number	Package	Code
Deoxyribonucleic Acid and Related Products				
CAS Number: 9007-49-2				
Worthington offers DNA purified from these sources:				
Calf thymus: (Code: DNA) Prepared and purified by a method developed at Worthington to have lower protein and RNA contamination than most other commercial preparations. This highly polymerized DNA is an excellent substrate for deoxyribonuclease. A sodium salt, it must be converted by adding magnesium ions to be susceptible to DNase.				
Calf thymus DNA, covalently bound to cellulose is also available:				
DNA Cellulose, Double-Stranded (Code: DNACELDS)				
DNA Cellulose, Single-Stranded (Code: DNACELSS)				
Salmon Testes: (Code: SDNA) Prepared by a modification of the method of Emanuel and Chaikoff, <i>J. Biol. Chem.</i> , 203, 164 (1953). A minimum of 75% native nucleic acid.				
Salmon Testes DNA, Denatured & Fragmented (Code: SDNAD) is also available. Prepared by mechanical shearing and heat denaturation.				

Name	Activity	Catalog Number	Package	Code
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Deoxyribonucleic Acid and Related Products (Continued)

Escherichia coli: (Code: DNAEC) Isolated as described by Marmur, *J. Mol. Biol.*, 3, 208 (1961).

Lambda phage DNA (Code: DNAL) is prepared from CsCl purified phage and is purified to an $A_{260}/A_{280} \geq 1.8$. Homogeneous in agarose gel electrophoresis. A solution in 10 mM Tris-HCl pH 8.0 with 1 mM EDTA.

DNA fragments prepared by restriction endonuclease digestion of purified lambda DNA are available (Codes: DNALBSTE; DNALCOR; DNALHIND). Supplied as solutions in 10 mM Tris-HCl pH 8.0 with 1 mM EDTA.

Technical Note: One A_{260} unit = 50 μ g DNA.

Stability/Storage: DNAL: Storage buffer 10 mM Tris-HCl, pH 8.0 containing 1 mM EDTA. Store at -20°C. Once thawed keep at 2-8°C.

Deoxyribonucleic Acid

Highly polymerized calf thymus DNA, hyperchromicity $\geq 27\%$. A substrate for deoxyribonuclease assays. Prepared by a method developed at Worthington to remove contaminating RNA and protein. Supplied dried. Store at 2-8°C.

Hyper-
chromicity
 $\geq 27\%$

LS002105
LS002106
LS002107
LS002108

100 mg
1 gm
5 gm
Bulk

DNA

DNA Cellulose, Double-Stranded

Prepared by a method developed at Worthington in which native, double-stranded calf thymus DNA is covalently bound to cellulose. Suitable for the purification of many DNA binding proteins such as polymerases, transcription factors, and terminators, etc. Supplied as a dry powder. One gram of DNA-cellulose will swell to 3 - 4 ml when fully hydrated. Store at 2-8°C.

≥ 3 mg DNA
per gm dry
weight

LS01120
LS01122
LS01124

1 gm
5 gm
Bulk

DNACELDS

DNA Cellulose, Single-Stranded

Prepared by a method developed at Worthington in which denatured, single-stranded calf thymus DNA is covalently bound to cellulose. Suitable for the purification of many proteins that are associated with nucleic acids such as DNA/RNA polymerases, endo- and exonucleases and reverse transcriptases. Supplied as a dry powder. One gram of DNA-cellulose will swell to 3 - 4 ml when fully hydrated. Store at 2-8°C.

≥ 3 mg DNA
per gm dry
weight

LS01130
LS01132
LS01134

1 gm
5 gm
Bulk

DNACELSS

Deoxyribonucleic Acid

Prepared from salmon testes by a modification to the method of Emanuel, C., and Chaikoff, I., *J. Biol. Chem.*, 203, 164 (1953). $\geq 75\%$ native nucleic acid. Supplied dried. Store at 2-8°C.

A_{260}/A_{280}
 ≥ 1.8

LS003554
LS003558
LS003557

1 gm
5 gm
Bulk

SDNA

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Name	Activity	Catalog Number	Package	Code
Deoxyribonucleic Acid and Related Products (Continued)				
Deoxyribonucleic Acid, Denatured, Fragmented				
Prepared from purified salmon testes DNA (Code: SDNA) by mechanical shearing and heat denaturation to an average fragment size of 200-1000 base pairs. To reverse any renaturation occurring during storage this material should be briefly boiled and rapidly chilled before use. Recommended concentration for use is 100 µg/ml. A solution at 5 mg/ml in 0.05 M NaCl. Store at -20°C. REQUIRES SPECIAL SHIPPING: ICE PACK		LS01440	10 ml	SDNAD
		LS01442	5 x 10 ml	
		LS01444	Bulk	
Deoxyribonucleic Acid				
Supplied as a dried powder purified from <i>E. coli</i> Type B cells (ATCC#11303) as described by Marmur, <i>J. Mol. Biol.</i> , 3, 208 (1961). Store at 2-8°C.	Hyperchromicity ≥ 27%	LS004449 LS004451	10 mg Bulk	DNAEC
Deoxyribonucleic Acid, Lambda				
Purified to an $A_{260}/A_{280} \geq 1.8$ from purified phage. Homogeneous by agarose gel electrophoresis. Generates the characteristic five and eight bands after digestion with EcoR I and Hind III respectively. A solution in 10 mM Tris-HCl, pH 8.0, with 1 mM EDTA. Store at -20°C. REQUIRES SPECIAL SHIPPING: DRY ICE	$A_{260}/A_{280} \geq 1.8$	LS01203	500 µg	DNAL
		LS01206	4 x 500 µg	
		LS01200	Bulk	
Deoxyribonucleic Acid, Lambda, BstE II Fragments				
DNA fragments prepared by the digestion of lambda DNA with the restriction endonuclease BstE II. On agarose gel electrophoresis the mixture separates into 14 individual bands having the following number of base pairs: 8454, 7242, 6369, 5686, 4822, 4324, 3675, 2323, 1929, 1371, 1264, 702, 224 and 117. A solution in 10 mM Tris-HCl, pH 8.0, with 1 mM EDTA. Store at -20°C. REQUIRES SPECIAL SHIPPING: DRY ICE		LS01430	100 µg	DNALBSTE
		LS01432	5 x 100 µg	
		LS01434	Bulk	



As a primary producer, we pay close attention to quality assurance in all phases of production.

Name	Activity	Catalog Number	Package	Code
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Deoxyribonucleic Acid and Related Products (Continued)

Deoxyribonucleic Acid, Lambda, EcoR I Fragments

DNA fragments prepared by the digestion of purified lambda DNA with the restriction endonuclease EcoR I. On agarose gel electrophoresis the mixture separates into five individual bands having the following number of base pairs: 21226, 7421, 5804, 4878, and 3530. A solution in 10 mM Tris-HCl, pH 8.0, with 1 mM EDTA. Store at -20°C. REQUIRES SPECIAL SHIPPING: DRY ICE

LS01293	100 µg
LS01296	5 x 100 µg
LS01290	Bulk

DNALECOR

Deoxyribonucleic Acid, Lambda, Hind III Fragments

DNA fragments prepared by the digestion of purified lambda DNA with the restriction endonuclease Hind III. On agarose gel electrophoresis the mixture separates into eight individual bands having the following number of base pairs: 23130, 9416, 6557, 4361, 2322, 2027, 564, and 125. (Note: A higher sample load may be required to clearly see the 564 and 125 base pair bands.) A solution in 10 mM Tris-HCl, pH 8.0, with 1 mM EDTA. Store at -20°C. REQUIRES SPECIAL SHIPPING: DRY ICE

LS01303	100 µg
LS01306	5 x 100 µg
LS01300	Bulk

DNALHIND

Related Products: Albumin, Nuclease-Free • Deoxyribonuclease I • Deoxyribonuclease II • Histones • Lysozyme Nuclease, Micrococcal • Nuclease, S1 • Phosphatase, Alkaline • Phosphodiesterase I • Phosphodiesterase II • Proteinase K Reverse Transcriptase, Recombinant HIV Ribonuclease • Ribonuclease T1 • Ribonuclease T2

Name	Activity	Catalog Number	Package	Code
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Diaphorase

Source: *Clostridium kluyveri*

EC: 1.6.99.1 **CAS Number:** 9001-68-7

Diaphorase catalyzes the reaction of a reduced di- or tri-phosphopyridine nucleotide hydrogen donor with a hydrogen acceptor, usually a dye in the leucoform.

Stability/Storage: Stable for 6-12 months at 2-8°C. Keep lyophilized powder at -20°C for long-term storage. Due to the presence of FMN, the enzyme, especially in solution, is light-sensitive.

Unit Definitions: For Code: DILW, 1 unit equals a decrease in absorbance at 600 nm of 1.0 per minute at 25°C, pH 7.5. For Code: DIL, 1 Unit reduces 1 micromole of DCPIP per minute at 25°C, pH 8.5.

Diaphorase

A lyophilized powder. Dialyzed to remove pyridine nucleotides. Store at 2-8°C.

≥ 25 Units per mg dry weight

LS004330	2 ku
LS004333	Bulk

DIL

Diaphorase

Supplied as a dialyzed, lyophilized powder. Store at 2-8°C.

≥ 30 units per mg dry weight

LS004327	1 ku
LS004326	Bulk

DILW

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Name	Activity	Catalog Number	Package	Code
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Elastase

Source: Porcine Pancreas

EC: 3.4.21.36 **CAS Number: 39445-21-1**

Porcine pancreatic elastase has a molecular weight of 25.9 kDa, and a pH optimum of 8.5. While elastase will hydrolyze a wide variety of protein substrates, it is unique among proteases in its ability to hydrolyze native elastin, a substrate not attacked by trypsin, chymotrypsin or pepsin. Soybean trypsin inhibitor and kallikrein inhibitor suppress proteolytic but not elastolytic activity. Elastase is assayed using a method adapted from that of Feinstein *et al.*, *Biochem. Biophys. Res. Comm.*, 50, 1020 (1973) and using the more soluble substrate of Bieth *et al.*, *Biochem. Med.*, 11, 350 (1974).

Stability/Storage: Elastase is unstable at pH ≤ 3.5. When stored as a dry powder the enzyme is stable for 6-12 months at 2-8°C. Elastase product codes: ES and ESL have poor solubility at neutral pH and at concentrations greater than 0.25%. It is helpful to make primary solutions in KCl or alkaline buffers before diluting into the reaction mixtures or media, compensating for ionic strength or pH changes. Stable at pH 4.0-10.4.

Technical Notes: 1 SucAla₃NA unit is approximately equivalent to 6 elastin digestion units. Aqueous liquid suspensions should be aseptically handled to avoid bacterial contamination. Due to the viscous nature of the aqueous suspension (Code: ES) the vial should be rinsed to recover contents.

Unit Definition: One Unit cleaves one micromole of N-succinyl-L-alanyl-L-alanyl-L-alanine-p-nitroanilide per minute at 25°C, pH 8.0.

Elastase, Purified

ESFF

Chromatographically purified.	≥ 8 Units per	LS006363	5 mg
A lyophilized powder.	mg protein	LS006365	20 mg
Store at 2-8°C.		LS006367	Bulk

REQUIRES SPECIAL SHIPPING: ICE PACK

Elastase, Lyophilized

ESL

Two times crystallized, (Code: ESL),	≥ 3 Units per	LS002290	25 mg
supplied as a dialyzed, lyophilized powder.	mg protein	LS002292	100 mg
The enzyme should be 0.22 micron		LS002294	1 gm
filtered after reconstitution and prior		LS002298	Bulk

to use. Suitable for the isolation of Type II lung cells. Store at 2-8°C. Does not require special shipping.

Elastase, Suspension

ES

Two times crystallized. Supplied as an	≥ 3 Units per	LS002274	25 mg
aqueous suspension. This preparation	mg protein	LS002279	100 mg
must be diluted to dissolve the enzyme.		LS002280	1 gm
The diluted enzyme should be 0.22 micron		LS002276	Bulk

filtered before use. Suitable for the isolation of Type II lung cells. Store at 2-8°C. DO NOT FREEZE. REQUIRES SPECIAL SHIPPING: ICE PACK

Related Products: Cell Isolation Optimizing System • Collagenase • Deoxyribonuclease I • Hepatocyte Isolation System
Hyaluronidase • Neonatal Cardiomyocyte Isolation System • Neutral Protease (Dispase®) • Papain • Papain Dissociation System
Pepsin • Proteinase K • *STEMxyme*® 1 • *STEMxyme*® 2 • Trypsin • Trypsin Inhibitors

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Name	Activity	Catalog Number	Package	Code
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Endoproteinase-Arg-C, see Clostripain, page 12

Endoproteinase Glu-C, see Protease, *Staphylococcus aureus*, page 58

Endoproteinase Lys-C

Source: *Lysobacter enzymogenes*

EC: 3.4.21.50 CAS Number: 72561-05-8

Endoproteinase-Lys-C is a serine endoproteinase that specifically cleaves peptide bonds at the carboxyl side of lysine. It has a molecular weight of 30,000 daltons and is used in the optimal pH range of 7.0-9.0. Lys-C is inhibited by diisopropyl-fluorophosphate, TLCK, Aprotinin and Leupeptin.

Stability/Storage: Stable for 12 months at 2-8°C.

Unit Definition: One Unit will hydrolyze 1.0 micromole of N-p-tosyl-Gly-Pro-Lys p-nitroanilide per minute at pH 7.7 and 25C.

Endoproteinase Lys-C, Sequencing Grade

LYSCSEQ

Chromatographically purified.	≥ 150 units	LS02143	20 ug
A lyophilized powder supplied in	per mg	LS02144	5x20 ug
20 ug high recovery vials.	protein	LS02145	Bulk

Store at -20°C.
PROTECT FROM MOISTURE.

Related Products: Endo-Glu-C • Chymotrypsin • Clostripain (Endoproteinase-Arg-C) Trypsin • *SequENZ*[®] Trypsin • Carboxypeptidase B • Carboxypeptidase Y

Name	Activity	Catalog Number	Package	Code
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Galactose Oxidase

Source: *Dactylium dendroides*

EC: 1.1.3.9 CAS Number: 9028-79-9

Galactose oxidase oxidizes galactose and some galactose derivatives in both free and polymeric forms. Oxidation occurs at the C6 position. The enzyme has a molecular weight of 68 ± 3 kDa, and the optimum pH is 7.0.

Technical Note: One A₄₂₅ unit is approximately equivalent to 0.54 μmole oxidized galactose.

Unit Definition: One unit equals a change in absorbance at 425 nm of 1.000 per minute at 25°C, pH 6.0 using a peroxidase/o-tolidine coupled assay with galactose as the substrate.

Galactose Oxidase

GAO

Supplied as a lyophilized powder	≥ 30 units per	LS004520	150 un
containing sodium phosphate and	mg dry weight	LS004522	450 un
sucrose as stabilizers.		LS004524	1 ku
Store at -20°C.		LS004523	Bulk

PROTECT FROM MOISTURE.
REQUIRES SPECIAL SHIPPING: ICE PACK

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Name	Activity	Catalog Number	Package	Code
Galactosidase, Beta				
Source: <i>Escherichia coli</i>				
EC: 3.2.1.23 CAS Number: 9031-11-2				
Beta-Galactosidase has a molecular weight of 540 kDa, and an optimum pH range of 6 – 8. Note: Product code BGC is not suitable for immunoconjugation applications due to the presence of ammonium sulfate.				
Unit Definition: One Unit hydrolyzes one micromole of <i>o</i> -nitrophenyl-beta-D-galactopyranoside per minute at 25°C, pH 7.5.				
Galactosidase, Beta BG				
A partially purified, lyophilized powder. Store at 2-8°C.	≥ 50 Units per mg dry weight	LS004090 LS004093	5 ku Bulk	
Galactosidase, Beta, Purified BGC				
Chromatographically purified. A suspension in 1.6 M ammonium sulfate. Store at 2-8°C.	≥ 300 Units per per mg protein	LS004099 LS004100 LS004102	1 ku 5 ku Bulk	

Name	Activity	Catalog Number	Package	Code
Glucose-6-Phosphate Dehydrogenase				
Source: <i>Leuconostoc mesenteroides</i>				
EC: 1.1.1.49 CAS Number: 9001-40-5				
The <i>Leuconostoc</i> GPDH exhibits dual coenzyme specificity, namely NAD and NADP (Olive and Levy, <i>Biochem.</i> , 6, 730 730, 1967). When assayed under conditions that are optimal for the particular coenzyme, the ratio of observed catalytic activity is NAD/NADP = 1.8.				
Stability/Storage: The <i>Leuconostoc mesenteroides</i> glucose-6-phosphate dehydrogenase is a relatively stable enzyme in solution. The lyophilized and ammonium sulfate preparations are stable for 12 months when stored at 2-8°C.				
Unit Definition: One Unit reduces one micromole of pyridine nucleotide per minute at 30°C and pH 7.8, using glucose-6-phosphate as substrate.				
Glucose-6-Phosphate Dehydrogenase, High Activity Suspension ZFDP				
Chromatographically purified for higher specific activity. Same as Code ZF except assayed using NAD. Phosphohexose isomerase, phosphogluconate dehydrogenase, adenylate kinase and creatine phosphokinase contaminant activities 0.02%, 0.003%, 0.002% and 0.002% respectively. A suspension in 3.7M ammonium sulfate. Store at 2-8°C.	≥ 590 NAD Units per mg protein	LS004002 LS004004 LS004006	1 ku 10 ku Bulk	
Glucose-6-Phosphate Dehydrogenase, Suspension ZF				
Chromatographically purified. A suspension in 3.7 M ammonium sulfate. Phosphohexose isomerase, phosphogluconate dehydrogenase, adenylate kinase and creatine phosphokinase contaminant activities ≤ 0.02%, 0.003%, 0.002% and 0.002%, respectively. Store at 2-8°C.	≥ 200 NAD Units per mg protein	LS003983 LS003985 LS003987	500 un 5 ku Bulk	

Name	Activity	Catalog Number	Package	Code
Glucose-6-Phosphate Dehydrogenase (Continued)				
Glucose-6-Phosphate Dehydrogenase, Suspension				ZFD
Chromatographically purified. Same as Code: ZF except assayed using NAD. Phosphohexose isomerase, phosphogluconate dehydrogenase, adenylate kinase and creatine phosphokinase contaminant activities ≤ 0.011%, 0.002%, 0.0011% and 0.0011% respectively. A suspension in 3.7 M ammonium sulfate. Store at 2-8°C	≥ 360 NAD	LS003992	900 un	
	Units per mg	LS003993	9 ku	
	protein	LS003994	Bulk	
Glucose-6-Phosphate Dehydrogenase, Lyophilized				ZFL
Chromatographically purified. Phosphohexose isomerase, phosphogluconate dehydrogenase, adenylate kinase and creatine phosphokinase contaminant activities ≤ 0.02%, 0.003%, 0.002% and 0.002% respectively. A lyophilized powder. Store at 2-8°C.	≥ 200 NAD	LS003981	1 ku	
	Units per mg	LS003980	10 ku	
	protein	LS003982	Bulk	
Glucose-6-Phosphate Dehydrogenase, Lyophilized				ZFLD
Chromatographically purified. Same as Code: ZFL except assayed using NAD. Phosphohexose isomerase, phosphogluconate dehydrogenase, adenylate kinase and creatine phosphokinase contaminant activities ≤ 0.011%, 0.002%, 0.0011% and 0.0011% respectively. A lyophilized powder. Store at 2-8°C.	≥ 360 NAD	LS003997	2 ku	
	Units per mg	LS003998	18 ku	
	protein	LS003999	Bulk	

Related Products: Hexokinase • Peroxidase • b-Galactosidase • Galactose Oxidase • Lactate Dehydrogenase

Name	Activity	Catalog Number	Package	Code
Hemoglobin				
Source: Bovine Erythrocytes				
CAS Number: 9008-02-0				
Hemoglobin is the major component of mammalian erythrocytes where it functions as the oxygen-carbon dioxide transport system. The molecule is composed of a heme group with four peptide chains and has a molecular weight of 64.5 kDa.				
Hemoglobin				HB
Suitable protease substrate. Prepared from repeatedly washed, then lysed, and dialyzed bovine red cells. A lyophilized powder. Store at 2-8°C.		LS002402	5 gm	
		LS002403	25 gm	
		LS002404	100 gm	
		LS002407	Bulk	

Related Products: Pepsin • Myoglobin

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Name	Activity	Catalog Number	Package	Code
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Hepatocyte Isolation System

Most traditional methods published for isolating hepatocytes use crude and partially purified enzyme preparations including various types of collagenase and other proteases. More recently the use of better characterized preparations of collagenase such as Worthington Types 1 - 7 (CLS-1-7) have provided better results. All partially purified collagenase preparations can contain lot-variable contaminating proteases, esterases and other enzymes requiring researchers to pre-screen several lots of enzyme and/or continually modify isolation parameters and protocols.

The Worthington Hepatocyte Isolation System has been developed to provide researchers with a reliable, convenient, and consistent hepatocyte cell isolation system. By using the pre-optimized combination of enzymes contained in this kit, it is possible to minimize the lot-to-lot variation and improve the quality of the isolated hepatocytes. In addition, Worthington use-tests each lot by isolating hepatocytes from adult rat to assure performance, reliability, and consistent yield of viable cells. The method is based on that described by Berry *et al.*, and modified by Seglen, *Methods in Cell Biology*, 13 (Prescott, D. ed.), Academic Press, 29 (1976), and further optimized in conjunction with several researchers.

Stability/Storage: The reagents are stable at ambient temperatures for the periods of time expected in normal shipping procedures, but the package should be refrigerated upon arrival. Contents may be stored at 2-8°C for 4-6 months before use. Store at 2-8°C.

Package Contents: The package contains sufficient materials for five separate adult rat liver perfusions. For larger or smaller tissue applications, prepare proportionate volumes of reagents at each step and combine them in the same ratio as described in the protocol.

- **Vial #1:** 10X CMF-HBSS Concentrate, 1 bottle, 500 ml
Sterile calcium- and magnesium-free Hank's Balanced Salt Solution (CMF-HBSS). The solution is used for washing and perfusing the liver prior to the addition of the dissociating enzyme solution.

- **Vial #2:** Collagenase/Elastase Enzyme Vial, 5 vials
Containing collagenase (Code: CLS-1) and elastase (Code: ESL) $\geq 20,000$ u/vial and ≥ 30 u/vial respectively. Before use, reconstitute with the L-15/MOPS solution and swirl gently to dissolve contents. Store unreconstituted vials at 2-8°C.

- **Vial #3:** 1,000 units DNase I each, 5 vials
Worthington DNase I (Code: D), filtered through 0.22 μ m pore size membrane, and lyophilized. Before use, reconstitute with L-15/MOPS solution and swirl gently to dissolve contents. Store unreconstituted vials at 2-8°C.

- **Vial #4:** 0.15 M MOPS, pH 7.5, 1 bottle, 75 ml
0.15 M MOPS, pH 7.5 buffer concentrate, used to buffer the reconstituted Leibovitz L-15 media.

- **Vial #5:** 7.5% Sodium Bicarbonate (NaHCO₃), 1 bottle, 100 ml
7.5% Sodium bicarbonate concentrate, used to buffer the diluted CMF-HBSS.

- **Pouch**, containing Leibovitz L-15 Media Powder, 1 x 1L
Reconstitute entire contents of pouch by cutting open top of envelope and pouring contents into beaker containing approximately 800 ml of cell culture grade water. Rinse pouch 2 - 3 times with an additional 100 ml water. Bring total volume to 1000 ml and filter through a 0.22 micron membrane.

Hepatocyte Isolation System

The package contains sufficient materials for five separate adult rat liver perfusions including five single use CLSH enzyme vials, five single use DNase vials, 10X CMF-Hank's Balanced Salt Solution, L-15 Media Powder, 0.15 M MOPS buffer, 7.5% sodium bicarbonate solution and optimized protocol. Store at 2-8°C.

N/A LK002060 1 bx

HIS

Name	Activity	Catalog Number	Package	Code
Hepatocyte Isolation System (Continued)				
Collagenase/Elastase Vial, HIS Kit				
Worthington collagenase (Code: CLS-1) and elastase (Code: ESL), filtered through 0.22 µm pore size membrane, and lyophilized. Before use, reconstitute with the L-15/MOPS solution and swirl gently to dissolve contents. Store unreconstituted vials at 2–8°C.	≥ 20,000 u/vial	LK002066	1 vi	CLSH
	≥ 30 u/vial	LK002067	5 vi	
DNase Vial, HIS Kit				
A component of the Hepatocyte Isolation kit containing 1,000 units DNase I each, 5 vials Worthington DNase I (Code: D), filtered through 0.22 µ pore size membrane, and lyophilized. Before use, reconstitute with L-15/MOPS solution and swirl gently to dissolve contents. Store unreconstituted vials at 2–8°C.	≥ 1,000 units	LK003170	1 vi	D2
	per vial	LK003172	5 vi	
Hank's Balanced Salt Solution (HBSS-CMF) 10X Solution, HIS Kit				
10X CMF-HBSS Concentrate, 1 bottle, 500 ml. Sterile calcium- and magnesium-free Hank's Balanced Salt Solution (CMF-HBSS). The solution is used for washing and perfusing the liver prior to the addition of the dissociating enzyme solution. Store at 2-8°C.	N/A	LK002064	1 ea	HBSS10



Quality manufacturing practices are followed every step of the way, in all departments, in our ISO9001 certified facility.

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Name	Activity	Catalog Number	Package	Code
Hepatocyte Isolation System (Continued)				
L-15 Media Powder, HIS Kit Leibovitz L-15 media powder, a component of the HIS kit. Reconstitute entire contents of pouch, QS to 1 liter with cell culture grade water, and 0.22 micron filter. Suitable for cell isolation and culture applications. Store at 2-8°C.	N/A	LK003250	1 ea	L15NK
0.15 M, MOPS Buffer, HIS Kit 0.15 M MOPS, pH 7.5, 0.22 µ filtered. Buffer concentrate used to buffer the constituted Leibovitz L-15 media in Hepatocyte Isolation System. Store at 2-8°C.	N/A	LK002070	1 ea	MOPS
Sodium Bicarbonate, 7.5%, HIS Kit 7.5% Sodium Bicarbonate (NaHCO ₃), 1 bottle, 100 ml 7.5% sodium bicarbonate concentrate, used to buffer the diluted CMF-HBSS. Store at 2-8°C.	N/A	LK002069	1 ea	NAH

Related Products: Cell Isolation Optimizing System • Collagenase • Deoxyribonuclease I • Elastase • Hyaluronidase
Neonatal Cardiomyocyte Isolation System • Neutral Protease (Dispase®) • Papain • Papain Dissociation System • Hepatocyte Isolation System
Proteinase K • Hepatocyte Isolation System • *STEMxyme*® 1 • *STEMxyme*® 2 • Trypsin • Trypsin Inhibitors



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Name	Activity	Catalog Number	Package	Code
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Hexokinase, Recombinant

Source: Recombinant Hexokinase from yeast

EC: 2.7.1.1 **CAS Number:** 9001-51-8

Hexokinase catalyzes the reaction:



Unit Definition: One Unit reduces one micromole of NAD per minute at 30°C, pH 8.0.

Note: HKQL product has been superseded by the recombinant code HKQLR

Hexokinase, Recombinant, Lyophilized

HKQLR

A lyophilized powder. Phosphohexose isomerase, 6-phosphogluconate dehydrogenase, adenylate kinase and creatine phosphokinase contaminant activities are ≤ 0.10%, ≤ 0.005%, ≤ 0.005% and 0.005%, respectively. Store at 2-8°C.	≥ 150 Units per mg protein	LS002511 LS002512 LS002514	2.5 ku 10 ku 1 ku
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Related Products: β-Galactosidase • Galactose Oxidase • Glucose-6-Phosphate Dehydrogenase
Lactate Dehydrogenase • Peroxidase

Name	Activity	Catalog Number	Package	Code
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Histones

Source: Calf Thymus

CAS Number: 37244-51-2

The histones are a group of water- and dilute acid-soluble basic proteins found associated with DNA in chromosomes. They are characterized by relatively high levels of lysine and arginine. Although histones are classified into a limited number of types of fractions with each particular fraction having a fundamentally distinct amino acid composition and sequence, numerous subfractions are observed due to the acetylation, methylation and phosphorylation of various amino acid residues.

Technical Note: Histones are characterized by gel electrophoresis and solubility. Soluble in physiological saline, phosphate buffered saline (PBS) pH 7.1, or water when pH is adjusted to neutral.

Histone, Dried

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An ethanol dried powder. Unfractionated mixture of histones. Store at 2-8°C.	N/A	LS002375 LS002377 LS002379	250 mg 1 gm Bulk
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Histone, Lyophilized

HLY

A dialyzed, lyophilized powder. Unfractionated mixture of histones. Store at 2-8°C.	N/A	LS002544 LS002546 LS002548	250 mg 1 gm Bulk
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Related Products: Actin • Albumin, Nuclease-Free • Deoxyribonuclease I • Deoxyribonuclease II
Deoxyribonucleic Acid and Related Products • Histones • Nuclease, Micrococcal • Nuclease, S1 • Phosphatase, Alkaline
Phosphodiesterase I • Phosphodiesterase II • Proteinase K • Reverse Transcriptase, Recombinant HIV • Ribonuclease • Ribonuclease T1
Ribonuclease T2

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Name	Activity	Catalog Number	Package	Code
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Hyaluronic Acid

Source: Bovine Vitreous Humor

CAS Number: 9004-61-9

Hyaluronic acid (HA) preparations have variable molecular weights depending on purification procedures, the extent of degradation, as well as the source. The range of molecular weight is 70 kDa to 2,000-4,000 kDa in a highly polymerized preparation. Bovine vitreous humor HA has a lower molecular weight than most other sources. The hyaluronic acids are a class of macromolecular proteoglycans characterized by a highly polymerized chain of the repeating disaccharide glucuronic acid (beta-1,3) N-acetylglucosamine (beta-1,4).

Hyaluronic Acid

VHHA

A partially purified powder.	N/A	LS003907	10 mg
Suitable as a substrate for hyaluronidase assays.		LS003909	50 mg
		LS003910	100 mg
Store at 2-8°C.		LS003911	Bulk

Related Product: Hyaluronidase

Name	Activity	Catalog Number	Package	Code
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Hyaluronidase

Source: Bovine Testes

EC: 3.2.1.35 **CAS Number:** 37326-33-3

Testicular hyaluronidase is a glycoprotein containing 5% mannose and 2.7% glucosamine. Optimum pH range is 4.5-6.0. The enzyme catalyzes the hydrolysis of endo-N-acetylhexosaminic bonds of hyaluronic acid and chondroitin sulfate A and C (but not B), primarily to tetrasaccharide residues.

Unit Definition: One unit is based on the change in absorbency (turbidity) at 540nm of an internal standard assayed concurrently with each lot. Internal standard replaces USP/NF reference no longer available.

Hyaluronidase

HSE

A partially purified, dialyzed, lyophilized powder.	≥ 300 units per mg dry weight	LS002594	50 ku
Store at -20°C.		LS002592	300 ku
		LS002591	Bulk

Hyaluronidase, Purified

HSEP

Chromatographically purified.	≥ 3,000 units per mg dry weight	LS005477	5 ku
A dialyzed, lyophilized powder.		LS005475	15 ku
Store at -20°C.		LS005474	30 ku
		LS005479	Bulk

Related Products: Carboxypeptidase B • Carboxypeptidase Y • Cell Isolation Optimizing System • Collagenase Deoxyribonuclease I • Hepatocyte Isolation System • Hyaluronic Acid • Neonatal Cardiomyocyte Isolation System • Papain Papain Dissociation System • Pepsin • Protease, *Staph aureus* (Endoproteinase Glu-C) • Proteinase K • *STEMxyme*® 1 *STEMxyme*® 2 • Trypsin • Trypsin Inhibitors

Name	Activity	Catalog Number	Package	Code
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Hydroxysteroid Dehydrogenase

Source: *Pseudomonas testosteroni*

EC: 1.1.1.50 and 1.1.1.51 **CAS Numbers:** 9028-56-2 / 9015-81-0

Hydroxysteroid dehydrogenases catalyze the interconversion of hydroxyl and carboxyl groups of steroids. *P. testosteroni* derived hydroxysteroid dehydrogenases are of two types: 3-alpha-hydroxysteroid dehydrogenase (alpha enzyme) and 3-beta-hydroxysteroid dehydrogenase (beta enzyme). The alpha enzyme has a molecular weight of 47 kDa. The alpha enzyme oxidizes only 3-alpha-hydroxysteroids of the C19, C21 and C24 series. It is inhibited by heavy metals and sulfhydryl-binding agents. The beta enzyme catalyzes the oxidation of 3-beta-hydroxy-steroids of the C19 and C21 series, 17-beta-hydroxysteroids of the C18, C19 and C21 series, as well as certain 16-beta-hydroxy-steroids. It is inhibited by heavy metals and reducing agents. The oxidation of testosterone is inhibited by 3,17-alpha-estradiol and other 1,3,5-estradiene derivatives. Worthington supplies two preparations: one from the regular *P. testosteroni* (ATCC 11966) culture which produces both the alpha and the beta enzymes, and a second from a mutant strain which produces almost exclusively the alpha enzyme. By using both, the amount of beta-hydroxysteroid can be determined by the difference in activities.

Technical Note: STDHP and STDH contain both alpha and beta activities. STDHMP, however, contains only the alpha activity.

Unit Definition: One Unit reduces one micromole of NAD per minute at 25°C, pH 9.0 using androsterone or testosterone as substrate.

Hydroxysteroid Dehydrogenase

A lyophilized powder obtained from induced cells. Contains both alpha and beta activities.
Store at -20°C.

REQUIRES SPECIAL SHIPPING: ICE PACK

≥ 0.03 Units
per mg
dry weight

LS004915
LS004916
LS004918

1 gm
5 gm
Bulk

STDH

Hydroxysteroid Dehydrogenase

A purified powder obtained from adapted cells of a mutant strain. Activity on androsterone only, no activity exhibited on testosterone.
Store at -20°C.

REQUIRES SPECIAL SHIPPING: ICE PACK

≥ 0.5 Units
per mg
dry weight

LS004908
LS004910
LS004911

10 un
50 un
Bulk

STDHMP

Hydroxysteroid Dehydrogenase

A purified powder obtained from induced cells. Contains both alpha and beta activities.
Store at -20°C.

REQUIRES SPECIAL SHIPPING: ICE PACK

≥ 0.5 Units per
per mg
dry weight

LS004922

Bulk

STDHP

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Name	Activity	Catalog Number	Package	Code
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Lactate Dehydrogenase

Source: Recombinant Rabbit Muscle Lactate Dehydrogenase Produced in *E.coli*

EC: 1.1.1.27 **CAS Number:** 9001-60-9

Mammalian lactate dehydrogenases (LDH) exist as five tetrameric isozymes composed of combinations of two different subunits. The H subunit predominates in heart muscle, which is geared for aerobic oxidation of pyruvate. The M subunit predominates in skeletal muscle and is concerned more with anaerobic metabolism and pyruvate reduction.

Unit Definition: One Unit oxidizes one micromole of NADH per minute at 25°C, pH 7.3.

**Lactate Dehydrogenase,
Recombinant, Lyophilized**

LADCL

Chromatographically purified.	≥ 250 Units	LS002755	5 ku
A lyophilized powder.	per mg	LS002756	25 ku
Store at -20°C	protein	LS002757	Bulk

Related Products: b-Galactosidase • Galactose Oxidase • Glucose-6-Phosphate Dehydrogenase • Hexokinase

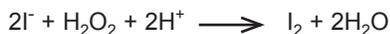
Name	Activity	Catalog Number	Package	Code
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Lactoperoxidase

Source: Bovine Milk

EC: 1.11.1.7 **CAS Number:** 9003-99-0

Lactoperoxidase (LPO) is a glycoprotein with a heme prosthetic group which may occur as a mixture of two isozymes. It has a molecular weight of 77.5 kDa. LPO catalyzes the hydrogen peroxide oxidation of iodide according to the following reaction:



Iodide reacts directly with the heme group; upon addition of H₂O₂ the complex iodinate the substrate. LPO is inhibited by hydrazines. The assay procedure has been updated from that of Morrison to an ABTS®/H₂O₂ based method with increased sensitivity and reproducibility.

Unit Definition: One Unit reduces one micromole of hydrogen peroxide per minute at 25°C, pH 6.0.

Lactoperoxidase

LPO

Chromatographically purified.	≥ 35 Units	LS000150	10 mg
A lyophilized powder.	mg dry weight	LS000151	50 mg
Store at -20°C.	ABTS®	LS000152	Bulk

Name	Activity	Catalog Number	Package	Code
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Lysozyme

Source: Egg Whites

EC: 3.2.1.17 **CAS Number:** 9001-63-2

Lysozyme preferentially hydrolyzes the beta-1,4 glycosidic linkages between N-acetylmuramic acid and N-acetylglucosamine which occur in the mucopeptide cell wall structure of certain microorganisms, such as *Micrococcus lysodeikticus* (Product code: ML). A slightly more limited activity is exhibited toward chitin oligomers. It has a molecular weight of 14.4 kDa. Optimum pH is 9.2. Lysozyme is inhibited by surface active agents such as dodecyl sulfate, alcohol and fatty acids. Imidazole and indole derivatives form inhibitory charged transfer complexes.

Stability/Storage: Stable for 3-5 years at 2-8°C. Solutions at pH 4-5 are stable for several weeks refrigerated and for days at ambient temperatures. Store at 2-8°C.

Technical Note: Due to assay differences, 8,000 u/mg by Worthington's assay is equivalent to 50,000 u/mg claimed by other suppliers.

Unit Definition: One unit is equal to a decrease in turbidity of 0.001 per minute at 450 nm at pH 7.0 and 25°C, using a 0.3 mg/ml suspension of *Micrococcus lysodeikticus* cells (WBC product code ML) as substrate.

Lysozyme

Two times Crystallized. A lyophilized powder containing sodium chloride and acetate. Store at 2-8°C.

≥ 5,000 units	LS002880	1 gm
per mg	LS002881	10 gm
dry weight	LS002883	Bulk

LY

Lysozyme, Purified, Salt Free

A dialyzed and lyophilized powder. Store at 2-8°C.

≥ 8,000 units	LS002931	1 gm
per mg	LS002933	5 gm
dry weight	LS002934	Bulk

LYSF

Related Products: Albumin, Nuclease-Free • Deoxyribonuclease I • Deoxyribonucleic Acid and Related Products • Histones *Micrococcus lysodeikticus* Cells • Nuclease, Micrococcal • Nuclease, S1 • Phosphatase, Alkaline • Phosphodiesterase I Phosphodiesterase II • Proteinase K • Reverse Transcriptase, Recombinant HIV • Ribonuclease • Ribonuclease A • Ribonuclease T1 Ribonuclease T2 • Ribonucleic Acid

Name	Activity	Catalog Number	Package	Code
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Micrococcus lysodeikticus Cells

Source: *Micrococcus lysodeikticus*

These are dried cells suitable as a lysozyme substrate.

Lysozyme preferentially hydrolyzes the beta-1,4 glycosidic linkages between N-acetylmuramic acid and N-acetylglucosamine which occur in the mucopeptide cell wall structure of certain microorganisms, such as *Micrococcus lysodeikticus*. It is also a source for the enzyme, polynucleotide phosphorylase.

Micrococcus lysodeikticus Cells

Dried cells. Suitable lysozyme substrate. Store at 2-8°C.

N/A	LS008736	5 gm
	LS008737	25 gm
	LS008739	Bulk

ML

Related Product: Lysozyme

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Name	Activity	Catalog Number	Package	Code
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Mucin

Source: Bovine Submaxillary Gland

CAS Number: 84195-52-8

Mucins are glycoproteins abundant with O-linked oligosaccharides secreted by epithelial mucous membranes. Their protective function is due to their high viscosity. Bovine submaxillary mucin has a molecular weight of 4 - 40 x 10⁵ daltons. The molecule consists of major and minor components with a protein moiety (36.6% of the molecule) and a carbohydrate moiety (56.7% of the molecule).

Stability/Storage: Protect from moisture. Store at 2-8°C.

Mucin

A dry powder prepared by the method of Nisizawa, and Pigman, *Arch. Oral. Biol.*, 1, 161 (1959). Suitable as a substrate for neuraminidase. Store at 2-8°C. PROTECT FROM MOISTURE.

N/A

LS002975

LS002976

LS002978

100 mg

500 mg

Bulk

MU

Name	Activity	Catalog Number	Package	Code
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Myoglobin, Lyophilized

Source: Bovine Muscle

CAS Number: 11080-17-4

Myoglobin is a small, globular protein that is responsible for oxygen storage in cardiac and skeletal muscle. It contains a single heme molecule and has a molecular weight of approximately 17 kDa.

Myoglobin, Lyophilized

Supplied as a dialyzed, lyophilized powder. Store at 2-8°C. PROTECT FROM MOISTURE.

≥ 90% Purity (SDS-PAGE)

LS002408

LS002410

LS002412

LS002414

250 mg

1 gm

5 gm

Bulk

MB

Related Products: Hemoglobin • Neuraminidase

Name	Activity	Catalog Number	Package	Code
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Neonatal Cardiomyocyte Isolation System

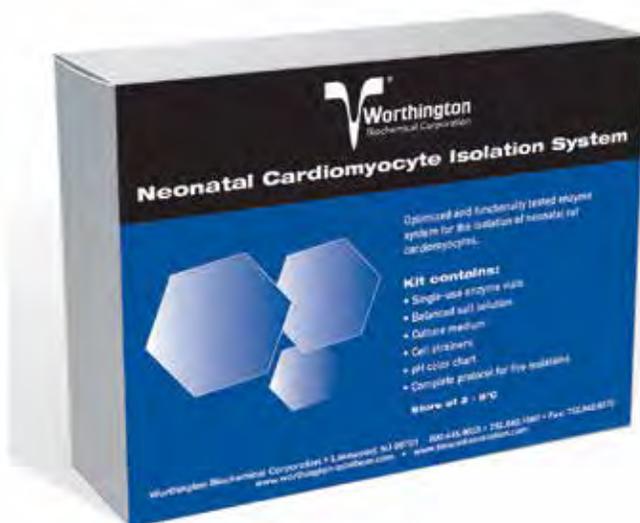
The Worthington Neonatal Cardiomyocyte Isolation System has been developed to provide researchers with a reliable, convenient, and consistent neonatal rat cardiomyocyte cell isolation method. By using purified, rather than crude enzyme preparations, it has been possible to minimize the lot-to-lot variation. In addition, Worthington use-tests the kits by isolating cardiomyocytes from neonatal rat hearts to assure performance, reliability and consistent yield of viable cells. The kit has been formulated in collaboration with Dr. Ronal MacGregor. The method is based on that described by Toraason *et al.*, *Toxicol.* 56, 107 (1988) in which the minced tissue is incubated overnight with purified trypsin at 2-8°C. As pointed out by Toraason, this step reduces the hands-on time required to harvest cells compared to the time involved in sequential incubations in warm trypsin or collagenase. Purified collagenase rather than crude collagenase is used to maximize yield and viability.

Contents of Kit

The package contains sufficient materials for five separate tissue dissociations, each containing up to twelve hearts. For larger or smaller tissue samples prepare proportionate volumes of reagents at each step and combine them in the same ratio as described in the protocol.

- **Vial 1:** 1 bottle, 500 ml: Sterile calcium- and magnesium-free Hank's Balanced Salt Solution (CMF HBSS), pH 7.4. The solution is used for reconstituting the contents of Vials #2 and #3 in addition to serving as the medium for the dissociation.
- **Vial 2:** 5 vials, 1000 µg each: Worthington Trypsin (Code: TRLS), chromatographically purified, dialyzed against 1 mM HCl, filtered through 0.22 micron pore size membrane, and lyophilized. Before use, reconstitute with 2 ml CMF HBSS (Vial #1) and swirl gently to dissolve contents. Store at 2-8°C.
- **Vial 3:** 5 vials, 2000 µg each: Worthington Soybean Trypsin Inhibitor (Code: SIC), a 0.22 micron pore size membrane-filtered, lyophilized powder. Before use, reconstitute with 1 ml CMF HBSS (Vial #1) and swirl gently to dissolve contents. Store at 2-8°C.
- **Vial 4:** 5 vials, 1500 units each: Worthington Purified Collagenase (Code: CLSPA), a 0.22 micron pore size membrane-filtered, lyophilized powder which has been chromatographically purified. It contains less than 50 caseinase units per milligram and is composed of two separable but very similar collagenases. Before use, reconstitute with 5 ml Leibovitz L-15 media (prepared as described below) and swirl gently to dissolve contents. Store at 2-8°C.
- **Pouch Containing Leibovitz L-15 Media Powder:** 1 x 1L, Reconstitute entire contents of pouch by cutting open top of envelope and pouring contents into beaker containing 800 ml of cell culture grade water. Rinse pouch 2-3 times with additional 100 ml. Bring total volume to 1 liter and filter through a 0.22 micron pore size filter.

The kit also includes 5 Cell Strainers (Falcon), a card correlating phenol red color with pH for checking balanced salt solutions and culture media.



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Name	Activity	Catalog Number	Package	Code
Neonatal Cardiomyocyte Isolation System (Continued)				
Neonatal Cardiomyocyte Isolation System				NCIS
Kit for performing five separate tissue dissociations, each containing up to twelve hearts. Contains single use vials of purified collagenase and trypsin, CMF-HBSS, Leibovitz L-15 media and Falcon cell strainers along with a detailed protocol. The kit is used by Worthington to assure performance. Store at 2-8°C.	N/A	LK003300 LK003303	1 ki 3 ki	
Collagenase Vial, NCIS				CLSPANK
A component of the NCIS kit. This material is 0.22 micron membrane filtered and lyophilized in autoclaved vials. A vial reconstituted with 5 ml of HBSS or equivalent yields a solution of 300 units/ml of collagenase, Code: CLSPA. Suitable for cell isolation and culture applications. Store at 2-8°C.	≥ 1,500 units per vial	LK003240 LK003245	1 vi 5 vi	
Trypsin Vial, NCIS				TRLSNK
A component of the NCIS kit. This material is 0.22 micron membrane filtered and lyophilized in autoclaved vials. A vial reconstituted with 2 ml of HBSS yields a solution of 500 µg/ml of trypsin, Code: TRLS. Suitable for cell isolation and culture applications. Store at 2-8°C.	≥ 180 Units per vial	LK003220 LK003225	1 vi 5 vi	
Inhibitor Vial, NCIS				SICNK
A component of the NCIS kit. This material is 0.22 micron membrane filtered and lyophilized in autoclaved vials. A vial reconstituted with 1 ml of HBSS or equivalent yields a solution of 2 mg/ml of trypsin inhibitor, Code: SIC. Suitable for cell isolation and culture applications. Store at 2-8°C.	1 mg inhibits at least 0.75 mg trypsin Code: TRL	LK003230 LK003235	1 vi 5 vi	
HBSS Solution				HBSS
Sterile calcium and magnesium free Hank's balanced salt solution (CMFHBSS), pH 7.4, as supplied in the NCIS kit; 1 x 500 ml. Store at 2-8°C.	N/A	LK003210	1 ea	

Name	Activity	Catalog Number	Package	Code
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Neonatal Cardiomyocyte Isolation System (Continued)

L-15 Media Powder

Leibovitz L-15 media powder, a component of the NCIS kit. Reconstitute entire contents of pouch, QS to 1 liter with cell culture grade water, and 0.22 micron filter. Suitable for cell isolation and culture applications.

Store at 2-8°C.

N/A

LK003250

1 ea

L15NK

Cell Strainers (Falcon)

Cell strainers (Falcon), components of the NCIS kit. Suitable for removal of tissue debris in cell isolation applications.

Store at room temperature.

N/A

LK003265

5 ea

CELSTRNK

Related Products: Cell Isolation Optimizing System • Collagenase • Deoxyribonuclease I • Hepatocyte Isolation System
Hyaluronidase • Neutral Protease (Dispase®) • Papain • Papain Dissociation System • Proteinase K • *STEMxyme*® 1
STEMxyme® 2 • Trypsin • Trypsin Inhibitor

Name	Activity	Catalog Number	Package	Code
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Neuraminidase

Source: *Clostridium perfringens*

EC: 3.2.1.18

CAS Number: 9001-67-6

Neuraminidase (sialidase) removes N-acetyl neuraminic acid (sialic acid) from a variety of glycoproteins. The enzyme has an optimum pH of 5.0-5.1. Little or no activity is observed at pH 4.0 or above pH 8.0.

Unit Definition: One Unit releases one micromole of sialic acid per minute at 37°C, pH 5.0, from bovine submaxillary mucin.

Neuraminidase, Purified

Chromatographically purified.

A lyophilized powder containing 50% (w/w) sucrose. Contaminating proteolytic activity ≤ 0.1% using trypsin as the standard.

Store at 2-8°C. PROTECT FROM MOISTURE.

≥ 10 Units per
mg protein

LS004759

LS004761

LS004762

LS004760

5 un

10 un

25 un

Bulk

NEUA

Neuraminidase

A partially purified, lyophilized powder.
Store at 2-8°C.

≥ 0.5 Units per
mg dry weight

LS004779

LS004780

LS004777

4 mg

10 mg

Bulk

NEUP

Related Products: β-Galactosidase • Galactose Oxidase • Glucose-6-Phosphate Dehydrogenase • Hexokinase
Lactate Dehydrogenase • Mucin

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Name	Activity	Catalog Number	Package	Code
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Neutral Protease (Dispase®), Animal Free

Source: *Bacillus polymyxa*

EC: 3.4.24.28 **CAS Number:** 42613-33-2

Neutral Protease (Dispase®) is an animal free, metallo, neutral protease, purified by methods developed at Worthington. Its mild proteolytic action makes the enzyme especially suitable for the preparation of primary and secondary (subcultivation) cell culture. This protease is also used as a secondary enzyme in cell isolation and tissue dissociation applications.

Stability/Storage: Stable at 2-8°C for 12 months. Store at 2-8°C. After reconstitution with water or buffer, aliquot and store at -20°C.

Unit Definition: One Unit releases Folin positive amino acids equivalent to 1 micromole tyrosine per minute from casein at 37°C, pH 7.5.

Neutral Protease (Dispase®), Purified

Chromatographically purified.
A lyophilized powder.
Store at 2-8°C.

≥ 4 Units per
mg dry weight

LS02100
LS02104
LS02106
LS02108

10 mg
50 mg
250 mg
Bulk

NPRO



Neutral Protease, Partially Purified

Partially purified. A lyophilized powder.
Store at 2-8°C.

≥ 0.1 Units per
mg dry weight

LS02110
LS02109
LS02111
LS02112

100 mg
1 gm
5 gm
Bulk

NPRO2



Related Products: Cell Isolation Optimizing System • Collagenase • Deoxyribonuclease I • Elastase • Hepatocyte Isolation System Hyaluronidase • Neonatal Cardiomyocyte Isolation System • Papain • Papain Dissociation System • Proteinase K • *STEMxyme*® 1 • *STEMxyme*® 2 • Trypsin • Trypsin Inhibitors

Name	Activity	Catalog Number	Package	Code
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Nuclease, Micrococcal

Source: *Staphylococcus aureus* (Strain ATCC #27735)

EC: 3.1.31.1 **CAS Number:** 9013-53-0

Micrococcal nuclease catalyzes cleavage of both DNA and RNA to yield 3'-nucleotides. It exhibits exo- and endo-5'-phosphodiesterase activities. The enzyme catalyzes endohydrolysis of the RNA and DNA preferentially at sites rich in adenylate or uridylate and deoxyadenylate or thymidylate. The enzyme has a molecular weight of 16.8 kDa and is calcium dependent. The pH optimum is 9.2 but varies depending upon the concentration of ionized calcium present.

Unit Definition: One unit corresponds to a change in optical density of 1.0 at 260 nm at 37°C, pH 8.0, using DNA as the substrate.

Nuclease, Micrococcal

Chromatographically purified to be essentially homogeneous chromatographically and electrophoretically (SDS-PAGE). A lyophilized powder.
Store at 2-8°C.

≥ 6,000 units
per mg protein

LS004797
LS004798
LS004796

15 ku
45 ku
Bulk

NFCP

Related Products: Albumin, Nuclease-Free • Deoxyribonuclease I • Deoxyribonucleic Acid and Related Products • Histones Lysozyme • Nuclease, Micrococcal • Phosphatase, Alkaline • Phosphodiesterase I • Phosphodiesterase II • Proteinase K Reverse Transcriptase, Recombinant HIV • Ribonuclease • Ribonuclease A • Ribonuclease T1 • Ribonuclease T2 • Ribonucleic Acid

Name	Activity	Catalog Number	Package	Code
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Nuclease, S1

Source: *Aspergillus oryzae*

EC: 3.1.30.1 **CAS Number:** 37288-25-8

Nuclease S1 isolated from certain *Neurospora* and *Aspergillus* species specifically hydrolyzes both terminal and internal phosphodiester bonds of single-stranded DNA and RNA. Nuclease S1 has a molecular weight of approximately 34 kDa and exists as a monomer. The optimum pH range is 4.0-4.6, and it is activated by Zn²⁺ and/or Ca²⁺. Inhibitors are EDTA, citrate and high concentrations of SDS.

Stability/Storage: For long term storage in solution, for up to six months, dilute SINUC to ≥ 6000 u/ml in water and freeze in aliquots. Dilute solutions can be stabilized by adding 0.1% albumin (Worthington Code: BSANF) and 10% glycerol.

Unit Definition: One unit hydrolyzes one microgram of denatured calf thymus DNA per minute at 37°C, pH 4.6.

Nuclease, S1

SINUC

Chromatographically purified.	≥ 100,000 to	LS04070	10 ku
Specific for single-stranded DNA (ssDNA) degradation. Activity on native (ds) DNA undetectable under the assay conditions. A frozen solution in 30 mM sodium acetate, pH 4.6, 50 mM NaCl, 1 mM ZnCl ₂ , and 50% glycerol. Store at -20°C.	500,000 units per ml	LS04072	50 ku
		LS04073	Bulk

REQUIRES SPECIAL SHIPPING: ICE PACK

Related Products: Albumin, Nuclease-Free • Deoxyribonuclease I • Deoxyribonucleic Acid and Related Products • Histones Lysozyme • Nuclease, S1 • Phosphatase, Alkaline • Phosphodiesterase II • Proteinase K • Reverse Transcriptase, Recombinant HIV Ribonuclease Ribonuclease A • Ribonuclease T1 • Ribonuclease T2 • Ribonucleic Acid

Name	Activity	Catalog Number	Package	Code
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Nucleohistone

Source: Calf Thymus

Nucleohistone is a sodium containing complex of histone and deoxyribonucleic acid. The nucleoprotein complex of histone and DNA is referred to as nucleohistone or deoxyribonucleoprotein. Intracellularly, these complexes are important factors in chromosomal structure and gene transcription.

Stability/Storage: Stable. Store at 2-8°C.

Technical Note: Soluble in 2 M NaCl.

Histone, Nucleo-

NHL

A complex of histone and DNA. Prepared by the procedure of Zamenhof, S., <i>Methods in Enzymol.</i> , 3, 696 (1957). A dialyzed, lyophilized powder. Store at 2-8°C.	N/A	LS003010	250 mg
		LS003011	1 gm
		LS003013	Bulk

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Name	Activity	Catalog Number	Package	Code
Ovalbumin				
Source: Egg White				
CAS Number: 9006-59-1				
Ovalbumin is a glycoprotein with molecular weight of 45 kDa. The molecule consists of a polypeptide with up to two phosphate groups per mole and a side chain of mannose and glucosamine residues.				
LowEndo™ Ovalbumin, Purified				
Ovalbumin, purified to remove endotoxin.	≥95% Purity	LS003059	10 mg	OAEF
A dialyzed, lyophilized powder.	(SDS-PAGE)	LS003061	100 mg	
Store at 2-8°C.	≤1 Endotoxin unit per mg	LS003062	500 mg	
		LS003064	Bulk	
Ovalbumin, Purified				
Highly purified. Major protein of egg white, with a molecular weight of 45 kDa.	≥95% Purity	LS003056	100 mg	OAC
A dialyzed, lyophilized powder.		LS003054	1 gm	
Store at 2-8°C.		LS003052	Bulk	
Ovalbumin				
Major protein of egg white, with a molecular weight of 45 kDa. A lyophilized powder.	≥90% Purity	LS003049	1 gm	OA
Store at 2-8°C.		LS003048	5 gm	
		LS003050	Bulk	

Name	Activity	Catalog Number	Package	Code
Papain				
Source: <i>Carica papaya</i> Latex				
EC: 3.4.22.2 CAS Number: 9001-73-4				
Papain is a sulfhydryl protease from <i>Carica papaya</i> Latex. It has a molecular weight of 23 kDa and an optimum pH range of 6.0-7.0. The action of papain on leucine methyl ester produces an insoluble polyleucine peptide. Papain breaks down the intercellular matrix of cartilage. Papain is activated by cysteine, sulfide, and sulfite. Stabilizing agents are EDTA, cysteine and dimercaptoethanol.				
Stability/Storage: Stable for 6-12 months at 2-8°C. Do not freeze aqueous suspensions.				
Technical Notes: Papain preparations should be incubated in the activation solution before use to ensure full activity. Applications include antibody fragmentation and primary/neural cell isolation.				
Unit Definition: One Unit hydrolyzes one micromole of benzoyl-L-arginine ethyl ester per minute at 25°C, pH 6.2, after activation in a solution containing 1.1 mM EDTA, 0.067 mM mercaptoethanol and 5.5 mM cysteine-HCl for 30 minutes.				
Papain, Suspension				
Supplied as a 2X crystalline suspension in 50 mM sodium acetate, pH 4.5. To ensure full activity, the enzyme should be incubated in a solution containing 1.1 mM EDTA, 0.067 mM mercaptoethanol and 5.5 mM cysteine-HCl for 30 minutes. It is recommended that the enzyme be 0.22 micron filtered after dissolution and prior to use.	Activates	LS003124	25 mg	PAP
Store at 2-8°C.	≥ 20 Units	LS003126	100 mg	
	per mg protein	LS003127	1 gm	
		LS003128	Bulk	
REQUIRES SPECIAL SHIPPING: ICE PACK				

Name	Activity	Catalog Number	Package	Code
Papain (Continued)				
Papain, Lyophilized				PAPL
Supplied as a lyophilized powder prepared from a 2X crystalline suspension, Code: PAP. To ensure full activity, the enzyme should be incubated in a solution containing 1.1 mM EDTA, 0.067 mM mercaptoethanol and 5.5 mM cysteine-HCl for 30 minutes. It is recommended that the enzyme be 0.22 micron filtered after dissolution and prior to use. Store at 2-8°C.	Activates	LS003118	25 mg	
	≥15 Units	LS003119	100 mg	
	per mg protein	LS003120	1 gm	
		LS003122	Bulk	
PDS Kit, Papain Vial				PAP2
A component of the Papain Dissociation System, for use in the tissue dissociation method of Huettnner, J., and Baughman, R., <i>J. Neuroscience</i> , 6, 3044 (1986). Contains papain, L-cysteine, and EDTA. This material is 0.22 micron membrane filtered and lyophilized in autoclaved vials. A vial reconstituted with 5 ml of EBSS or equivalent yields a solution at 20 Units of papain per ml in 1 mM L-cysteine with 0.5 mM EDTA. Store at 2-8°C.	≥ 100 Units	LK003176	1 vi	
	per vial	LK003178	5 vi	

Related Products: Cell Isolation Optimizing System • Collagenase • Deoxyribonuclease I • Hepatocyte Isolation System
Hyaluronidase • Neonatal Cardiomyocyte Isolation System • Neutral Protease (Dispase®) • Papain Dissociation System • Proteinase K
STEMxyme® 1 • STEMxyme® 2 • Trypsin • Trypsin Inhibitors



Our mission is to provide superior tools from discovery research through larger scale bioprocessing applications.

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Name	Activity	Catalog Number	Package	Code
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Papain (Neural) Dissociation System

The Worthington Papain Dissociation System is a set of reagents intended for use in the neural cell isolation method of Huettner and Baughman, *J. Neurosci.*, 6, 3044 (1986). The materials are designed for convenience and simplicity and are useful to the occasional user as well as the more experienced and frequent user. Each lot is use-tested for performance in rat spinal neural cell isolation and this kit provides freshly prepared enzyme solutions for each dissociation.

Stability/Storage: The reagents are stable at ambient temperatures for the periods of time expected in normal shipping procedures, but the package should be refrigerated upon arrival. Contents may be stored at 2-8°C for 4 months before use. Store at 2-8°C.

Package Contents

The package contains sufficient materials for dissociation of five separate tissue aliquots of up to 0.3-0.4 cm³ each. For larger tissue samples prepare proportionately larger volumes of reagents at each step and combine them in the same ratio as described in the protocol.

- **Vial 1:** Sterile Earle's Balanced Salt Solution (EBSS) with calcium, magnesium, bicarbonate and phenol red, one vial per package, 100 ml. Aliquots of this vial are used to reconstitute other vials and to prepare dilute inhibitor solution. Refrigerate between uses and equilibrate with sterile O₂:CO₂ before each use.
- **Vial 2:** Papain containing L-cysteine and EDTA, 5 x 100 Unit single-use vials per package. The material is 0.22 micron membrane filtered and lyophilized in autoclaved vials. A vial reconstituted with 5 ml of EBSS (Vial 1) yields a solution at 20 Units of papain per ml in 1 mM L-cysteine with 0.5 mM EDTA. Brief incubation at 37°C is needed to insure full solubility and activity.
- **Vial 3:** Deoxyribonuclease I (DNase), 5 x 1000 unit single use vials per package. This material is 0.22 micron membrane filtered and lyophilized in autoclaved vials. A vial reconstituted with 0.5 ml of EBSS (Vial 1) yields a solution at 2000 units of deoxyribonuclease per ml. Avoid vigorous mixing.
- **Vial 4:** Ovomuroid protease inhibitor with bovine serum albumin, one vial per package, 32 ml upon reconstitution. This material is 0.22 micron membrane filtered and lyophilized in autoclaved vials. A vial reconstituted with 32 ml of EBSS (Vial 1) yields a solution at an effective concentration of 10 mg of ovomucoid inhibitor and 10 mg of albumin per ml. Aliquots of this vial are used for each dissociation. Refrigerate between uses and equilibrate with sterile O₂:CO₂ before each use. Stable after reconstitution when stored at 2-8°C.

Also included is a card correlating color with pH for use as a guide in O₂:CO₂ equilibration.

Papain Dissociation System

Set of five single use vials of papain and five single use vials of DNase, 100 ml of Earle's balanced salt solution (EBSS), and an inhibitor vial for use in the tissue dissociation method of Huettner and Baughman, *J. Neuroscience*, 6, 3044 (1986). Use-tested by Worthington using new-born rat pup spinal cord. The package contains sufficient materials for dissociation of five separate tissue aliquots of up to 0.3-0.4 cm³ each. Store at 2-8°C.

LK003150 1 bx
LK003153 3 bx

PDS

Papain Dissociation System, Without EBSS

Complete kit as described for product Code: PDS, but without the Earle's Balanced Salt Solution (EBSS). Store at 2-8°C.

LK003160 1 bx
LK003163 3 bx

PDS2

Name	Activity	Catalog Number	Package	Code
Papain (Neural) Dissociation System (Continued)				
PDS Kit, Papain Vial				PAP2
A component of the Papain Dissociation System, for use in the tissue dissociation method of Huettner and Baughman, <i>J. Neuroscience</i> , 6, 3044 (1986). Contains papain, L-cysteine, and EDTA. This material is 0.22 micron membrane filtered and lyophilized in autoclaved vials. A vial reconstituted with 5 ml of EBSS or equivalent yields a solution at 20 Units of papain per ml in 1 mM L-cysteine with 0.5 mM EDTA. Store at 2-8°C.	≥ 100 Units per vial	LK003176 LK003178	1 vi 5 vi	
PDS Kit, DNase Vial				D2
A component of the Papain Dissociation System. This material is 0.22 micron membrane filtered and lyophilized in autoclaved vials. A vial reconstituted with 0.5 ml of EBSS or equivalent yields a solution of 2000 units/ml of deoxyribonuclease (1 mg/ml). Store at 2-8°C.	≥ 1,000 units per vial	LK003170 LK003172	1 vi 5 vi	
PDS Kit, Inhibitor Vial				OI-BSA
Ovomucoid protease inhibitor and bovine serum albumin which is 0.22 micron filtered and lyophilized in autoclaved vials to contain 10 mg/ml each upon reconstitution with 32 ml of EBSS. Store at 2-8°C.	≥ 300 mg TRL inhibited per vial	LK003182	1 vi	
PDS Kit, EBSS Vial				EBSS
Earle's balanced salt solution (EBSS) as supplied in the Papain Dissociation System. Store at 2-8°C.		LK003188	1 vi	

Related Products: Cell Isolation Optimizing System • Collagenase • Deoxyribonuclease I • Hepatocyte Isolation System
Hyaluronidase • Neonatal Cardiomyocyte Isolation System • Neutral Protease (Dispase®) • Papain Dissociation System
Proteinase K • *STEMxyme*® 1 *STEMxyme*® 2 • Trypsin • Trypsin Inhibitors

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Name	Activity	Catalog Number	Package	Code
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Pectinase

Source: *Aspergillus niger*

EC: 4.2.2.10 **CAS Number:** 9033-35-6

Purified pectinase is a multi-component preparation highly effective in depolymerizing plant pectins with varying degrees of esterification. The product contains substantial hemicellulase, cellulase, pectinesterase and xylanase activities which, together with pectin lyase and polygalacturonase, work synergistically to digest plant cell wall tissues. When used with Worthington purified cellulase, purified pectinase has been found to be highly successful for generating good yields of viable protoplasts in several plant systems, e.g., corn, soybean, red beet, sunflower, tomato and citrus. In general, a concentration range of 0.1% to 0.5% pectinase (with accompanying 0.5% to 1.5% cellulase) used at 24°C to 37°C for periods of 1 to 16 hours will yield good results.

Stability/Storage: Protect from moisture. If not using entire bottle at once, weigh into single-use aliquots on arrival and store tightly covered and desiccated, at 2-8°C. Material is very hygroscopic and can become tacky and difficult to weigh if exposed to moisture.

Unit Definition: One Unit releases 1 micromole of D-galacturonic acid from polygalacturonic acid per minute at 37°C, pH 5.0.

Technical Note: Pectinase is extremely hydroscopic; store desiccated to protect from moisture.

Pectinase

PASE

A chromatographically purified preparation also containing hemicellulase, cellulase, pectinesterase and xylanase activities. Suitable for plant protoplast isolation applications. Supplied as a dialyzed, lyophilized powder. Store at 2-8°C. PROTECT FROM MOISTURE.	≥ 20 Units per mg dry weight	LS004297 LS004298 LS004296	250 mg 1 gm Bulk
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Related Product: Cellulase

Name	Activity	Catalog Number	Package	Code
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Pepsin

Source: Porcine Stomach

EC: 3.4.23.1 **CAS Number:** 9001-75-6

Pepsin is an acidic protease. Its inactive zymogen precursor, pepsinogen, is produced in the stomach mucosa. There are several pepsins designated A, B, C, and D. Pepsin A, the major component, has a molecular weight of 35 kDa and an optimum pH of approximately 1.0 for substrates such as casein or hemoglobin if the substrate is native protein. Pepsin cleaves proteins preferentially at carboxylic groups of aromatic amino acids such as phenylalanine and tyrosine. It will not cleave at bonds containing valine, alanine or glycine. Pepsin is assayed based on the method of Anson, *J. Gen. Physiol.*, 22, 79 (1938) using hemoglobin as the substrate. Pepsin is unstable above pH 6.

Stability/Storage: Pepsin is stable for 1-2 years at 2-8°C.

Unit Definition: One unit releases 0.001 A₂₈₀ as TCA soluble hydrolysis products from denatured hemoglobin per minute at 37°C. One FIP Unit, expressed as micromoles of tyrosine equivalents liberated per minute at 25°C, can be calculated as follows: 1 Worthington unit x 0.0071 = FIP Units.

Pepsin A

PM

Two times crystallized from dilute alcohol. A lyophilized powder. Store at 2-8°C.	≥ 2,500 units per mg dry weight	LS003319 LS003317 LS003322	1 gm 10 gm Bulk
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Related Products: Collagenase • Deoxyribonuclease I • Hemoglobin • Hyaluronidase • Neutral Protease (Dispase®) • Proteinase K

Name	Activity	Catalog Number	Package	Code
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Peroxidase

Source: Horseradish Roots

EC: 1.11.1.7 **CAS Number:** 9003-99-0

Peroxidase (HRP) is a hemoprotein catalyzing the oxidation by hydrogen peroxide of a number of substrates such as ascorbate, ferrocyanide, cytochrome c and the leuco form of many dyes. HRP has a molecular weight of 40 kDa and an optimum pH of 7.0.

Stability/Storage: HPOFF is stable for 9-12 months at 2-8°C. HPOD is stable 2 to 3 years at 2-8°C.

Unit Definition: One Worthington Unit decomposes 1 micromole of H₂O₂ per minute at 25°C, pH 7.0 using aminoantipyrine and phenol.

Technical Note: The RZ (Reinheitzahl), which is the absorbance ratio, A₄₀₃/A₂₇₅ has been used as an indication of purity. However, Shannon *et al.*, *J. Biol. Chem.*, 241, 266 (1966) report that this ratio for the isozymes varies from 2.50 to 4.19. This, together with the influence exerted by buffer and pH, would seem to render questionable the precision of this ratio as a criterion of purity.

Numerous different methodologies are utilized for the determination of peroxidase activity. Listed below are some approximate conversions as determined by Worthington:

- 1 Worthington Unit = 4.6 o-dianisidine units previously used by Worthington
- 1 Worthington Unit = 0.62 ABTS® units (µmole of dye oxidized per minute, pH 6.0, 25°C, 1.7 mM dye)
- 1 Worthington Unit = 2 ABTS® units (µmole of dye oxidized per minute, pH 5.0, 25°C, 8.7 mM dye)
- 1 Worthington Unit = 0.5 guaiacol units (µmole of guaiacol oxidized per minute, pH 7.0, 25°C)
- 1 Worthington Unit = 0.5 pyrogallol to purpogallin unit (mg of product per 20 seconds, pH 6.0, 20°C)
- 1 Worthington Unit = 5 pyrogallol to purpogallin units (µmole of product per minute at pH 6.0, 30°C)

Peroxidase, EIA Grade, Purified

Chromatographically purified.
Single basic isozyme with RZ ≥ 2.9.
A lyophilized powder. Suitable for immunoconjugation.
Store at 2-8°C or -20°C.

≥ 500 Units per
per mg protein

LS006474
LS006476
LS006472

5 ku
50 ku
Bulk

HPOFF

Peroxidase

A soluble, dialyzed, lyophilized powder.
RZ ≥ 1.0.
Store at -20°C.

≥ 85 Units per
mg dry weight

LS002559
LS002560
LS002561

100 mg
1 gm
Bulk

HPOD



*We support the new generation of life science researchers,
as well as STEM education programs.*

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Name	Activity	Catalog Number	Package	Code
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Phosphatase, Acid

Source: Wheat Germ (*Triticum vulgare*)

EC: 3.1.3.2 **CAS Number: 9001-77-8**

Acid phosphatase is an esterase with broad activity at an optimal pH below 7.0. There are three isozymes, EI, EII, and EIII of similar molecular weight (55 kDa ± 5 kDa). Their optimum pHs are 5.5, 4.5 and 4.0, respectively. Acid phosphatase activity was observed by Teller, *Worthington Library Archives* in 1954 in preparations of a wheat germ lipase described by Singer, *J. Biol. Chem.*, 174, 11, in 1948. Equivalent commercial preparations have been distributed labeled as lipase and acid phosphatase thus generating some confusion. Subsequent work has confirmed that the non-specific esterase activity of the wheat germ preparation may be measured both as lipase (triacetin as substrate) and phosphatase. The enzyme assay is based on the work of Brandenberger and Hanson, *Helv. Chim. Acta*, 36, 900 (1953) and Hofstee, *Arch. Biochem. Biophys.*, 51, 239 (1954).

Unit Definition: One Unit hydrolyzes one micromole of *o*-carboxyphenyl phosphate per minute at 25°C, pH 5.0.

Phosphatase, Acid

AP

A non-specific esterase partially purified to the 0.35-0.55 fraction by the method described by Singer, <i>J. Biol. Chem.</i> , 174, 11 (1948). Also active as a lipase. A lyophilized powder. Store at -20°C.	≥ 0.15 Units per mg dry weight	LS001141 LS001144	1 gm Bulk
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Name	Activity	Catalog Number	Package	Code
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Phosphatase, Alkaline

EC: 3.1.3.1 **CAS Number: 9001-78-9**

Alkaline phosphatase is a broad term associated with non-specific phosphomonoesterases with an alkaline pH optimum.

Unit Definitions:

CAP: One Worthington Unit hydrolyzes 1 micromole of *p*-nitrophenol phosphate per minute at 37°C, pH 9.8.

BAPF, BAPC, BAPSF: One Unit hydrolyzes 1 micromole of *p*-nitrophenol phosphate per minute at 25°C, pH 8.0.

PC: One Unit hydrolyzes 1 micromole of *o*-carboxyphenol phosphate per minute at 25°C, pH 8.8.

Technical Notes: Worthington chicken intestine alkaline phosphatase (Code: PC) is the preparation used in the NF/USP dexamethasone phosphate measurement.

Phosphatase, Alkaline, Purified

CAP

Source: Calf Intestine	≥ 3,000 Units per mg protein	LS004228	1 mg
Chromatographically purified, EIA grade.	(37°C, pH 9.8, DEA)	LS004230	5 mg
A solution in 50% glycerol containing 5 mM MgCl ₂ and 0.12 mM ZnCl ₂ . Protein concentration is approximately 20 mg/ml. Store at 2-8°C.		LS004234	Bulk

Phosphatase, Alkaline, Purified

BAPF

Source: <i>Escherichia coli</i>	≥ 30 Units per mg protein	LS006130	1 mg
Chromatographically purified from Code: BAPC. Ribonuclease ≤ 0.002% by weight as RNase A using a poly C assay. Phosphodiesterase not detectable when assayed at 0.1 mg/ml with <i>p</i> -nitrophenyl thymidine 5' phosphate. A suspension in 2.6 M ammonium sulfate, pH 8.0. Store at 2-8°C.	(25°C, pH 8.0)	LS006124 LS006123 LS006122	5 mg 25 mg Bulk

Name	Activity	Catalog Number	Package	Code
Phosphatase, Alkaline (Continued)				
Phosphatase, Alkaline				BAPC
Source: <i>Escherichia coli</i>				
Chromatographically purified.	≥ 20 Units per	LS005129	5 mg	
A suspension in 2.6 M ammonium sulfate, pH 8.0.	mg protein	LS005130	10 mg	
Store at 2-8°C.	(25°C, pH 8.0)	LS005131	Bulk	
Phosphatase, Alkaline				BAPSF
Source: <i>Escherichia coli</i>				
Partially purified. A suspension in 2.6 M ammonium sulfate, pH 8.0.	≥ 10 Units per	LS004081	10 mg	
Store at 2-8°C.	mg protein	LS004082	Bulk	
Phosphatase, Alkaline				PC
Source: Chicken Intestine				
Partially purified. A dried powder.	≥ 0.9 Units per	LS003172	250 mg	
Used in the NF/USP dexamethasone phosphate assay.	mg dry weight	LS003171	1 gm	
Store at 2-8°C.	(25°C pH 8.8)	LS003170	5 gm	
		LS003174	Bulk	

Related Products: Albumin, Nuclease-Free • Deoxyribonuclease I • Deoxyribonucleic Acid and Related Products • Histones • Lysozyme • Nuclease, Micrococcal • Nuclease, S1 • Phosphatase, Alkaline • Phosphodiesterase II • Proteinase K
Reverse Transcriptase, Recombinant HIV • Ribonuclease • Ribonuclease T1 • Ribonuclease T2 • Ribonucleic Acid

Name	Activity	Catalog Number	Package	Code
Phosphodiesterase I				
Source: <i>Crotalus adamanteus</i> Venom				
EC: 3.1.4.1		CAS Number: 9025-82-5		
Venom exonuclease (Phosphodiesterase I) successively hydrolyzes 5'-mononucleotides from 3'-OH-terminated ribo- and deoxyribo-oligonucleotides. The enzyme has an optimal pH range of 9.8-10.4 and a molecular weight of 115 kDa. Phosphodiesterase is inhibited by reducing agents such as glutathione, cysteine and ascorbic acids. It is completely inhibited by 5 mM EDTA while ATP, ADP and AMP are partial inhibitors. The enzyme has an absolute requirement for Mg ²⁺ .				
Unit Definition: One Unit hydrolyzes one micromole of <i>p</i> -nitrophenyl thymidine-5-phosphate per minute at 25°C, pH 8.9.				
Phosphodiesterase I				VPH
Purified by the method of Williams, Sung and Laskowski, <i>JBC</i> , 236, 1130 (1961). Further treated to inactivate contaminating 5'-nucleotidase activity according to Sulkowski and Laskowski, <i>Biochim. Biophys. Acta</i> , 240, 443 (1961). Lyophilized in vials.	≥ 20 Units per	LS003926	100 un	
Store at -20°C.	mg dry weight	LS003928	Bulk	
REQUIRES SPECIAL SHIPPING: ICE PACK				

Related Products: Albumin, Nuclease-Free • Deoxyribonuclease I • Deoxyribonucleic Acid and Related Products • Histones • Lysozyme • Nuclease, Micrococcal • Nuclease, S1 • Phosphatase, Alkaline • Phosphodiesterase II • Proteinase K
Reverse Transcriptase, Recombinant HIV • Ribonuclease • Ribonuclease T1 • Ribonuclease T2 • Ribonucleic Acid

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Name	Activity	Catalog Number	Package	Code
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Phosphodiesterase II

Source: Bovine Spleen

EC: 3.1.16.1 **CAS Number:** 9068-54-6

Spleen exonuclease (Phosphodiesterase II) excises 3'-phosphomononucleotides from oligonucleotides having a free OH terminus. The optimum pH for the enzyme is 5.5 using succinate and phosphate buffer and pH 6-7 with 0.1 M acetate buffer. The enzyme is assayed using a modification of the procedure of Hilmo, *Biochem. Prep.*, 8, (Meister, A., ed.), John Wiley and Sons, NY, 105 (1961).

Unit Definition: One unit increases the absorbance at 260 nm by 0.200 in 30 minutes at 37°C, pH 6.5, with an RNA substrate.

Phosphodiesterase II

SPH

Prepared from the 1 mM sodium pyrophosphate, pH 6.9, alumina gel eluate of Hilmo, <i>Biochem. Prep.</i> , 8, (Meister, A., ed.), John Wiley & Sons, NY, NY, p. 105 (1961). Lyophilized in vials. Store at -20°C.	≥ 1.2 units per mg dry weight	LS003603 LS003602 LS003600	10 un 25 un Bulk
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REQUIRES SPECIAL SHIPPING: ICE PACK

Related Products: Albumin, Nuclease-Free • Deoxyribonuclease I • Deoxyribonucleic Acid and Related Products
Histones • Lysozyme Nuclease, Micrococcal • Nuclease, S1 • Phosphatase, Alkaline • Phosphodiesterase II • Proteinase K
Reverse Transcriptase, Recombinant HIV • Ribonuclease • Ribonuclease T1 • Ribonuclease T2 • Ribonucleic Acid

Name	Activity	Catalog Number	Package	Code
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Phospholipase A2

Source: *Crotalus adamanteus* Venom

EC: 3.1.1.4 **CAS Number:** 9001-84-7

Phospholipase A2 is a member of the class of heat-stable, calcium-dependent enzymes catalyzing the hydrolysis of the 2-acyl bond of 3-n-phosphoglycerides. The enzyme has a molecular weight of 30 kDa. Phospholipase A2 is activated by Ca²⁺. It is inhibited by zinc, barium, and manganese ions. Activity values for phospholipase A2 preparations which are derived from titrimetric assay procedures can be quite dependent on source and type of lecithin, its preparation as a substrate emulsion, other components of the reaction mixture, and the method and instrumentation used.

Unit Definition: One Unit releases one micromole of acid from soybean lecithin per minute at 25°C, pH 8.9

Phospholipase A2

PLA

A chromatographically purified, dialyzed, lyophilized powder. Store at 2-8°C.	≥ 200 Units per mg dry weight	LS005660 LS005662	1 mg Bulk
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Name	Activity	Catalog Number	Package	Code
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Plasma Amine Oxidase

Source: Bovine Plasma

EC: 1.4.3.21 **CAS Number: 9001-53-0**

Plasma amine oxidase (PAO) catalyzes the reaction: $RCH_2NH_2 + O_2 + H_2O \longrightarrow RCHO + NH_3 + H_2O_2$

Bovine plasma amine oxidase has a molecular weight of 170 kDa and an optimum pH of 6.2 for spermine and 7.2 for spermidine. Amine oxidases are divided into two classes: the pyridoxal- and copper-containing enzyme to which plasma amine oxidase belongs, and the FAD-containing amino oxidases. Natural substrates include catecholamines, tryptamine derivatives and other physiologically active amines. Plasma amine oxidase is used in research requiring nitrogen group transfers. The molecule is composed of two identical polypeptide chains. There are two pyridoxal-phosphates and two atoms of Cu^+ per molecule. Bovine plasma amine oxidase is inhibited by copper chelating agents, many carboxyl reagents such as cuprizone, hydroxylamine and cyanide. Benzoic acid and benzyl alcohol are both non-competitive inhibitors ($K_i = 30$ and 34 mM respectively). The assay for determination of amine oxidases employed at Worthington is essentially that of Tabor *et al.*, *JBC*, 208, 645 (1954) with the reaction temperature reduced to 25°C.

Stability/Storage: Stable for 12 months at -20°C. Store at -20°C.

Unit Definition: 1 Tabor unit oxidizes 1 micromole of benzylamine per minute at 25°C, pH 7.2.

Technical Note: 1 I.U. equals 4,330 Tabor units. (T.U.)

Plasma Amine Oxidase

Chromatographically purified through step five of the procedure of Yamada, and Yasunobu, *J. Biol. Chem.*, 237, 1511 (1962). A lyophilized powder. (One IU = 4,330 Tabor Units).

Store at -20°C.

≥ 17 Tabor units per mg dry weight	LS003113	600 un
	LS003114	3 ku
	LS003110	Bulk

PAO

Name	Activity	Catalog Number	Package	Code
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Polyphenol Oxidase

Source: Mushrooms

EC: 1.14.18.1 **CAS Number: 9002-10-2**

Polyphenol oxidase (tyrosinase) is a bifunctional, copper-containing oxidase having catecholase and cresolase activity. It is responsible for browning reactions through the phylogenetic scale. The enzyme has a molecular weight of 128 kDa. It is a tetramer containing four atoms of copper per molecule and two binding sites for aromatic compounds including phenolic substrates. There is a distinct binding site for oxygen. The optimum pH range is 6-7.

Unit Definition: One unit causes an increase in the absorbance at 280 nm of 0.001 per minute at 25°C, pH 6.5, using L-tyrosine as substrate.

Polyphenol Oxidase (Tyrosinase)

A lyophilized powder. Store at -20°C. REQUIRES SPECIAL SHIPPING: ICE PACK

≥ 500 units per mg dry weight	LS003789	25 ku
	LS003792	100 ku
	LS003793	500 ku
	LS003791	Bulk

TY

Worthington Protease Products, Specifications and Applications Table

Enzyme	Specificity	Molecular Weight KDa	pH Optimum	Extinction Coefficient E1%, 280nm	Common Substrates	Activators	Inhibitors	Product Code/ Applications
Partially Purified for Tissue Dissociation and Protein Digestion								
Collagenase	-Pro-X-†-Gly-Pro-Y- X = neutral Y = nonspecific	68-130	6.3-7.5	13.20 (ColH, Theoretical) 13.40 (ColG, Theoretical)	Collagen FALGPA Wünsch	Ca ²⁺ , Zn ²⁺	α2-macroglobulin Cysteine, histidine DTT, 2-mercapto EDTA, EGTA Hg ²⁺ & other heavy metal ions o-phenanthroline	See page 14 for Collagenase products Tissue dissociation/ Primary cell isolation applications (see Tissue Dissociation Guide for specific references)
Elastase	Elastin, -X-†-Y- X = uncharged, nonaromatic Y = nonspecific	25.9	8.0-8.5	21.8 (Theoretical)	Casein Denatured collagen Elastin, Fibrin Suc-Ala3-NA	None required	α-antitrypsin DFP α2-macroglobulin PMSF	ES/ESL, suspension/lyo powder, p. 28 Tissue Dissociation/ Primary cell isolation applications (see Tissue Dissociation Guide for specific references)
Neutral Protease (Dispase®)	-X-†-Leu/Phe-†-Y- X/Y = nonspecific	36.0	5.9-7.0	13.96 (Theoretical)	BAEE Casein	Ca ²⁺ , Mg ²⁺ , Mn ²⁺ , Fe ²⁺ , and Al ³⁺	EDTA, EGTA Hg ²⁺ & other heavy metal ions o-phenanthroline	NPRO/NPRO2, p. 44 Tissue Dissociation/ Primary cell isolation and cell harvesting applications (see Tissue Dissociation Guide for specific references)
Papain	-X-†-Y- X = nonspecific but Arg, Lys and Phe preferred Y = nonspecific	23.0	6.0-7.0	22.88 (Theoretical)	BAEE	Cysteine EDTA Reducing agents GSH, NBS	AESBF, Antipain Cystatin, Leupeptin α2-macroglobulin Hg ²⁺ & other heavy metal ions DFP, PMSF TLCK, TPCK, E-64	PAP/PAPL, suspension/lyo powder, p. 46 Neural tissue dissociation/ primary cell isolation applications (see Tissue Dissociation Guide for specific references) Antibody cleavage RBC modification
Pepsin	-X-†-Y- X = nonspecific but aromatic & hydrophobic preferred Y ≠ Ala, Gly, Val	34.6	1.0-4.0 unstable ≥5	14.39 (Theoretical)	Casein Hemoglobin	None required	Pepstatin A Diazoketones Epoxides	PM, p.50 Collagen bioprocessing/ purification Antibody cleavage
Proteinase K	-X-†-Y- X = nonspecific but aliphatic, aromatic & hydrophobic preferred Y = nonspecific	28.9	7.5-12	12.6 (Theoretical)	Casein Hemoglobin Keratin	Ca ²⁺ Active in 0.5-1% SDS	DFP EGTA PMSF	PROKR, PROKRS, p. 59 DNA/RNA purification
Trypsin	-X-†-Y- X = Arg, Lys Y = nonspecific	23.8	7.5-8.5	14.3	BAEE Casein TAME	Ca ²⁺ Lanthanide	Aprotinin, Benzamidine DFP, EDTA, Leupeptin α2-macroglobulin PMSF, TLCK Trypsin Inhibitors (LBI, OI, SI/SIC)	See page 66 for Trypsin products Protein Digestion/ Sequencing (purified) Tissue dissociation/ Primary cell isolation applications (see Tissue Dissociation Guide for specific references)

Worthington Protease Products, Specifications and Applications Table

Enzyme	Specificity	Molecular Weight KDa	pH Optimum	Extinction Coefficient E1%, 280nm	Common Substrates	Activators	Inhibitors	Product Code/ Applications
Proteases For Protein Sequencing								
Carboxy-peptidase B	H ₂ -N-Rn-Y-†-X-COOH X = basic amino acids (Arg, Lys, Orn) Y = nonspecific	34.3	7.0-9.0	21.4 (Folk 1971)	Hippuryl-L-arginine	None required	EDTA Hg ²⁺ & other heavy metal ions EDTA, EGTA o-phenanthroline	COBC/, p.4 Sequence analysis by successive cleavage of C-terminal basic amino acids Insulin production
Carboxy-peptidase Y	H ₂ -N-Rn-Y-†-X-COOH X, Y = non-specific, prefers aromatic	64.0	4.5-6.0	15.0 (Hayashi <i>et al.</i> 1973, and Kuhn <i>et al.</i> 1973)	ATEE Bz-Phe-Ala-Leu Z-Phe-Ala	None required	APCK, Aprotinin DFP 4-Hydroxymercuribenzoate PMSF	COY, p. 5 C-terminal sequencing & Modification/labeling of peptides and proteins
Chymotrypsin TLCK treated	-X-†-Y- X = aromatic Y = nonspecific	25.6	7.8-8.0	20.57 (Theoretical)	ATEE BTEE	None required	a-antitrypsin Aprotinin DFP, PMSF, TPCK a ₂ -macroglobulin	CDSEQ, CDTLCK, p. 10 Sequence analysis Peptide synthesis, mapping/fingerprinting
Endo-Arg-C (Clostripain)	-Arg-†-Y- Y = nonspecific	53	7.4-7.8	16.57 (Theoretical)	BAEE	Ca ²⁺ Reducing agents	EDTA, TLCK, Tris Hg ²⁺ & other heavy metal ions	CPSEQ, CP, p.12 Peptide mapping & synthesis Sequence analysis Hydrolysis/condensation of amide bonds
Endo-Glu-C (Staph. Protease V8)	-Glu-†-Y- (NH ₄ buffers pH 4, 7.8) -Asp-†-Y- (PO ₄ buffer pH 7.8)	27.0	4.0 & 7.8	4.26 (Houmard 1976)	Casein Z-Phe-Leu-Glu-4NA	None required	DFP F-, Cl-, Br-, CH ₃ COO- NO ₃ - a ₂ -macroglobulin	STSEQ, STAP, p. 58 Peptide mapping & sequence analysis
Endo-Lys-C	-Lys-+-Y- Y = nonspecific	30.0	7.0-9.0	18.63 (Theoretical)	N-p-Tosyl-Gly-Pro-Lys pNA	None required	DFP, TLCK, Aprotinin, Leupeptin	LYS-C, LYSEQ, p.29 Peptide mapping and sequence analysis
SequENZ® Trypsin, Sequencing Grade, Modified							Aprotinin, Benzamidine DFP, EDTA, Leupeptin a ₂ -macroglobulin PMSF, TLCK Trypsin Inhibitors (egg white, lima bean, pancreatic, soybean)	TRSEQZ, Modified Sequencing Grade, p. 66 chemically modified to reduce autolysis Peptide mapping & sequence analysis Cleavage fusion proteins
Trypsin, Sequencing Grade, Native	-X-†-Y- X = Arg, Lys Y = nonspecific	23.8	7.5-8.5	14.3	BAEE Casein TAME	Ca ²⁺ Lanthanide		TRSEQII, Sequencing Grade, Native, p. 67 Peptide mapping & sequence analysis Cleavage fusion proteins
Trypsin, TPCK Treated								TRTPCK, TPCK Treated, p. 67 Peptide mapping & sequence analysis Cleavage fusion proteins

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Name	Activity	Catalog Number	Package	Code
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Protease, *Staphylococcus aureus* (Endoproteinase Glu-C)

Source: *Staphylococcus aureus* V8

EC: 3.4.21.19 **CAS Number:** 66676-43-5

Protease *Staphylococcus aureus* V8 (Endoproteinase-Glu-C) specifically cleaves peptide bonds on the COOH-terminal side of either aspartic or glutamic acids. In the presence of ammonium, the enzyme specificity is limited to glutamic sites. It has a molecular weight of 27 kDa and optimum pH of 4.0 and 7.8 with hemoglobin as the substrate. Protease *Staphylococcus aureus* V8 is inhibited by diisopropylfluorophosphate and monovalent anions such as F⁻, Cl⁻, CH₃COO⁻ and NO₃⁻. Enzyme activity is determined by the casein digestion assay described by Drapeau, *Methods Enzymol.*, 45, 469 (1976).

Stability/Storage: Autolysis occurs at temperatures greater than 40°C. The enzyme is fully active in USP 0.2% SDS. Stable for 12 months at 2-8°C.

Unit Definition: One unit causes a change of 0.001 A₂₈₀ nm per minute at 37°C, pH 7.8 using casein as the substrate.

Protease, *S. aureus* Sequencing Grade

Chromatographically purified according to Drapeau, *et al.*, *J. Biol. Chem.*, 247, 6720 (1972). Supplied in vials containing 10 µg or 50 µg lyophilized powder for protein sequencing applications. Store at 2-8°C.

≥ 500 units	LS02126	5x10 ug
per mg dry weight	LS02128	5x50 ug
	LS02129	Bulk

STSEQ

Protease, *S. aureus* (Endoproteinase Glu-C)

Chromatographically purified according to Drapeau, G., Boily, Y., and Houmard, J., *J. Biol. Chem.*, 247, 6720 (1972). A lyophilized powder. Store at 2-8°C.

≥ 500 units	LS003608	1 mg
per mg dry weight	LS003605	5 mg
	LS003606	Bulk

STAP

Related Products: Carboxypeptidase B • Carboxypeptidase Y • Chymotrypsin • Clostripain (Endoproteinase-Arg-C) Endo-Arg-C Endo-Glu-C • Neutral Protease (Dispase®) • Proteinase K • Trypsin, Modified • Trypsin



The Worthington tradition of quality, value and service extends to our families, co-workers and customers.

Name	Activity	Catalog Number	Package	Code
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Proteinase K

Source: Recombinant *tritirachium album* Proteinase K Produced in Yeast

EC: 3.4.21.64 **CAS Number: 39450-01-6**

Proteinase K is a serine endopeptidase with a broad spectrum of action, originally isolated from the fungus *Tritirachium album limber*. Worthington Recombinant Proteinase K is supplied as a highly purified lyophilized powder (PROKR) and ready-to-use liquid (PROKRS), and tested to be free of DNase and RNase contaminants.

Characteristics of Proteinase K from *Tritirachium album limber*:

Molecular weight: 28.9 kDa.

Extinction Coefficient: 14.2

pH Optimum: Stable over a wide pH range: 4.0-12.5, optimum pH 7.5-8.0, using denatured hemoglobin as substrate.

Stability: Although calcium ions do not affect the enzyme activity, they do protect Proteinase K against autolysis and increase thermal stability when present at a concentration of 1 - 5 µmoles. An interesting characteristic of Proteinase K is that it retains its activity in the presence of sodium dodecyl sulphate (SDS) or urea. (0.5 - 1% SDS and 1 - 4 M urea). Raising the temperature of the reaction from 37°C to 50 - 60°C can increase the activity several folds. A special feature of Proteinase K is its ability to digest native proteins, thereby inactivating enzymes such as DNase and RNase without recourse to a denaturation process.

Proteinase K is inactivated by diisopropyl fluorophosphate (DFP) or phenyl methane sulphonyl fluoride (PMSF). Chelating agents such as citrate and EDTA have no effect on the enzyme activity. Proteinase K can also be inactivated by heating above 65°C for 15-20 minutes or by extraction with phenol/chloroform.

Storage: The lyophilized powder is stable for ≥ 1 year at 2-8°C. Solutions in 50 mM Tris-HCl, pH 8.0 with 1 mM CaCl₂ are stable for months at 2-8°C. Store at 2-8°C.

Unit Definition: One unit releases one micromole of Folin positive amino acids per minute, measured as tyrosine, at 37°C, pH 7.5, using urea denatured hemoglobin as the substrate.

Specificity: In addition to cleavage of peptide bonds, it is able to catalyze peptide amide hydrolysis.

Application: Note: PROK/PROKS products have been superseded by the recombinant product codes PROKR/PROKRS. The recommended working concentration for Proteinase K is 0.05-1 mg/ml.

Proteinase K is very useful in the isolation of highly native, undamaged DNAs or RNAs, since most microbial or mammalian DNases and RNases are rapidly inactivated by the enzyme, particularly in the presence of 0.2 - 1% SDS.

Proteinase K, Recombinant

A lyophilized powder. Purified to remove DNase and RNase. Store at 2-8°C.

≥ 20 units per
mg dry weight

LS004248
LS004249
LS004250
LS004252

25 mg
100 mg
1 gm
Bulk

PROKR

Proteinase K, Recombinant, Solution

A concentrated, ready to use liquid formulation. Proteinase K prepared at 20mg/ml in 10mM Tris-HCl, 1mM calcium acetate, pH 7.5 containing 50% glycerol. DNase and RNase free. Store at -20°C
REQUIRES SPECIAL SHIPPING: ICE PACK.

≥ 20 units per
mg dry weight

LS004254
LS004256
LS004258

5 ml
25 ml
Bulk

PROKRS

Related Products: Albumin, Nuclease-Free • DNase I • DNase I, Recombinant • Histones • Ribonuclease A • Lysozyme
Nuclease, Micrococcal • Nuclease, S1 • Nucleic Acids • Phosphatase, Alkaline • Phosphodiesterase I • Phosphodiesterase II
Reverse Transcriptase, Recombinant HIV • Ribonuclease T1 • Ribonuclease T2 • Ribonucleic Acid

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Name	Activity	Catalog Number	Package	Code
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Reverse Transcriptase, Recombinant HIV

Source: Recombinant protein produced in *Escherichia coli*

EC: 2.7.7.49 CAS Number: 9068-38-6

Chromatographically purified heterodimer composed of 66 kDa and 51 kDa subunits. Supplied as a solution in 10 mM potassium phosphate, pH 7.4, 1 mM DTT and 20% glycerol. Primarily for AIDS research purposes; this enzyme has less fidelity than all other reverse transcriptases in applications such as the preparation of cDNA from mRNA for cloning purposes.

Unit Definition: One unit incorporates 1 nanomole of tritiated dTMP into acid precipitable products using poly(A)/oligo(dT)12-18 as the template/primer in 20 minutes at 37°C, pH 8.3.

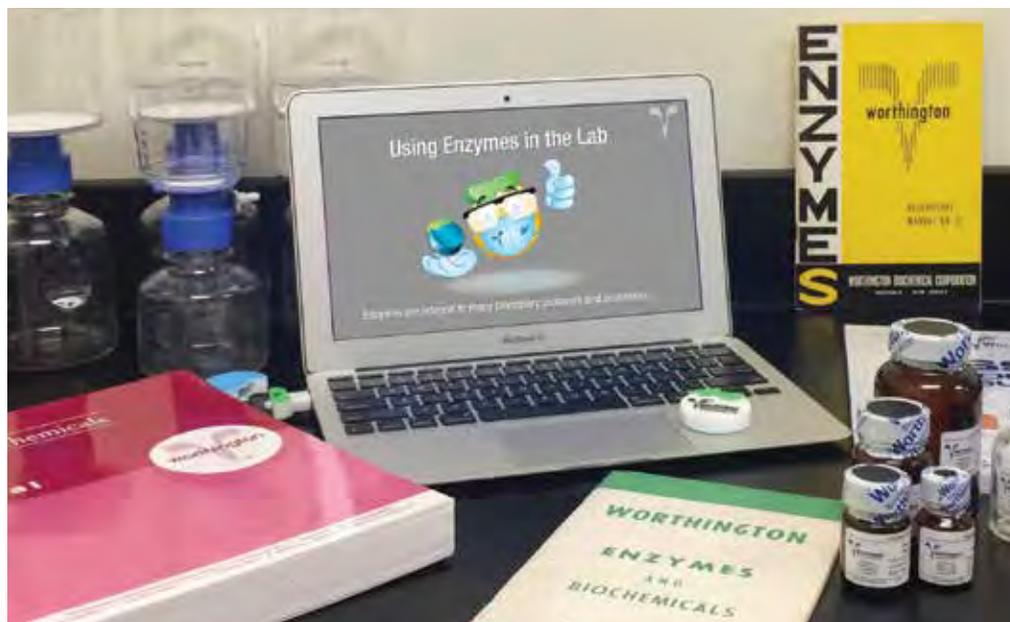
Reverse Transcriptase, Recombinant, HIV

RTHIV

Chromatographically purified dimeric form with M.W. of 66 kDa and 51 kDa.	≥ 5,000 units per mg protein	LS05003	200 un
A solution in 10 mM potassium phosphate, pH 7.4, 1 mM DTT and 20% glycerol.		LS05006	5x200 un
Store at -20°C.		LS05000	Bulk

REQUIRES SPECIAL SHIPPING: DRY ICE

Related Products: Albumin, Nuclease-Free • Deoxyribonuclease I • Deoxyribonucleic Acid and Related Products • Histones • Lysozyme Nuclease, Micrococcal • Nuclease, S1 • Phosphatase, Alkaline • Phosphodiesterase I • Phosphodiesterase II • Proteinase K • Ribonuclease Ribonuclease T1 • Ribonuclease T2 • Ribonucleic Acid



From writing the definitive Enzyme Manual decades ago, to our just released Introduction to Enzymes Video, our field account managers are here to assist you with the best products and services for your research.

Name	Activity	Catalog Number	Package	Code
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Ribonuclease

Source: Bovine Pancreas

EC: 3.1.27.5 **CAS Number:** 9001-99-4

Pancreatic ribonuclease (RNase I) catalyzes cleavage of the phosphodiester bond between the 5'-ribose of a nucleotide and the phosphate group attached to the 3'-ribose of an adjacent pyrimidine nucleotide forming a 2',3'-cyclic phosphate which may then be hydrolyzed to the corresponding 3'-nucleoside phosphate. Ribonuclease A has a molecular weight of 13.7 kDa. It operates in an optimum pH range of 7.0-7.5.

Ribonuclease B has a molecular weight of 14.7 ± 0.3 kDa. It is a glycoprotein which possesses an amino acid composition indistinguishable from that of RNase A. It contains 6 residues of mannose and 2 residues of N-acetylglucosamine per molecule. It is a glycosylated derivative of RNase A.

Ribonuclease is inhibited by heavy metal ions and it is competitively inhibited by DNA. Since Molecular Biology Grade RNase A (Product Code: RPDF) is essentially free of DNase and protease activities, this product is useful in removing RNA from DNA in nucleic acid work and where other enzymes are used or where intact proteins must be recovered.

Stability/Storage: Molecular Biology Grade product (Product Code: RPDF) is stable at least 2 years at 2-8°C or -20°C. Other grades of RNase A are stable 2-3 years at 2-8°C. R and RAF: Store at 2-8°C and protect from moisture. Product Code: RASE: Store at -20°C to maintain monomeric form. Product Code: RPDF: Store at 2-8°C or at -20°C.

Unit Definition: One Kalnitsky unit causes an increase in absorbance of 1.0 at 260nm at 37°C and pH 5.0 when yeast ribosomal RNA is hydrolyzed to acid soluble oligonucleotides. One Kunitz unit equals 50 Worthington units.

Technical Notes: Special care should be given to handling of the enzyme because of its affinity for glass surfaces. The enzyme remains active but aggregates upon lyophilization and in solution at temperatures ≥ 2°C at low ionic strength. Heating solutions of RNase A to inactivate DNase may not be satisfactory since RNase activity may be lost if precipitate formation occurs and heat treated DNase may reactivate over time. Product Code: RPDF is suitable as supplied for applications requiring minimal DNase and protease levels and needs no further treatment. Product Code: RAF can be used without treatment in some applications. To heat-treat RAF, use 10 mM acetate pH 5.0 with or without 15 mM CaCl₂ for 15 minutes at 100°C or longer at 80°C. Product may precipitate if heated at neutral pH. Heat treatment of Product Code: RASE will precipitate product due to the presence of phosphate.

Ribonuclease A, DNase & Protease Free

Molecular Biology Grade. Supplied as a solution containing approximately 5 mg/ml in 50% glycerol. Prepared specifically for use in purifying DNA plasmids. Each lot is assayed for DNase and protease. Store at 2-8°C. Storage at -20°C is acceptable.

≥ 2,000 units	LS002131	1 mg
per mg protein	LS002132	5 mg
	LS002130	Bulk

RPDF

Ribonuclease A, Purified

A highly purified, lyophilized preparation which may contain aggregates as a result of lyophilization but which exhibits same specific activity as RASE (below). Store at 2-8°C. PROTECT FROM MOISTURE.

≥ 3,000 units	LS005649	25 mg
per mg dry	LS005650	100 mg
weight	LS005655	Bulk

RAF

Ribonuclease A, Purified Solution

Monomeric form, purified by method used for RAF (above) and further processed to remove aggregates. Available as a solution in 0.1 M phosphate buffer, pH 7.4 containing 0.1% v/v phenol as a preservative. Store at -20°C.

≥ 3,000 units	LS005677	25 mg
per mg protein	LS005679	100 mg
	LS005681	Bulk

RASE

REQUIRES SPECIAL SHIPPING: DRY ICE

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Name	Activity	Catalog Number	Package	Code
Ribonuclease (Continued)				
Ribonuclease A				R
Chromatographically purified.	≥ 2,500 units	LS003431	200 mg	
Lyophilized.	per mg dry	LS003433	1 gm	
Store at 2-8°C.	weight	LS003435	Bulk	
PROTECT FROM MOISTURE.				

Ribonuclease B				RB
A partially purified preparation containing a mixture of RNase A and RNase B.	≥ 1,000 units	LS005710	100 mg	
A soluble, dialyzed lyophilized powder.	per mg dry	LS005715	Bulk	
Store at 2-8°C.	weight			

Related Products: Albumin, Nuclease-Free • Deoxyribonuclease I • Deoxyribonucleic Acid and Related Products • Histones
Lysozyme • Nuclease, Micrococcal • Nuclease, S1 • Phosphatase, Alkaline • Phosphodiesterase I • Phosphodiesterase II • Proteinase K
Reverse Transcriptase, Recombinant HIV • Ribonuclease T1 • Ribonuclease T2 • Ribonucleic Acid

Name	Activity	Catalog Number	Package	Code
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Ribonuclease A, Recombinant

Source: Recombinant bovine pancreatic Ribonuclease A produced in *Pichia pastoris*

EC: 3.1.27.5 **CAS Number:** 9001-99-4

Recombinant RNase A catalyzes cleavage of the phosphodiester bond between the 5'-ribose of a nucleotide and the phosphate group attached to the 3'-ribose of an adjacent pyrimidine nucleotide forming a 2',3'-cyclic phosphate which may then be hydrolyzed to the corresponding 3'-nucleoside phosphate. Ribonuclease A has a molecular weight of 13.7 kDa. It operates in an optimum pH range of 7.0-7.5.

Stability/Storage: RRA1 and RRA2 are stable 2-3 years at 2-8°C. Protect from moisture.

Unit Definition: One Kunitz unit causes an increase in absorbance of 1.0 at 260nm at 37°C and pH 5.0 when yeast ribosomal RNA is hydrolyzed to acid soluble oligonucleotides. One Kunitz unit equals 50 Worthington units.

Ribonuclease A, Recombinant DNase and Protease Free				RRA1
Recombinant Bovine pancreatic	≥ 3,000	LS01506	10 ku	
Ribonuclease A produced in <i>Pichia pastoris</i> .	units per mg	LS01508	25 ku	
Chromatographically purified, free of animal derived components, DNases and Proteases. Supplied as a lyophilized powder. Store at 2-8°C.	dry weight	LS01510	Bulk	

Ribonuclease A, Recombinant Bioprocess Grade				RRA2
Recombinant Bovine pancreatic	≥ 175	LS01512	100 mg	
Ribonuclease A produced in <i>Pichia pastoris</i> , Animal Free/AF, Bioprocess grade. For the removal of RNA in bioprocessing applications. May contain DNases and Proteases. Supplied as a lyophilized powder. Store at 2-8°C.	units per mg	LS01514	1 gm	
	dry weight	LS01516	Bulk	

Name	Activity	Catalog Number	Package	Code
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Ribonuclease T1, Animal Free

Source: *Aspergillus oryzae*

EC: 4.6.1.24 **CAS Number:** 9026-12-4

Ribonuclease T1 is a non-mammalian endoribonuclease, highly specific for the cleavage of RNA or deaminated RNA between guanosine 3'-phosphate residues (or inosine 3'-phosphate) and the 5'-OH residues of adjacent nucleotides with the formation of the corresponding intermediate 2', 3'-cyclic phosphates. It cleaves single-stranded RNA releasing oligonucleotides from the guanosine 3'-phosphate termini. The enzyme has a molecular weight of 11 kDa. The optimum pH is 7.5. RNase T1 is inhibited by Ag⁺, Zn²⁺, Cu²⁺, and Hg²⁺ at 1 X mM. The stimulatory effects of both histidine and EDTA are attributed to chelation of contaminating inhibitor cations. The enzyme assay is essentially the method of Egami *et al.*, *Prog. in Nucleic Acid Res. and Molec. Biol.*, 3, 59 (1964) based upon the release of acid soluble oligonucleotides following the digestion of yeast RNA.

Uses: Ribonuclease T1 has extensive applications in molecular cloning and DNA sequencing. Because of its specificity it has been a commonly used cleavage enzyme for the determination of structure, nearest neighbor frequencies, and RNA sequencing. The enzyme has further application in the preparation of nucleoside 2',3'-cyclic phosphates, the synthesis of oligonucleotides, and the removal of RNA from DNA preparations.

Animal Free (AF): This enzyme is also used as a non-mammalian source of RNase in various applications.

Stability/Storage: Stable 12-24 months at 2-8°C. Store at 2-8°C.

Unit Definition: One unit releases the equivalent of one A260 unit of acid-soluble products from yeast RNA in 15 minutes at 37°C, pH 7.5.

Technical Note: Some suppliers reference sequencing units; one sequencing unit is equivalent to 0.075 Worthington unit.

Ribonuclease T1, Chromatographically Purified

Highly purified, microbial (non-mammalian) RNase prepared with non-animal components.

Store at 2-8°C.

REQUIRES SPECIAL SHIPPING: ICE PACK

≥ 300,000

units per mg protein

LS01485

LS01487

LS01488

100 ku

500 ku

Bulk

RT1S



Ribonuclease T1, Chromatographically Purified, Lyophilized

Highly purified, microbial (non-mammalian) RNase prepared with non-animal components.

Supplied as a dialyzed, lyophilized powder.

Store at 2-8°C.

≥ 300,000

units per mg protein

LS01490

LS01492

LS01494

500 ku

2500 ku

Bulk

RT1L



Choose from a wide range of high quality enzymes for a variety of life science research applications.

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Name	Activity	Catalog Number	Package	Code
Ribonuclease T2, Recombinant <i>Aspergillus oryzae</i>, Animal Free				

Source: Recombinant protein produced in *Pichia pastoris*

EC: 4.6.1.19 **CAS Number:** 37278-25-4

Aspergillus oryzae Ribonuclease T2 is a member of the RNase T2 family of endonucleases that are present in a wide variety of microbial, plant and animal species. In contrast to *Aspergillus oryzae* Ribonuclease T1, which is an exclusively guanylic-acid specific endonuclease, all RNase T2-like enzymes are essentially base non-specific. However, RNase T2 endonucleases from different species can show slight base preferences. The fungal enzymes, including *Aspergillus oryzae* RNaseT2, show slight base preference in the following order: A>G>C, U. RNase T2 cleaves between the 3'-phosphate residue of one base and the 5'-OH residue of the adjacent nucleotide forming a 2', 3'-cyclic phosphate intermediate followed by the generation of oligonucleotides with 3'-phosphate residues. RNase T2 has a molecular weight of 36 kDa and 12-15% of its mass is composed of carbohydrate. It has an isoelectric point of 5.0 and optimum activity at pH 4.5. RNase T2 is strongly inhibited by Cu⁺⁺, Zn⁺⁺ and Hg⁺⁺ and to a lesser degree by Ca⁺⁺, Mg⁺⁺ and heparin. Mononucleotides and RNase T2 digestion products can also act as competitive inhibitors. EDTA will stimulate activity, especially in the presence of divalent cations.

Uses: Ribonuclease T2 is often used for 3' analysis of RNA and RNase protection assays.

Animal Free (AF): This enzyme is also used as a non-mammalian source of RNase in various applications.

Stability/Storage: Stable at 12-18 months at 2-8°C. Store at 2-8°C.

Unit Definition: One unit will cause an increase in absorbance of 1.0 at 260 nm at 37°C, pH 4.5 in 15 minutes.

Ribonuclease T2, Recombinant

Highly purified recombinant microbial (non-mammalian) RNase prepared with non-animal components. Free of DNase and protease. Supplied as a lyophilized powder. Store at 2-8°C.

≥ 10,000 units per mg protein	LS01501	50 ku
	LS01502	250 ku
	LS01505	Bulk

RT2R



Related Products: Albumin, Nuclease-Free • Deoxyribonuclease I • Deoxyribonucleic Acid and Related Products • Deoxyribonuclease Recombinant Histones • Lysozyme • Nuclease, Micrococcal • Nuclease, S1 • Phosphatase, Alkaline • Phosphodiesterase I • Phosphodiesterase II • Proteinase K Reverse Transcriptase, Recombinant HIV • Ribonuclease • Ribonuclease A • Ribonucleic Acid • Ribonuclease T2



Animal free enzymes, exceeding expectations and meeting industry standards – quality assurance lot-to-lot.

Name	Activity	Catalog Number	Package	Code
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Ribonucleic Acid

Source: Baker's Yeast

CAS Number: 63231-32-0

Ribonucleic acids are long-chain polymers of nucleotides linked through 3',5'-phosphodiester bonds.

Ribonucleic Acid

Primarily ribosomal RNA.

Suitable substrate for ribonuclease assays.

Store at 2-8°C.

N/A

LS003452

LS003453

LS003451

100 mg

1 gm

Bulk

RNA

Related Products: Albumin, Nuclease-Free • Deoxyribonuclease I • Deoxyribonucleic Acid and Related Products
Deoxyribonucleic Acid Fragments • Histones • Lysozyme • Nuclease, Micrococcal • Nuclease, S1 • Phosphatase, Alkaline
Phosphodiesterase I • Phosphodiesterase II • Proteinase K • Reverse Transcriptase, Recombinant HIV • Ribonuclease
Ribonuclease T1 • Ribonuclease T2

Name	Activity	Catalog Number	Package	Code
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Superoxide Dismutase

Source: Bovine Erythrocytes

EC: 1.15.1.1

CAS Number: 9054-89-1

Superoxide dismutase (SOD) catalyzes the removal of the O₂⁻ free radical. The enzyme protects oxygen-metabolizing cells against harmful effects of superoxide free-radicals. Superoxide dismutase is inactivated by H₂O₂. It consists of two subunits of identical molecular weight joined by a disulfide bond. The molecular weight is 32.5 kDa, and there are two Cu(II) and two Zn(II) atoms per molecule. The isoelectric point of the enzyme is 4.95.

Unit Definition: One unit inhibits by 50% the maximum reduction of nitro blue tetrazolium under the specified conditions.

Superoxide Dismutase

Chromatographically purified essentially as described by McCord and Fridovich, *J. Biol. Chem.*, 244, 6049 (1969). A dialyzed, lyophilized powder. Store at 2-8°C.

≥ 1,400 units
per mg dry
weight

LS003540

LS003541

LS003542

2 mg

10 mg

Bulk

SODBE

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Name	Activity	Catalog Number	Package	Code
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Trypsin

Source: Bovine Pancreas

EC: 3.4.21.4 **CAS Number:** 9002-07-7

Trypsin is a pancreatic serine protease with substrate specificity based upon positively charged lysine and arginine side chains. It is derived from a 34 kDa inactive precursor zymogen, trypsinogen, after enzymatic removal of an N-terminal 6-amino acid leader sequence resulting in the 23.8 kDa trypsin molecule. The optimum pH is 8.0. Trypsin is inhibited by organophosphorus compounds such as diisopropylfluorophosphate and natural inhibitors from pancreas. Soybean, lima bean, and egg white are also sources of natural inhibitors. Trypsin cleaves amide and ester bonds of Arg and Lys. The Worthington Sequencing Grade Trypsin has been further purified to remove trace contaminating proteases and autolysis products which could interfere in trypsin digestion experiments, and exhibits a single band on SDS PAGE.

Uses: For tissue culture work, Worthington trypsin, Codes: TRL, TRLS, TRLVMF and TRTVMF have been used by many researchers. Product Codes: TRSEQZ, TRSEQII and TRTPCK are typically used for protein sequencing, mapping and structure studies. Worthington modified sequencing grade trypsin, Product Code: TRSEQZ, is subjected to extensive purification to remove contaminating proteases and tryptic autolysis by-products which could affect the specificity of the digestion process. Subsequently, the enzyme is chemically modified to minimize the autolysis process as well as increase the stability. The modified trypsin is processed further to remove residual autodegradation products. The specificity of the enzyme is routinely checked after the chemical modification.

Stability/Storage: Most grades of Worthington trypsin are stable for 2-3 years when stored at 2-8°C. Protect from moisture.

Unit Definition: TAME Unit: One Unit hydrolyzes 1 micromole of *p*-toluene-sulfonyl-L-arginine methyl ester (TAME) per minute at 25°C, pH 8.2, in the presence of 10 mM calcium.
One TAME Unit = 19.2 USP/NF units = 57.5 BAEE units.

Technical Notes: The Virus and Mycoplasma Free trypsin (Code: TRTVMF) has been filtered through an 0.22 micron pore size membrane, lyophilized, subjected to gamma irradiation, and tested for virus and mycoplasma.

Worthington certifies that all lots of Trypsin products are subjected to a pH of less than 3.0 for greater than five (5) hours during processing.

SequENZ® Trypsin, Modified, Sequencing Grade

TRSEQZ

Trypsin, treated with	≥ 150 Units	LS02120	4 x 25 µg
L-(tosylamido-2-phenyl) ethyl	per mg protein	LS02122	4 x 100 µg
chloromethyl ketone to inhibit	(≥ 8,625	LS02123	1 mg
contaminating chymotryptic activity,	BAEE/2875	LS02124	Bulk
chemically modified to promote stability	USP/NF units		
and further purified to remove autolysis	per mg protein)		
fragments, resulting in a highly stable			
trypsin product resistant to autolysis			
while retaining specificity. Store at -20°C			
PROTECT FROM MOISTURE.			
REQUIRES SPECIAL SHIPPING: ICE PACK			

SequENZ® Trypsin, Modified, Sequencing Grade Solution

TRSEQZS

Ready to use liquid preparation of	≥ 150 Units	LS02150	250 µg
Trypsin, treated with L-(tosyl-amido-2-	per ml TAME	LS02152	1,000 µg
-phenyl) ethyl chloromethyl ketone to		LS02155	Bulk
inhibit contaminating chymotryptic activity,			
chemically modified to promote stability			
and further purified to remove autolysis			
fragments, resulting in a highly stable			
trypsin product resistant to autolysis			
while retaining specificity. Store at 2-8°C			
REQUIRES SPECIAL SHIPPING: ICE PACK			

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Name	Activity	Catalog Number	Package	Code
Trypsin (Continued)				
Trypsin, 0.22µ Filtered				
Trypsin chromatographically purified, diafiltered, (Code TRL3) filtered through a 0.22 micron pore size membrane and lyophilized in sterile vials. This product is not tested for pyrogenicity. Store at 2-8°C.	≥ 180 Units	LS003736	50 mg	TRL3
	per mg	LS003734	5 x 50 mg	
	protein (≥ 10,350 BAEE/3,450 USP/NF u/mg protein)	LS003738	Bulk	
Trypsin Vial, NCIS				
A component of the NCIS kit. This material is 0.22 micron membrane filtered and lyophilized in autoclaved vials. A vial reconstituted with 2 ml of HBSS yields a solution of 500 µg/ml of trypsin, Code: TRLS. Suitable for cell isolation and culture applications. Store at 2-8°C.	≥ 180 Units	LK003220	1 vi	TRL3NK
	per vial	LK003225	5 vi	
Trypsin, Sterile, Irradiated				
Chromatographically purified (Code: TRL), lyophilized, irradiated and tested for the absence of mycoplasma and extraneous virus according to 9 CFR113.53c. Each vial is filled to contain ≥ 100 mg. Store at 2-8°C.	≥ 180 Units	LS004454	100 mg	TRLVMF
	per mg	LS004452	5 x 100 mg	
	protein (≥ 10,350 BAEE/3,450 USP/NF u/mg protein)			
Trypsin, TPCK-Treated, Irradiated				
Chromatographically purified trypsin treated with L-(tosylamido-2-phenyl) ethyl chloromethyl ketone (TPCK) to inhibit contaminating chymotryptic activity according to (Kostka and Carpenter, <i>J. Biol. Chem.</i> 239, 1799, 1964), Code: TRTPCK, lyophilized, irradiated and tested for the absence of mycoplasma and extraneous virus according to 9 CFR 113.53c. Each vial is filled to contain ≥ 100 mg. Store at 2-8°C.	≥ 180 Units	LS003750	100 mg	TRTVMF
	per mg	LS003752	5 x 100 mg	
	protein (≥ 10,350 BAEE/3,450 USP/NF u/mg protein)			

Related Products: Cell Isolation Optimizing System • Chymotrypsin • Clostripain (Endoproteinase-Arg-C) • Collagenase Deoxyribonuclease I • Hepatocyte Isolation System • Hyaluronidase • Neonatal Cardiomyocyte Isolation System • Neutral Protease (Dispase®) Papain Dissociation System • Protease Staph (Endoproteinase-Glu-C) • Proteinase K • *STEMxyme*® 1 & *STEMxyme*® 2 • Trypsin Inhibitors

Name	Activity	Catalog Number	Package	Code
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Trypsin Inhibitors

CAS Number: 9035-81-8

Lima Bean Inhibitor: Lima bean trypsin inhibitor, which inhibits bovine as well as human trypsin and plasmin, acts upon both trypsin and chymotrypsin by forming equimolar complexes. Lima bean inhibitors may be chromatographically separated into as many as six variants. Jones *et al.*, *Biochem.*, 2, 66, (1963) characterized four of them. All have similar but not identical amino acid composition, contain six or seven disulfide bonds and lack methionine and tryptophan. Molecular weights vary between 8 kDa and 10 kDa.

Stability/Storage: The lima bean inhibitor is stable 1-2 years at 2-8°C.

Ovomucoid: Ovomucoids are the glycoprotein protease inhibitors of avian egg white. There are several protease inhibitors in egg white. The Worthington product is that described by Lineweaver and Murray, *J. Biol. Chem.*, 171, 565 (1947). It has a molecular weight of approximately 28 kDa.

Stability/Storage: Ovomucoid is stable 1-2 years when stored at 2-8°C.

Soybean Inhibitor: The soybean trypsin inhibitor was first crystallized by Kunitz in 1945 and is one of several such inhibitors found in soybeans. Its molecular weight is 21.5 ± 0.8 kDa and the optimum pH is 7.0. Soybean inhibitor inhibits trypsin mole-for-mole and to a lesser extent chymotrypsin.

Stability/Storage: The soybean inhibitor is stable for 1-2 years at 2-8°C.

Unit Definition: The activity of the inhibitors is expressed as the amount of twice crystallized trypsin (Worthington Code: TRL) inhibited per milligram of inhibitor. 1 mg TRL ≥ 180 TAME units, 10,350 BAEE units, 3,450 USP/NF units.

Trypsin Inhibitor, Lima Bean

Animal Free

Fraction III of the preparation described by Fraenkel-Conrat *et al.*, *Arch. Biochem. Biophys.*, 37, 393 (1952). Supplied as a dialyzed, lyophilized powder. Store at 2-8°C.

1 mg inhibits
≥ 2.2 mg
trypsin,
Code: TRL

LS002829
LS002830
LS002831

100 mg
1 gm
Bulk

LBI



Trypsin Inhibitor, Ovomucoid

Mucoprotein and antitryptic factor of egg white described by Lineweaver and Murray, *J. Biol. Chem.*, 171, 565 (1947). A dialyzed, dried powder. Store at 2-8°C.

1 mg inhibits
≥ 1.2 mg
trypsin,
Code: TRL

LS003085
LS003087
LS003086
LS003089

500 mg
1 gm
2 gm
Bulk

OI

Trypsin Inhibitor, Soybean, Purified

Animal Free

Chromatographically purified. A dialyzed, lyophilized powder. Purity checked using SDS PAGE. Store at 2-8°C.

1 mg inhibits
≥ 1.2 mg
trypsin,
Code: TRL

LS003570
LS003571
LS003573

100 mg
1 gm
Bulk

SI



Trypsin Inhibitor, Soybean

Animal Free

Partially purified by methods developed at Worthington. A diafiltered, lyophilized powder. Store at 2-8°C.

1 mg inhibits
≥ 0.75 mg
trypsin,
Code: TRL

LS003587
LS003589
LS003590

1 gm
10 gm
Bulk

SIC



Related Products: Cell Isolation Optimizing System • Chymotrypsin • Collagenase • Deoxyribonuclease I
Hepatocyte Isolation System Hyaluronidase • Neonatal Cardiomyocyte Isolation System • Neutral Protease (Dispase)
Papain • Papain Dissociation System • Proteinase K • Trypsin

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Name	Activity	Catalog Number	Package	Code
Trypsin Inhibitors (Continued)				
Inhibitor Vial, NCIS				
A component of the NCIS kit.	1 mg inhibits	LK003230	1 vi	SICNK
This material is 0.22 micron membrane filtered and lyophilized in autoclaved vials.	at least 0.75 mg trypsin	LK003235	5 vi	
A vial reconstituted with 1 ml of HBSS or equivalent yields a solution of 2 mg/ml of trypsin inhibitor, Code: SIC. Suitable for cell isolation and culture applications.	Code: TRL			
Store at 2-8°C.				

Name	Activity	Catalog Number	Package	Code
Tyrosine Decarboxylase				
Source: <i>Streptococcus faecalis</i> (NCTC6783)				
EC: 4.1.1.25 CAS Number: 9002-09-9				
Tyrosine decarboxylase catalyzes the removal of the carboxyl group from tyrosine to produce tyramine and carbon dioxide. Pyridoxal 5'-phosphate is a necessary cofactor. By using the apoenzyme prepared from cells grown on a vitamin B6-deficient medium, the concentration of pyridoxal phosphate may be determined. The holoenzyme may be used to determine tyrosine, phenylalanine and dihydroxyphenylalanine either manometrically or colorimetrically.				
Unit Definition: One Unit results in the decomposition of one micromole of tyrosine per minute at 37°C under the specified conditions.				
Tyrosine Decarboxylase				
Holoenzyme. Dried cells.	≥ 0.2 Unit per mg dry weight	LS004966	25 un	TYD
Store at -20°C. REQUIRES SPECIAL SHIPPING: DRY ICE		LS004964	Bulk	
Tyrosine Decarboxylase, Apoenzyme				
Apoenzyme. Dried cells grown in B6 deficient media.	Activates	LS004968	250 mg	TYDAPO
Store at -20°C.	≥ 0.2 Units per mg dry weight	LS004970	1 gm	
REQUIRES SPECIAL SHIPPING: DRY ICE		LS004973	Bulk	

Name	Activity	Catalog Number	Package	Code
Urease				
Source: Jack Bean (<i>Canavalia ensiformis</i>)				
EC: 3.5.1.5 CAS Number: 9002-13-5				
Urease catalyzes the hydrolysis of urea. The molecular weight of the jack bean enzyme is 480 kDa, with an optimum pH of 6.0. It is inhibited by heavy metals.				
Unit Definition: One Unit oxidizes one micromole of NADH per minute at 25°C, pH 7.6. The hydrolysis of urea is measured by coupling ammonia production to a glutamate dehydrogenase reaction.				
Urease				
Fractionated from crude jack bean meal extract. Tested for ammonia.	≥ 45 Units per mg dry weight	LS003885	250 mg	URC
A soluble, lyophilized preparation.		LS003886	1 gm	
Store at -20°C.		LS003887	10 gm	
REQUIRES SPECIAL SHIPPING: ICE PACK		LS003889	Bulk	

Name	Activity	Catalog Number	Package	Code
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Uricase

Source: *Candida utilis*

EC: 1.7.3.3 **CAS Number:** 9002-12-4

Uricase from *Candida* yeast has a molecular weight of ~120,000 daltons and an optimum pH of 8.5. The enzyme is stable at pH 8.5-9.5 and at temperatures below 35°C. The pI is 5.6. It is inhibited by various purine analogs of urate and by copper chelating agents. The enzyme is highly specific for uric acid.

Unit Definition: One Unit oxidizes one micromole of uric acid per minute at 25°C, pH 8.5.

Uricase

A soluble, lyophilized preparation.
Store at -20°C.

≥ 2 Units per
mg dry weight

LS003857
LS003855

100 un
Bulk

URYW



Worthington employees take pride in developing the highest quality enzymes.

Catalog Number Listing

Number	Product	Code	Package	Page
LK002060	Hepatocyte Isolation System	HIS	1 bx	32
LK002064	Hank's Balanced Salt Solution 10X (HBSS-CMF)	HBSS10	1 ea	33
LK002066	Collagenase/Elastase Vial (CLSH)	CLSH	1 vi	17,33
LK002067	Collagenase/Elastase Vial (CLSH)	CLSH	5 vi	17,33
LK002069	Sodium bicarbonate, 7.5%, (NAH)	NAH	1 ea	34
LK002070	0.15m, MOPS Buffer, (MOPS)	MOPS	1 ea	34
LK003150	Papain Dissociation System	PDS	1 bx	48
LK003153	Papain Dissociation System	PDS	3 bx	48
LK003160	Papain Dissociation System, Without EBSS	PDS2	1 bx	48
LK003163	Papain Dissociation System, Without EBSS	PDS2	3 bx	48
LK003170	DNase Vial (D2)	D2	1 vi	22, 33, 49
LK003172	DNase Vial (D2)	D2	5 vi	22, 33, 49
LK003176	PDS Kit, Papain Vial	PAP2	1 vi	47, 49
LK003178	PDS Kit, Papain Vial	PAP2	5 vi	47, 49
LK003182	PDS Kit, Inhibitor Vial	OI-BSA	1 vi	49
LK003188	PDS Kit, EBSS Vial	EBSS	1 vi	49
LK003200	Cell Isolation Optimizing System	CIT	1 bx	8
LK003210	HBSS Solution	HBSS	1 ea	42
LK003220	Trypsin Vial, NCIS	TRLSNK	1 vi	42, 68
LK003225	Trypsin Vial, NCIS	TRLSNK	5 vi	42, 68
LK003230	Inhibitor Vial, NCIS	SICNK	1 vi	42, 70
LK003235	Inhibitor Vial, NCIS	SICNK	5 vi	42, 70
LK003240	Collagenase Vial, NCIS	CLSPANK	1 vi	16, 42
LK003245	Collagenase Vial, NCIS	CLSPANK	5 vi	16, 42
LK003250	L-15 Media Powder (L15NK)	L15NK	1 ea	34, 43
LK003265	Cell Strainers (Falcon)	CELSTRNK	5 ea	43
LK003300	Neonatal Cardiomyocyte Isolation System	NCIS	1 kt	42
LK003303	Neonatal Cardiomyocyte Isolation System	NCIS	3 kt	42
LS000150	Lactoperoxidase	LPO	10 mg	38
LS000151	Lactoperoxidase	LPO	50 mg	38
LS000152	Lactoperoxidase	LPO	Bulk	38
LS000290	Albumin, Nuclease-Free	BSANF	100 mg	1
LS000291	Albumin, Nuclease-Free	BSANF	5x100 mg	1
LS000292	Albumin, Nuclease-Free	BSANF	Bulk	1
LS001041	Actin	ACT	1 mg	1
LS001043	Actin	ACT	Bulk	1
LS001045	Actin	ACT	5 mg	1
LS001069	Alcohol Dehydrogenase, Lyophilized	ADHL	100 mg	2
LS001070	Alcohol Dehydrogenase, Lyophilized	ADHL	1 gm	2
LS001071	Alcohol Dehydrogenase, Lyophilized	ADHL	Bulk	2

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Catalog Number Listing

Number	Product	Code	Package	Page
LS001089	Alcohol Dehydrogenase, Suspension	ADHS	Bulk	2
LS001123	Aldolase, Suspension	ALD	100 mg	2
LS001125	Aldolase, Suspension	ALD	Bulk	2
LS001128	Aldolase, Lyophilized	ALDC	Bulk	2
LS001130	Aldolase, Lyophilized	ALDC	100 mg	2
LS001141	Phosphatase, Acid	AP	1 gm	52
LS001144	Phosphatase, Acid	AP	Bulk	52
LS001260	Carbonic Anhydrase	CA	50 mg	4
LS001263	Carbonic Anhydrase	CA	250 mg	4
LS001265	Carbonic Anhydrase	CA	Bulk	4
LS001332	Chymotrypsin, Alpha, 1X	CDAG	Bulk	11
LS001333	Chymotrypsin, Alpha, 1X	CDAG	1 gm	11
LS001334	Chymotrypsin, Alpha, 1X	CDAG	10 gm	11
LS001430	Chymotrypsin, Alpha, TLCK Treated	CDTLCK	25 mg	11
LS001432	Chymotrypsin, Alpha, TLCK Treated	CDTLCK	100 mg	11
LS001434	Chymotrypsin, Alpha, TLCK Treated	CDTLCK	1 gm	11
LS001438	Chymotrypsin, Alpha, TLCK Treated	CDTLCK	Bulk	11
LS001448	Chymotrypsin, Alpha, 3X	CDI	250 mg	11
LS001450	Chymotrypsin, Alpha, 3X	CDI	1 gm	11
LS001451	Chymotrypsin, Alpha, 3X	CDI	10 gm	11
LS001453	Chymotrypsin, Alpha, 3X	CDI	Bulk	11
LS001475	Chymotrypsin, Alpha, Purified	CDS	100 mg	11
LS001477	Chymotrypsin, Alpha, Purified	CDS	Bulk	11
LS001479	Chymotrypsin, Alpha, Purified	CDS	1 gm	11
LS001628	Cholinesterase, Butyryl	CHE	500 un	10
LS001632	Cholinesterase, Butyryl	CHE	4 ku	10
LS001636	Cholinesterase, Butyryl	CHE	Bulk	10
LS001641	Clostripain (Endoproteinase-Arg-C)	CP	1 mg	12
LS001643	Clostripain (Endoproteinase-Arg-C)	CP	5x1 mg	12
LS001646	Clostripain (Endoproteinase-Arg-C)	CP	10 mg	12
LS001647	Clostripain (Endoproteinase-Arg-C)	CP	Bulk	12
LS001652	Collagen	CL	5 gm	12
LS001654	Collagen	CL	1 gm	12
LS001656	Collagen	CL	10 gm	12
LS001658	Collagen	CL	Bulk	12
LS001663	Collagen, Soluble	CLCS	Bulk	12
LS001847	Catalase, Lyophilized	CTL	2 gm	5
LS001849	Catalase, Lyophilized	CTL	10 gm	5
LS001851	Catalase, Lyophilized	CTL	Bulk	5
LS001872	Catalase, Suspension	CTR	10 ml	5

Catalog Number Listing

Number	Product	Code	Package	Page
LS001873	Catalase, Suspension	CTR	100 ml	5
LS001874	Catalase, Suspension	CTR	Bulk	5
LS001896	Catalase, Filtered	CTS	10 ml	5
LS001898	Catalase, Filtered	CTS	10x10 ml	5
LS002004	Deoxyribonuclease I	D	5 mg	21
LS002006	Deoxyribonuclease I	D	20 mg	21
LS002007	Deoxyribonuclease I	D	100 mg	21
LS002009	Deoxyribonuclease I	D	Bulk	21
LS002058	Deoxyribonuclease I, Filtered	DCLS	11 mg	21
LS002060	Deoxyribonuclease I, Filtered	DCLS	25 mg	21
LS002105	Deoxyribonucleic Acid, Calf Thymus	DNA	100 mg	25
LS002106	Deoxyribonucleic Acid, Calf Thymus	DNA	1 gm	25
LS002107	Deoxyribonucleic Acid, Calf Thymus	DNA	5 gm	25
LS002108	Deoxyribonucleic Acid, Calf Thymus	DNA	Bulk	25
LS002130	Ribonuclease A, DNase & Protease Free	RPDF	Bulk	61
LS002131	Ribonuclease A, DNase & Protease Free	RPDF	1 mg	61
LS002132	Ribonuclease A, DNase & Protease Free	RPDF	5 mg	61
LS002138	Deoxyribonuclease I	DP	25 mg	22
LS002139	Deoxyribonuclease I	DP	100 mg	22
LS002140	Deoxyribonuclease I	DP	1 gm	22
LS002141	Deoxyribonuclease I	DP	Bulk	22
LS002145	Deoxyribonuclease I	DPB	100 mg	22
LS002147	Deoxyribonuclease I	DPB	1 gm	22
LS002149	Deoxyribonuclease I	DPB	Bulk	22
LS002172	Deoxyribonuclease I, Standard Vial	DSV	5x2 ku	21
LS002173	Deoxyribonuclease I, Standard Vial	DSV	2 ku	21
LS002274	Elastase, Suspension	ES	25 mg	28
LS002276	Elastase, Suspension	ES	Bulk	28
LS002279	Elastase, Suspension	ES	100 mg	28
LS002280	Elastase, Suspension	ES	1 gm	28
LS002290	Elastase, Lyophilized	ESL	25 mg	28
LS002292	Elastase, Lyophilized	ESL	100 mg	28
LS002294	Elastase, Lyophilized	ESL	1 gm	28
LS002298	Elastase, Lyophilized	ESL	Bulk	28
LS002375	Histone, Dried	H	250 mg	35
LS002377	Histone, Dried	H	1 gm	35
LS002379	Histone, Dried	H	Bulk	35
LS002402	Hemoglobin	HB	5 gm	31
LS002403	Hemoglobin	HB	25 gm	31
LS002404	Hemoglobin	HB	100 gm	31

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Catalog Number Listing

Number	Product	Code	Package	Page
LS002407	Hemoglobin	HB	Bulk	31
LS002408	Myoglobin	MB	250 mg	40
LS002410	Myoglobin	MB	1 gm	40
LS002412	Myoglobin	MB	5 gm	40
LS002414	Myoglobin	MB	Bulk	40
LS002425	Deoxyribonuclease II	HDA	80 ku	24
LS002427	Deoxyribonuclease II	HDA	Bulk	24
LS002515	Hexokinase, Lyophilized, Recombinant	HKQLR	2.5 ku	34
LS002516	Hexokinase, Lyophilized, Recombinant	HKQLR	10 ku	34
LS002518	Hexokinase, Lyophilized, Recombinant	HKQLR	Bulk	34
LS002544	Histone, Lyophilized	HLY	250 mg	35
LS002546	Histone, Lyophilized	HLY	1 gm	35
LS002548	Histone, Lyophilized	HLY	Bulk	35
LS002559	Peroxidase	HPOD	100 mg	51
LS002560	Peroxidase	HPOD	1 gm	51
LS002561	Peroxidase	HPOD	Bulk	51
LS002591	Hyaluronidase	HSE	Bulk	36
LS002592	Hyaluronidase	HSE	300 ku	36
LS002594	Hyaluronidase	HSE	50 ku	36
LS002598	Cellulase	CEL	250 mg	9
LS002600	Cellulase	CEL	Bulk	9
LS002601	Cellulase	CEL	1 gm	9
LS002603	Cellulase	CEL	10 gm	9
LS002609	Cellulase	CELF	Bulk	9
LS002610	Cellulase	CELF	1 gm	9
LS002611	Cellulase	CELF	10 gm	9
LS002755	Lactate Dehydrogenase, Lyophilized, Recombinant	LADCL	5 ku	38
LS002756	Lactate Dehydrogenase, Lyophilized, Recombinant	LADCL	25 ku	38
LS002757	Lactate Dehydrogenase, Lyophilized, Recombinant	LADCL	Bulk	38
LS002763	Amino Acid Oxidase, L-	LAO	2 mg	3
LS002764	Amino Acid Oxidase, L-	LAO	5 mg	3
LS002766	Amino Acid Oxidase, L-	LAO	Bulk	3
LS002829	Trypsin Inhibitor, Lima Bean	LBI	100 mg	69
LS002830	Trypsin Inhibitor, Lima Bean	LBI	1 gm	69
LS002831	Trypsin Inhibitor, Lima Bean	LBI	Bulk	69
LS002880	Lysozyme	LY	1 gm	39
LS002881	Lysozyme	LY	10 gm	39
LS002883	Lysozyme	LY	Bulk	39
LS002931	Lysozyme, Purified, Salt Free	LYSF	1 gm	39
LS002933	Lysozyme, Purified, Salt Free	LYSF	5 gm	39

Catalog Number Listing

Number	Product	Code	Package	Page
LS002934	Lysozyme, Purified, Salt Free	LYSF	Bulk	39
LS002975	Mucin	MU	100 mg	40
LS002976	Mucin	MU	500 mg	40
LS002978	Mucin	MU	Bulk	40
LS003010	Histone, Nucleo-	NHL	250 mg	45
LS003011	Histone, Nucleo-	NHL	1 gm	45
LS003013	Histone, Nucleo-	NHL	Bulk	45
LS003048	Ovalbumin	OA	5 gm	46
LS003049	Ovalbumin	OA	1 gm	46
LS003050	Ovalbumin	OA	Bulk	46
LS003052	Ovalbumin, Purified	OAC	Bulk	46
LS003054	Ovalbumin, Purified	OAC	1 gm	46
LS003056	Ovalbumin, Purified	OAC	100 mg	46
LS003059	Ovalbumin, LowEndo™, Purified	OAEF	10 mg	46
LS003061	Ovalbumin, LowEndo™, Purified	OAEF	100 mg	46
LS003062	Ovalbumin, LowEndo™, Purified	OAEF	500 mg	46
LS003064	Ovalbumin, LowEndo™, Purified	OAEF	Bulk	46
LS003085	Trypsin Inhibitor, Ovomuroid	OI	500 mg	69
LS003086	Trypsin Inhibitor, Ovomuroid	OI	2 gm	69
LS003087	Trypsin Inhibitor, Ovomuroid	OI	1 gm	69
LS003089	Trypsin Inhibitor, Ovomuroid	OI	Bulk	69
LS003110	Plasma Amine Oxidase	PAO	Bulk	55
LS003113	Plasma Amine Oxidase	PAO	600 un	55
LS003114	Plasma Amine Oxidase	PAO	3 ku	55
LS003118	Papain, Lyophilized	PAPL	25 mg	47
LS003119	Papain, Lyophilized	PAPL	100 mg	47
LS003120	Papain, Lyophilized	PAPL	1 gm	47
LS003122	Papain, Lyophilized	PAPL	Bulk	47
LS003124	Papain, Suspension	PAP	25 mg	46
LS003126	Papain, Suspension	PAP	100 mg	46
LS003127	Papain, Suspension	PAP	1 gm	46
LS003128	Papain, Suspension	PAP	Bulk	46
LS003170	Phosphatase, Alkaline	PC	5 gm	53
LS003171	Phosphatase, Alkaline	PC	1 gm	53
LS003172	Phosphatase, Alkaline	PC	250 mg	53
LS003174	Phosphatase, Alkaline	PC	Bulk	53
LS003317	Pepsin A	PM	10 gm	50
LS003319	Pepsin A	PM	1 gm	50
LS003322	Pepsin A	PM	Bulk	50
LS003431	Ribonuclease A	R	200 mg	62

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Catalog Number Listing

Number	Product	Code	Package	Page
LS003433	Ribonuclease A	R	1 gm	62
LS003435	Ribonuclease A	R	Bulk	62
LS003451	Ribonucleic Acid	RNA	Bulk	65
LS003452	Ribonucleic Acid	RNA	100 mg	65
LS003453	Ribonucleic Acid	RNA	1 gm	65
LS003540	Superoxide Dismutase	SODBE	2 mg	65
LS003541	Superoxide Dismutase	SODBE	10 mg	65
LS003542	Superoxide Dismutase	SODBE	Bulk	65
LS003554	Deoxyribonucleic Acid, Salmon Testes	SDNA	1 gm	25
LS003557	Deoxyribonucleic Acid, Salmon Testes	SDNA	Bulk	25
LS003558	Deoxyribonucleic Acid, Salmon Testes	SDNA	5 gm	25
LS003570	Trypsin Inhibitor, Soybean, Purified, Animal Free	SI	100 mg	69
LS003571	Trypsin Inhibitor, Soybean, Purified, Animal Free	SI	1 gm	69
LS003573	Trypsin Inhibitor, Soybean, Purified, Animal Free	SI	Bulk	69
LS003587	Trypsin Inhibitor, Soybean, Animal Free	SIC	1 gm	69
LS003589	Trypsin Inhibitor, Soybean, Animal Free	SIC	10gm	69
LS003590	Trypsin Inhibitor, Soybean, Animal Free	SIC	Bulk	69
LS003600	Phosphodiesterase II	SPH	Bulk	54
LS003602	Phosphodiesterase II	SPH	25 un	54
LS003603	Phosphodiesterase II	SPH	10 un	54
LS003605	Protease, S. aureus (Endoproteinase Glu-C)	STAP	5 mg	58
LS003606	Protease, S. aureus (Endoproteinase Glu-C)	STAP	Bulk	58
LS003608	Protease, S. aureus (Endoproteinase Glu-C)	STAP	1 mg	58
LS003702	Trypsin	TRL	100 mg	67
LS003703	Trypsin	TRL	1 gm	67
LS003704	Trypsin	TRL	10 gm	67
LS003706	Trypsin	TRL	Bulk	67
LS003707	Trypsin, TRL3	TRL3	1 gm	67
LS003708	Trypsin, TRL3	TRL3	100 mg	67
LS003709	Trypsin, TRL3	TRL3	Bulk	67
LS003734	Trypsin, Filtered	TRLS	5x50 mg	68
LS003736	Trypsin, Filtered	TRLS	50 mg	68
LS003738	Trypsin, Filtered	TRLS	Bulk	68
LS003740	Trypsin, TPCK Treated	TRTPCK	100 mg	67
LS003741	Trypsin, TPCK Treated	TRTPCK	500 mg	67
LS003742	Trypsin, TPCK Treated	TRTPCK	Bulk	67
LS003744	Trypsin, TPCK Treated	TRTPCK	1 gm	67
LS003750	Trypsin, TPCK-Treated, Irradiated	TRTVMF	100 mg	68
LS003752	Trypsin, TPCK-Treated, Irradiated	TRTVMF	5x100 mg	68
LS003789	Polyphenol Oxidase (Tyrosinase)	TY	25 ku	55

Catalog Number Listing

Number	Product	Code	Package	Page
LS003791	Polyphenol Oxidase (Tyrosinase)	TY	Bulk	55
LS003792	Polyphenol Oxidase (Tyrosinase)	TY	100 ku	55
LS003793	Polyphenol Oxidase (Tyrosinase)	TY	500 ku	55
LS003855	Uricase	URYW	Bulk	71
LS003857	Uricase	URYW	100 un	71
LS003885	Urease	URC	250 mg	70
LS003886	Urease	URC	1 gm	70
LS003887	Urease	URC	10 gm	70
LS003889	Urease	URC	Bulk	70
LS003907	Hyaluronic Acid	VHHA	10 mg	36
LS003909	Hyaluronic Acid	VHHA	50 mg	36
LS003910	Hyaluronic Acid	VHHA	100 mg	36
LS003911	Hyaluronic Acid	VHHA	Bulk	36
LS003926	Phosphodiesterase I	VPH	100 un	53
LS003928	Phosphodiesterase I	VPH	Bulk	53
LS003980	Glucose-6-Phosphate Dehydrogenase, Lyophilized	ZFL	10 ku	31
LS003981	Glucose-6-Phosphate Dehydrogenase, Lyophilized	ZFL	1 ku	31
LS003982	Glucose-6-Phosphate Dehydrogenase, Lyophilized	ZFL	Bulk	31
LS003983	Glucose-6-Phosphate Dehydrogenase, Suspension	ZF	500 un	30
LS003985	Glucose-6-Phosphate Dehydrogenase, Suspension	ZF	5 ku	30
LS003987	Glucose-6-Phosphate Dehydrogenase, Suspension	ZF	Bulk	30
LS003992	Glucose-6-Phosphate Dehydrogenase, Suspension	ZFD	900 un	31
LS003993	Glucose-6-Phosphate Dehydrogenase, Suspension	ZFD	9 ku	31
LS003994	Glucose-6-Phosphate Dehydrogenase, Suspension	ZFD	Bulk	31
LS003997	Glucose-6-Phosphate Dehydrogenase, Lyophilized	ZFLD	2 ku	31
LS003998	Glucose-6-Phosphate Dehydrogenase, Lyophilized	ZFLD	18 ku	31
LS003999	Glucose-6-Phosphate Dehydrogenase, Lyophilized	ZFLD	Bulk	31
LS004002	Glucose-6-Phosphate Dehydrogenase, High-Activity, Suspension	ZFDP	1 ku	30
LS004004	Glucose-6-Phosphate Dehydrogenase, High-Activity, Suspension	ZFDP	10 ku	30
LS004006	Glucose-6-Phosphate Dehydrogenase, High-Activity, Suspension	ZFDP	Bulk	30
LS004081	Phosphatase, Alkaline	BAPSF	10 mg	53
LS004082	Phosphatase, Alkaline	BAPSF	Bulk	53
LS004090	Galactosidase, Beta	BG	5 ku	30
LS004093	Galactosidase, Beta	BG	Bulk	30
LS004099	Galactosidase, Beta, Purified	BGC	1 ku	30
LS004100	Galactosidase, Beta, Purified	BGC	5 ku	30
LS004102	Galactosidase, Beta, Purified	BGC	Bulk	30
LS004106	STEMxyme® 1, Collagenase/Neutral Protease, Animal Free	STZ1	50 mg	18
LS004107	STEMxyme® 1, Collagenase/Neutral Protease, Animal Free	STZ1	5x50 mg	18
LS004112	STEMxyme® 2 Collagenase/Neutral Protease, Animal Free	STZ2	50 mg	18

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LS004113	STEMxyme® 2 Collagenase/Neutral Protease, Animal Free	STZ2	5x50 mg	18
LS004118	Collagenase Type A, Filtered, Animal Free	CLSAFAS	50 mg	19
LS004119	Collagenase Type A, Filtered, Animal Free	CLSAFAS	5X50 mg	19
LS004124	Collagenase Type B, Filtered, Animal Free	CLSAFBS	50 mg	18
LS004125	Collagenase Type B, Filtered, Animal Free	CLSAFBS	5x50 mg	19
LS004130	Collagenase Type C, Filtered, Animal Free	CLSAFCS	50 mg	19
LS004131	Collagenase Type C, Filtered, Animal Free	CLSAFCS	5x50 mg	19
LS004138	Collagenase Type C, Animal Free	CLSAFC	100 mg	19
LS004140	Collagenase Type C, Animal Free	CLSAFC	1 gm	19
LS004141	Collagenase Type C, Animal Free	CLSAFC	5 gm	19
LS004143	Collagenase Type C, Animal Free	CLSAFC	Bulk	19
LS004145	Collagenase Type B, Animal Free	CLSAFB	100 mg	19
LS004147	Collagenase Type B, Animal Free	CLSAFB	1 gm	19
LS004148	Collagenase Type B, Animal Free	CLSAFB	5 gm	19
LS004150	Collagenase Type B, Animal Free	CLSAFB	Bulk	19
LS004152	Collagenase Type A, Animal Free	CLSAFA	100 mg	19
LS004154	Collagenase Type A, Animal Free	CLSAFA	1 gm	18
LS004156	Collagenase Type A, Animal Free	CLSAFA	5 gm	18
LS004158	Collagenase Type A, Animal Free	CLSAFA	Bulk	19
LS004160	Collagenase Type D, Animal Free	CLSAFD	100 mg	19
LS004162	Collagenase Type D, Animal Free	CLSAFD	500 mg	19
LS004163	Collagenase Type D, Animal Free	CLSAFD	2500 mg	19
LS004165	Collagenase Type D, Animal Free	CLSAFD	Bulk	19
LS004174	Collagenase, Type 2	CLS-2	100 mg	16
LS004176	Collagenase, Type 2	CLS-2	1 gm	16
LS004177	Collagenase, Type 2	CLS-2	5 gm	16
LS004179	Collagenase, Type 2	CLS-2	Bulk	16
LS004180	Collagenase, Type 3	CLS-3	100 mg	16
LS004182	Collagenase, Type 3	CLS-3	1 gm	16
LS004183	Collagenase, Type 3	CLS-3	5 gm	16
LS004185	Collagenase, Type 3	CLS-3	Bulk	16
LS004186	Collagenase, Type 4	CLS-4	100 mg	16
LS004188	Collagenase, Type 4	CLS-4	1 gm	16
LS004189	Collagenase, Type 4	CLS-4	5 gm	16
LS004191	Collagenase, Type 4	CLS-4	Bulk	16
LS004194	Collagenase, Type 1	CLS-1	100 mg	16
LS004196	Collagenase, Type 1	CLS-1	1 gm	16
LS004197	Collagenase, Type 1	CLS-1	5 gm	16
LS004200	Collagenase, Type 1	CLS-1	Bulk	16
LS004202	Collagenase, Type 2, Filtered	CLSS-2	50 mg	17

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LS004204	Collagenase, Type 2, Filtered	CLSS-2	5x50 mg	17
LS004205	Collagenase, Type 2, Filtered	CLSS-2	1 gm	17
LS004206	Collagenase, Type 3, Filtered	CLSS-3	50 mg	17
LS004208	Collagenase, Type 3, Filtered	CLSS-3	5x50 mg	17
LS004209	Collagenase, Type 4, Filtered	CLSS-4	1 gm	17
LS004210	Collagenase, Type 4, Filtered	CLSS-4	50 mg	17
LS004212	Collagenase, Type 4, Filtered	CLSS-4	5x50 mg	17
LS004214	Collagenase, Type 1, Filtered	CLSS-1	50 mg	17
LS004216	Collagenase, Type 1, Filtered	CLSS-1	5x50 mg	17
LS004217	Collagenase, Type 1, Filtered	CLSS-1	1 gm	17
LS004228	Phosphatase, Alkaline, Purified	CAP	1 mg	52
LS004230	Phosphatase, Alkaline, Purified	CAP	5 mg	52
LS004234	Phosphatase, Alkaline, Purified	CAP	Bulk	52
LS004248	Proteinase K, Recombinant, Animal Free	PROKR	25 mg	59
LS004249	Proteinase K, Recombinant, Animal Free	PROKR	100 mg	59
LS004250	Proteinase K, Recombinant, Animal Free	PROKR	1 gm	59
LS004252	Proteinase K, Recombinant, Animal Free	PROKR	Bulk	59
LS004254	Proteinase K, Recombinant, Solution, Animal Free	PROKRS	5 ml	59
LS004256	Proteinase K, Recombinant, Solution, Animal Free	PROKRS	25 ml	59
LS004258	Proteinase K, Recombinant, Solution, Animal Free	PROKRS	Bulk	59
LS004296	Pectinase	PASE	Bulk	50
LS004297	Pectinase	PASE	250 mg	50
LS004298	Pectinase	PASE	1 gm	50
LS004326	Diaphorase	DILW	Bulk	27
LS004327	Diaphorase	DILW	1 ku	27
LS004330	Diaphorase	DIL	2 ku	27
LS004333	Diaphorase	DIL	Bulk	27
LS004449	Deoxyribonucleic Acid, E. coli	DNAEC	10 mg	26
LS004451	Deoxyribonucleic Acid, E. coli	DNAEC	Bulk	26
LS004452	Trypsin, Sterile, Irradiated	TRLVMF	5x100 mg	68
LS004454	Trypsin, Sterile, Irradiated	TRLVMF	100 mg	68
LS004520	Galactose Oxidase	GAO	150 un	29
LS004522	Galactose Oxidase	GAO	450 un	29
LS004523	Galactose Oxidase	GAO	Bulk	29
LS004524	Galactose Oxidase	GAO	1 ku	29
LS004759	Neuraminidase, Purified	NEUA	5 un	43
LS004760	Neuraminidase, Purified	NEUA	Bulk	43
LS004761	Neuraminidase, Purified	NEUA	10 un	43
LS004762	Neuraminidase, Purified	NEUA	25 un	43
LS004777	Neuraminidase	NEUP	Bulk	43

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LS004779	Neuraminidase	NEUP	4 mg	43
LS004780	Neuraminidase	NEUP	10 mg	43
LS004796	Nuclease, Micrococcal	NFCP	Bulk	44
LS004797	Nuclease, Micrococcal	NFCP	15 ku	44
LS004798	Nuclease, Micrococcal	NFCP	45 ku	44
LS004908	Hydroxysteroid Dehydrogenase	STDHMP	10 un	37
LS004910	Hydroxysteroid Dehydrogenase	STDHMP	50 un	37
LS004911	Hydroxysteroid Dehydrogenase	STDHMP	Bulk	37
LS004915	Hydroxysteroid Dehydrogenase	STDH	1 gm	37
LS004916	Hydroxysteroid Dehydrogenase	STDH	5 gm	37
LS004918	Hydroxysteroid Dehydrogenase	STDH	Bulk	37
LS004922	Hydroxysteroid Dehydrogenase	STDHP	Bulk	37
LS004964	Tyrosine Decarboxylase	TYD	Bulk	70
LS004966	Tyrosine Decarboxylase	TYD	25 un	70
LS004968	Tyrosine Decarboxylase, Apoenzyme	TYDAPO	250 mg	70
LS004970	Tyrosine Decarboxylase, Apoenzyme	TYDAPO	1 gm	70
LS004973	Tyrosine Decarboxylase, Apoenzyme	TYDAPO	Bulk	70
LS005129	Phosphatase, Alkaline	BAPC	5 mg	53
LS005130	Phosphatase, Alkaline	BAPC	10 mg	53
LS005131	Phosphatase, Alkaline	BAPC	Bulk	53
LS005273	Collagenase, Purified	CLSPA	10 ku	16
LS005275	Collagenase, Purified	CLSPA	4 ku	16
LS005277	Collagenase, Purified	CLSPA	Bulk	16
LS005280	Collagenase, Type 5	CLS-5	100 mg	16
LS005282	Collagenase, Type 5	CLS-5	1 gm	16
LS005283	Collagenase, Type 5	CLS-5	5 gm	16
LS005284	Collagenase, Type 5	CLS-5	Bulk	16
LS005286	Collagenase, Type 5, Filtered	CLSS-5	50 mg	17
LS005287	Collagenase, Type 5, Filtered	CLSS-5	5 x 50 mg	17
LS005288	Collagenase, Type 5, Filtered	CLSS-5	1 gm	17
LS005290	Collagenase, Purified, Animal Free	CLSAFP	4 ku	18
LS005292	Collagenase, Purified, Animal Free	CLSAFP	10 ku	18
LS005294	Collagenase, Purified, Animal Free	CLSAFP	Bulk	18
LS005301	Carboxypeptidase B	COBC	10 mg	4
LS005302	Carboxypeptidase B	COBC	Bulk	4
LS005304	Carboxypeptidase B	COBC	50 mg	4
LS005305	Carboxypeptidase B	COBC	5 mg	4
LS005318	Collagenase, Type 6	CLS-6	100 mg	17
LS005319	Collagenase, Type 6	CLS-6	500 mg	17
LS005321	Collagenase, Type 6	CLS-6	2.5 gm	17

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LS005323	Collagenase, Type 6	CLS-6	Bulk	17
LS005332	Collagenase, Type 7	CLS-7	100 mg	17
LS005333	Collagenase, Type 7	CLS-7	500 mg	17
LS005335	Collagenase, Type 7	CLS-7	2.5 gm	17
LS005337	Collagenase, Type 7	CLS-7	Bulk	17
LS005410	Deoxyribonuclease II, Purified	HDAC	20 ku	24
LS005411	Deoxyribonuclease II, Purified	HDAC	Bulk	24
LS005416	Deoxyribonuclease II, Purified, Solution	HDACS	2 ku	24
LS005418	Deoxyribonuclease II, Purified, Solution	HDACS	5 ku	24
LS005420	Deoxyribonuclease II, Purified, Solution	HDACS	Bulk	24
LS005474	Hyaluronidase, Purified	HSEP	30 ku	36
LS005475	Hyaluronidase, Purified	HSEP	15 ku	36
LS005477	Hyaluronidase, Purified	HSEP	5 ku	36
LS005479	Hyaluronidase, Purified	HSEP	Bulk	36
LS005622	Chymotrypsinogen A, Purified	CGC	Bulk	11
LS005623	Chymotrypsinogen A, Purified	CGC	5 gm	11
LS005630	Chymotrypsinogen A, Purified	CGC	1 gm	11
LS005649	Ribonuclease A, Purified	RAF	25 mg	61
LS005650	Ribonuclease A, Purified	RAF	100 mg	61
LS005655	Ribonuclease A, Purified	RAF	Bulk	61
LS005660	Phospholipase A2	PLA	1 mg	54
LS005662	Phospholipase A2	PLA	Bulk	54
LS005677	Ribonuclease A, Purified Solution	RASE	25 mg	61
LS005679	Ribonuclease A, Purified Solution	RASE	100 mg	61
LS005681	Ribonuclease A, Purified Solution	RASE	Bulk	61
LS005710	Ribonuclease B	RB	100 mg	62
LS005715	Ribonuclease B	RB	Bulk	62
LS006122	Phosphatase, Alkaline, Purified	BAPF	Bulk	52
LS006123	Phosphatase, Alkaline, Purified	BAPF	25 mg	52
LS006124	Phosphatase, Alkaline, Purified	BAPF	5 mg	52
LS006130	Phosphatase, Alkaline, Purified	BAPF	1 mg	52
LS006308	Amino Acid Oxidase, D-	DAOFF	25 mg	3
LS006310	Amino Acid Oxidase, D-	DAOFF	5 mg	3
LS006311	Amino Acid Oxidase, D-	DAOFF	Bulk	3
LS006320	Deoxyribonuclease I, Recombinant, Bioprocess Grade, Animal Free	DR2	25 ku	23
LS006322	Deoxyribonuclease I, Recombinant, Bioprocess Grade, Animal Free	DR2	100 ku	23
LS006323	Deoxyribonuclease I, Recombinant, Bioprocess Grade, Animal Free	DR2	500 ku	23
LS006325	Deoxyribonuclease I, Recombinant, Bioprocess Grade, Animal Free	DR2	Bulk	23
LS006328	Deoxyribonuclease I	DPFF	125 ku	21
LS006330	Deoxyribonuclease I	DPFF	25 ku	21

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LS006331	Deoxyribonuclease I, RNase & Protease Free	DPRF	2500 un	21
LS006332	Deoxyribonuclease I	DFFF	Bulk	21
LS006333	Deoxyribonuclease I, RNase & Protease Free	DPRF	10 ku	21
LS006334	Deoxyribonuclease I, RNase & Protease Free	DPRF	Bulk	21
LS006342	Deoxyribonuclease I, RNase & Protease Free, Solution	DPRFS	100 un	21
LS006343	Deoxyribonuclease I, RNase & Protease Free	DPRF	50 ku	21
LS006344	Deoxyribonuclease I, RNase & Protease Free, Solution	DPRFS	500 un	21
LS006348	Deoxyribonuclease I, RNase & Protease Free, Solution	DPRFS	Bulk	21
LS006353	Deoxyribonuclease I, Recombinant, Solution, Animal Free	DR1S	2 ku	23
LS006355	Deoxyribonuclease I, Recombinant, Solution, Animal Free	DR1S	5x2 ku	23
LS006357	Deoxyribonuclease I, Recombinant, Solution, Animal Free	DR1S	Bulk	23
LS006360	Deoxyribonuclease I, Recombinant, Animal Free	DR1	Bulk	23
LS006361	Deoxyribonuclease I, Recombinant, Animal Free	DR1	10 ku	23
LS006362	Deoxyribonuclease I, Recombinant, Animal Free	DR1	50 ku	23
LS006363	Elastase, Purified	ESFF	5 mg	28
LS006365	Elastase, Purified	ESFF	20 mg	28
LS006367	Elastase, Purified	ESFF	Bulk	28
LS006472	Peroxidase, EIA Grade, Purified	HPOFF	Bulk	51
LS006474	Peroxidase, EIA Grade, Purified	HPOFF	5 ku	51
LS006476	Peroxidase, EIA Grade, Purified	HPOFF	50 ku	51
LS008736	Micrococcus lysodeikticus Cells	ML	5 gm	39
LS008737	Micrococcus lysodeikticus Cells	ML	25 gm	39
LS008739	Micrococcus lysodeikticus Cells	ML	Bulk	39
LS009043	Adenosine Deaminase	ADA	250 un	1
LS009044	Adenosine Deaminase	ADA	Bulk	1
LS009068	Carboxypeptidase Y	COY	5 mg	5
LS009070	Carboxypeptidase Y	COY	1 mg	5
LS009071	Carboxypeptidase Y	COY	Bulk	5
LS01120	DNA Cellulose, Double-Stranded	DNACELDS	1 gm	25
LS01122	DNA Cellulose, Double-Stranded	DNACELDS	5 gm	25
LS01124	DNA Cellulose, Double-Stranded	DNACELDS	Bulk	25
LS01130	DNA Cellulose, Single-Stranded	DNACELSS	1 gm	25
LS01132	DNA Cellulose, Single-Stranded	DNACELSS	5 gm	25
LS01134	DNA Cellulose, Single-Stranded	DNACELSS	Bulk	25
LS01200	Deoxyribonucleic Acid, Lambda	DNAL	Bulk	26
LS01203	Deoxyribonucleic Acid, Lambda	DNAL	500 ug	26
LS01206	Deoxyribonucleic Acid, Lambda	DNAL	4 x 500 ug	26
LS01290	Deoxyribonucleic Acid, Lambda, EcoR I Fragments	DNALCOR	Bulk	27
LS01293	Deoxyribonucleic Acid, Lambda, EcoR I Fragments	DNALCOR	100 ug	27
LS01296	Deoxyribonucleic Acid, Lambda, EcoR I Fragments	DNALCOR	5x100 ug	27

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LS01300	Deoxyribonucleic Acid, Lambda, Hind III Fragments	DNALHIND	Bulk	27
LS01303	Deoxyribonucleic Acid, Lambda, Hind III Fragments	DNALHIND	100 ug	27
LS01306	Deoxyribonucleic Acid, Lambda, Hind III Fragments	DNALHIND	5x100 ug	27
LS01430	Deoxyribonucleic Acid, Lambda, BstE II Fragments	DNALBSTE	100 ug	26
LS01432	Deoxyribonucleic Acid, Lambda, BstE II Fragments	DNALBSTE	5x100 ug	26
LS01434	Deoxyribonucleic Acid, Lambda, BstE II Fragments	DNALBSTE	Bulk	26
LS01440	Deoxyribonucleic Acid, Denatured, Fragmented	SDNAD	10 ml	26
LS01442	Deoxyribonucleic Acid, Denatured, Fragmented	SDNAD	5x10 ml	26
LS01444	Deoxyribonucleic Acid, Denatured, Fragmented	SDNAD	Bulk	26
LS01485	Ribonuclease T1, Chromatographically Purified, Animal Free	RT1S	100 ku	63
LS01487	Ribonuclease T1, Chromatographically Purified, Animal Free	RT1S	500 ku	63
LS01488	Ribonuclease T1, Chromatographically Purified, Animal Free	RT1S	Bulk	63
LS01490	Ribonuclease T1, Chromatographically Purified, Lyophilized	RT1L	500 ku	63
LS01492	Ribonuclease T1, Chromatographically Purified, Lyophilized	RT1L	2500 ku	63
LS01494	Ribonuclease T1, Chromatographically Purified, Lyophilized	RT1L	Bulk	63
LS01501	Ribonuclease T2, Recombinant, Animal Free	RT2R	50 ku	64
LS01502	Ribonuclease T2, Recombinant, Animal Free	RT2R	250 ku	64
LS01505	Ribonuclease T2, Recombinant, Animal Free	RT2R	Bulk	64
LS01506	Ribonuclease A, Recombinant, DNase and Protease Free, Animal Free	RRA1	10 ku	62
LS01508	Ribonuclease A, Recombinant, DNase and Protease Free, Animal Free	RRA1	25 ku	62
LS01510	Ribonuclease A, Recombinant, DNase and Protease Free, Animal Free	RRA1	Bulk	62
LS01512	Ribonuclease A, Recombinant, Bioprocess Grade, Animal Free	RRA2	100 mg	62
LS01514	Ribonuclease A, Recombinant, Bioprocess Grade, Animal Free	RRA2	1 gm	62
LS01516	Ribonuclease A, Recombinant, Bioprocess Grade, Animal Free	RRA2	Bulk	62
LS02100	Neutral Protease (Dispase®), Purified, Animal Free	NPRO	10 mg	44
LS02104	Neutral Protease (Dispase®), Purified, Animal Free	NPRO	50 mg	44
LS02106	Neutral Protease (Dispase®), Purified, Animal Free	NPRO	250 mg	44
LS02108	Neutral Protease (Dispase®), Purified, Animal Free	NPRO	Bulk	44
LS02109	Neutral Protease, Partially Purified, Animal Free	NPRO2	1 gm	44
LS02110	Neutral Protease, Partially Purified, Animal Free	NPRO2	100 mg	44
LS02111	Neutral Protease, Partially Purified, Animal Free	NPRO2	5 gm	44
LS02112	Neutral Protease, Partially Purified, Animal Free	NPRO2	Bulk	44
LS02115	Trypsin, Purified, Sequencing Grade II	TRSEQII	4x25 ug	67
LS02117	Trypsin, Purified, Sequencing Grade II	TRSEQII	4x100 ug	67
LS02118	Trypsin, Purified, Sequencing Grade II	TRSEQII	Bulk	67
LS02119	Trypsin, Purified, Sequencing Grade II	TRSEQII	1 mg	67
LS02120	Trypsin, Modified, SequENZ® Sequencing Grade	TRSEQZ	4x25 ug	66
LS02122	Trypsin, Modified, SequENZ® Sequencing Grade	TRSEQZ	4x100 ug	66
LS02123	Trypsin, Modified, SequENZ® Sequencing Grade	TRSEQZ	1 mg	66
LS02124	Trypsin, Modified, SequENZ® Sequencing Grade	TRSEQZ	Bulk	66

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LS02126	Protease, S. aureus, Sequencing Grade	STSEQ	5x10 ug	58
LS02128	Protease, S. aureus, Sequencing Grade	STSEQ	5x50 ug	58
LS02129	Protease, S. aureus, Sequencing Grade	STSEQ	Bulk	58
LS02130	Chymotrypsin, Alpha, TLCK Treated, Sequencing Grade	CDSEQ	4x25 ug	10
LS02132	Chymotrypsin, Alpha, TLCK Treated, Sequencing Grade	CDSEQ	4x100 ug	10
LS02135	Clostripain (Endoproteinase-Arg-C) Sequencing Grade	CPSEQ	10 ug	12
LS02139	Clostripain (Endoproteinase-Arg-C) Sequencing Grade	CPSEQ	Bulk	12
LS02143	Endoproteinase Lys-C, Sequencing Grade	LYSCSEQ	20 ugP	29
LS02144	Endoproteinase Lys-C, Sequencing Grade	LYSCSEQ	5x20 ugP	29
LS02145	Endoproteinase Lys-C, Sequencing Grade	LYSCSEQ	Bulk	29
LS02150	SequENZ® Trypsin, Modified Sequencing Grade, Solution	TRSEQZS	250 ug	66
LS02152	SequENZ® Trypsin, Modified Sequencing Grade, Solution	TRSEQZS	1000 ug	66
LS02155	SequENZ® Trypsin, Modified Sequencing Grade, Solution	TRSEQZS	Bulk	66
LS04070	Nuclease, S1	SINUC	10 ku	45
LS04072	Nuclease, S1	SINUC	50 ku	45
LS04073	Nuclease, S1	SINUC	Bulk	45
LS05000	Reverse Transcriptase, Recombinant, HIV	RTHIV	Bulk	60
LS05003	Reverse Transcriptase, Recombinant, HIV	RTHIV	200 un	60
LS05006	Reverse Transcriptase, Recombinant, HIV	RTHIV	5x200 un	60
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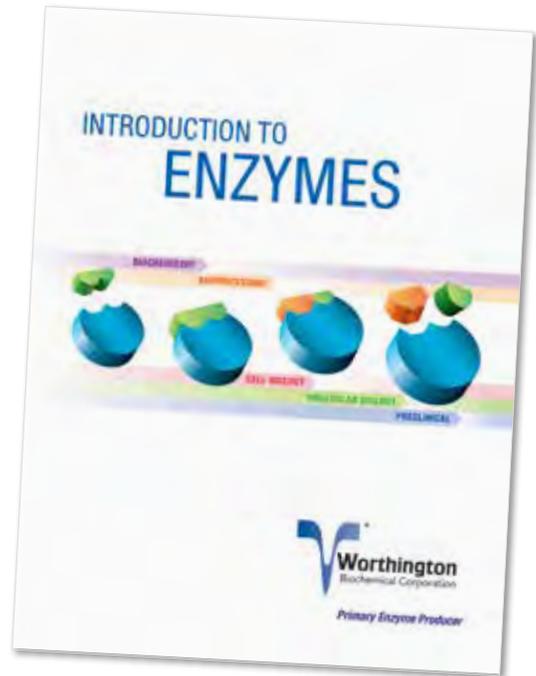


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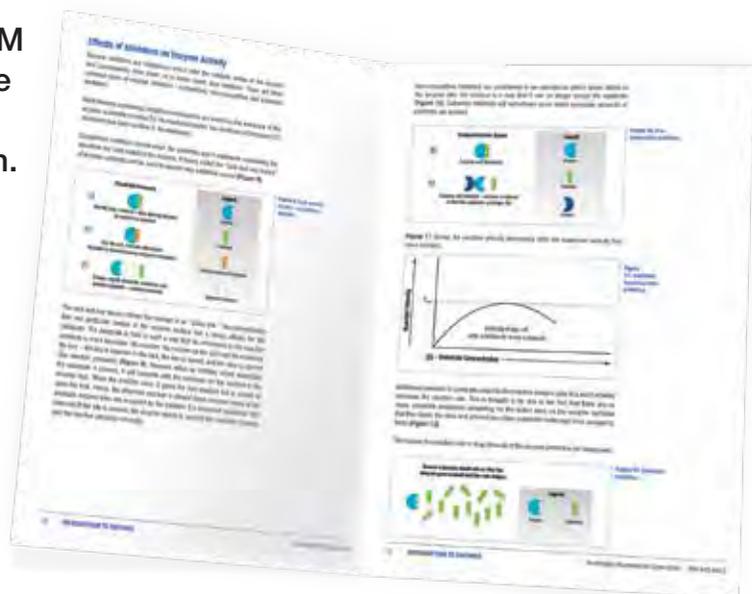
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Austria:

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A-1150 Wien (Vienna), Austria
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Website: <https://www.eubio.at>
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Belgium:

GESTIMED s.p.r.l./b.v.b.a.

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1160 Bruxelles/Brussels, Belgium
Telephone: 02 672 26 02
Fax: 02 672 26 02
Website: <https://www.gestimed.be>
Email: info@gestimed.be

Brazil:

Sellex

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205 / 1105
04562-030
Sao Paulo SP, Brazil
Telephone: (011) 5506-4646
Website: <https://www.sellex.com>
Email: vendas@sellex.com

Sinapse Biotecnologia Ltda

Rua Barra Bonita, 149
Sao Paulo SP, Brazil
Telephone: 11 2605-5655
Fax: 11 2605-5655
Website: <https://www.sinapsebiotecnologia.com.br>

Canada:

Canadian Customers may contact us directly:

Worthington Biochemical Corporation

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Website: <https://www.worthington-biochem.com>
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Cedarlane

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Burlington, Ontario L7L 5R2, Canada
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Fax: 289-288-0020
Website: <https://www.cedarlanelabs.com>
Email: general@cedarlanelabs.com

Chile:

Fermelo S.A.

Terranova 150
Providencia, 7501003, Chile
Telephone: 2 2247-2976
Fax: 2 2247-2978
Website: <https://www.fermelo.cl>
Email: contacto@fermelo.cl

China:

Amyjet Scientific, Inc.

13/F, Block 1, Harbour of Technology
Times No. 35, Optical Valley Ave.
Wuhan, Hubei, China 1430074
Toll-Free: 400-6800-868
Telephone: +86-0270-59626688
Fax: +86-027059716800
WeChat: 13797054060
Website: <https://www.amyjet.com>
Email: sales@amyjet.com

China:

4A Biotech Company, Ltd.

Room 802, Incubation Center,
No. 88 KeChuang 6th St., Beijing Economic-
Technological Development Area
Beijing, China 101111
Telephone:0086 10 56315211 0
Fax:0086 10 56315212
Website: <https://www.4aBio.com>
Email: info@4aBio.com

Biohub International Trade Co., Ltd.

Chuansha Rd # 6619, Pudong
Shanghai 201200 P.R.C.
Telephone:0086 021 50724187
Fax:0086 021 50724961
Website: <https://www.qfbio.com>
Email: sale3@78bio.com

EQUL Ltd.

Yunjin Road 500-A809, Xuhui
Shanghai, China 200232
Telephone:021-64280805
WeChat: 18930649931, 17701670025
QQ: 1503639923, 1938800732
Website: <https://www.equl.cn>
Email: info@equl.cn

Gene Company Ltd.

Unit A, 8/F Shell Industrial Building
12 Lee Chung Street
Chai Wan, Hong Kong
R.O.C.
Telephone:.....852 2896-6283
Fax:.....852 2515-9371
Website: <https://www.genehk.com>
Email: info@genehk.com

Genetimes Excell Technology, Inc.

Unit 501, Building 18
No. 481 Guiping Road
Shanghai, P.R. China
Zip: 200233
Telephone: (021) 33676611
Fax: (021) 33676258
Website: <https://www.genetimes.com.cn>
Email: order@genetimes.com.cn

China:

MACGENE (Beijing) Biotechnology Ltd.

Yue-Hue-Xuan, Suite 910
#2, Bei-Tai-Ping-Zhuang Road
Hai Dian District
Beijing, China 100088
Telephone: (010) 8205-7786
Fax:..... (010) 8205-9875
Website: <https://www.macgene.com>
Email: order@macgene.com

Shanghai Universal BioTech Co., Ltd.

Building No. 16, New Wealth Park
No. 15 Gudan Road
Shanghai, China 201314
Telephone: 86-21-3893 9000
Fax: 86-21-3801 5116
Website: <https://www.univ-bio.com>
Email: purchasing@univ-bio.com

Denmark:

BioNordika (Denmark) A/S

Marielundvej 48, 1tv
DK-2730 Herlev
Denmark
Telephone:.....45 3956 2000
Fax:45 3956 1942
Website: <https://www.bionordika.dk>
Email: info@bionordika.dk

Finland:

BioNordika Finland OY

Kutomotie 18
00380 Helsinki
Finland
Telephone:..... +358 20 7410 270
Fax: +358 20 7410 277
Website: <https://www.bionordika.fi>
Email: info@bionordika.fi

Sigma-Aldrich Finland OY

Keilaranta 6
02150 Espoo
Finland
Telephone:..... +358 9 3509250
Fax: +46-8-7424243
Email: NordicOrder@sial.com

France:

Serlabo Technologies

1914 Route d'Avignon
84320 Entraigues, France
Telephone: +33 4 90 23 77 20
Fax: +33 4 90 23 77 30
Website: <https://www.serlabo.fr>
Email: baudet@serlabo.fr

Germany:

CellSystems GmbH

Junkersring 5
53844 Troisdorf, Germany
Telephone: (0) 2241-25515-0
Fax: (0) 2241-25515-30
Website: <https://www.cellsystems.de>
Email: info@cellsystems.de

Hong Kong:

Gene Company, Ltd.

Unit A, 8/F, Shell Industrial Bldg
12 Lee Chung Street
Chai Wan, Hong Kong
Telephone: 852 2896-6283
Fax: 852 2515-9371
Website: <https://www.genehk.com>
Email: info@genehk.com

Line Analytics Life Sciences, Ltd.

8/F Eastwood Centre
5 A Kung Ngam Village Road
Shaukeiwan, Hong Kong
Telephone: (852) 2578 5839
Fax: (852) 2807 2674
Website: <https://www.hcdl.hcdh.com.hk>
Email: sales.lals@hcdh.com.hk

India:

Arun & Company

702/B Polaris, 6th Floor
Off Marol Maroshi Road
Behind Sangeet Plaza, Marol, Andheri (East)
Mumbai 400059, India
Telephone: +91 22 67723000
Fax: +91 22 67253399
Website: <https://www.arunandco.com>
Email: diagnostics@zytex.com

India:

Rahesh & Company

602/B Polaris Off Marol Maroshi Road
Marol, Andheri (East)
Mumbai 400059, India
Telephone: +91 22 67723000
Fax: +91 22 67253399
Website: <https://www.arunandco.com>
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Indonesia:

CV Gamma Scientific Biolab

Jl. Bandara Abd Saleh GF No. 29
Malang 65138
Jawa Timur, Indonesia
Telephone: +62 81 79628475; 62
Fax: +62 341 717703
Website: <https://www.gammascientificbiolab.co.id>
Email: gammascientific@gmail.com

PT Genetika Science Indonesia

Ruko Puri Mansion Blok A no. 19
Jl. Lingkar Luar Barat, Kembangan
Jakarta Barat 11610
Telephone: +62-21-29866875
Fax: +62-21-29866879
Website: <https://www.ptgenetika.com>
Email: info@ptgenetika.com

Israel:

Enco Scientific Services, Ltd.

17 Mivtza Kadash Street
Petach Tiqva
POB 8009
Petach Tiqva 4918001, Israel
Telephone: 3 9349922
Fax: 3 9349876
Website: <https://www.enco.co.il>
Email: info@enco.co.il

Italy:

D.B.A. Italia, s.r.l.

Via Umbria 10
20090 Segrate (Milano), Italy
Telephone:02 269 22300
Fax:02 269 26058/23535
Website: <https://www.dbaitalia.it>
Email: info@dbaitalia.it

Japan:

Funakoshi Company, Ltd.

9-7, Hongo 2-Chrome,
Bunkyo-ku
Tokyo 113-0033, Japan
Telephone:03 5684 1620
Fax:03 5684 1775
Website: <https://www.funakoshi.co.jp>
Email: reagent@funakoshi.co.jp

Jordan:

Genetics Company for Biotechnology (EI Weratha)

Wasfi El Tal Street, Burj Sharaf El Hayajneh
Bldg # 195 - 7th Floor
Amman 11953 Jordan
Telephone:+962 6 5536402
Fax:+962 6 5536398
Website: <https://www.genetics-jo.com>
Email: sales@genetics-jo.com

Malaysia:

BioSynTech Malaysia Group Sdn. Bhd.

BioSyntech Malaysia Group Sdn
Revongen Corporation Center
Level 17, Top Glove Tower
No. 16 Persiaran Setia Dagang
Setia Alam, Seksyen U13, 40170
Shah Ala
Telephone: +6 03 3359 1166
Fax: +6 03 3358 0303
Website: <https://www.bstmgroup.com>
Email: info@bstmgroup.com

Malaysia:

Essen-Haus Sdn. Bhd.

CT-10-12 Corporate Tower,
Subang Square,
Jalan SS15/4G,
47500 Subang Jaya,
Selangor, Malaysia
Telephone:03 5631 0273
Fax:03 5631 0068
Email: sales@essen-haus.com.my

i-DNA Biotechnology (M) Sdn. Bhd.

A-1-6, Pusat Perdagangan
Kuchai,
No. 2, Jalan 1/127, Off Jalan
Kuchai Lama
58200 Kuala Lumpur
Malaysia
Telephone: (03) 7982 0322
Fax: (03) 7987 4566
Website: <https://www.i-dna.com.my>
Email: sales@i-dna.com.my

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Rancho Sandoval
Tecate 21430
B.C.
Mexico
Telephone: 52 (665) 521-2151
Fax: 52 (665) 521-2151
Email: ventas@paralaciencia.com

Netherlands:

Antonides

De Hagen 12
8325 DB Vollenhove
The Netherlands
Telephone: +31 (0) 88-1885500
Fax: +31 (0) 88-1885599
Website: <https://www.antonides.com>
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Norway:

Nerliens Meszansky AS

Okernveien 121
0579 Oslo, Norway
Telephone: + 47 22 666500
Fax: + 47 22 666501
Website: <https://www.nmas.no>
Email: info@nmas.no

Portugal:

LabClinics, S.A.

c/Industria 54
08025 Barcelona
Spain
Telephone:93 446 4700
Fax:93 348 1039
Website: <https://www.labclinics.com>
Email: info@labclinics.com

Singapore:

i-DNA Biotechnology (M) Sdn Bhd

237 Pandan Loop
#07-08 Westech Building
Singapore 128424
Telephone:+65 6779 0665
Fax:+65 6776 0368
Website: <https://www.i-dna.sg>
Email: info@i-dna.sg

South Korea:

Chayon Laboratories, Inc.

22 Yeoksam-ro 7-gil
Gangnam-ku,
Seoul 06244, Korea
Telephone:82 2 3471 4100
Fax:82 2 3471 0040
Website: <https://www.chayon.co.kr>
Email: info@chayon.co.kr

Dong In Biotech Co., Ltd.

459, Ogeum-ro, Songpa-gu
Seoul 05743, Rep. of Korea
Telephone: +82-2-431-7375
Website: <https://www.donginbio.com>
Email: info@donginbio.com

South Korea:

Kim & Friends, Inc.

SK Twintech Tower B-304
345-9 Gasan-dong
Geumcheon-gu, Seoul 08589, Korea
Telephone:..... 82-2-26747-6611
Fax:..... 82-2-2647-6687
Website: <https://www.kimnfriends.co.kr>
Email: kimnfriends@hanmail.net

South Korea:

LRS Laboratories, Inc.

1011 Ho, Biz center
190-1 Sangdaewondong, Jungwon-gu
Songnam-shi, Kyunggi-do 462-807, Korea
Telephone:..... +82-31-776-2741
Fax:..... +82-31-776-2740
Website: <https://www.lrslab.co.kr>
Email: info@lrslab.co.kr

Spain:

LabClinics, S.A.

c/Industria 54
08025 Barcelona
Spain
Telephone:93 446 4700
Fax:93 348 1039
Website: <https://www.labclinics.com>
Email: info@labclinics.com

Sweden:

BioNordika (Sweden) AB

Norrbackagatan 47A
SE-113 34 Stockholm
Sweden
Telephone:..... 08 306010
Fax:08 306015
Website: <https://www.bionordika.se>
Email: info@bionordika.se

Switzerland:

BioConcept

Paradiesrain 14
Postfach 427
4123 Allschwil 1
Switzerland
Telephone:..... 061 486 80 80
Fax:061 486 80 00
Website: <https://www.bioconcept.ch>
E-mail: info@bioconcept.ch

Taiwan:

Integrated Bio LTD

6F-3, No. 800
Zhongzheng Road
Zhonghe Dist., New Taipei City
Taiwan 23586
R.O.C.
Telephone: +886-2-8221-8898
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Website: <https://www.integrated-bio.com>
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Thailand:

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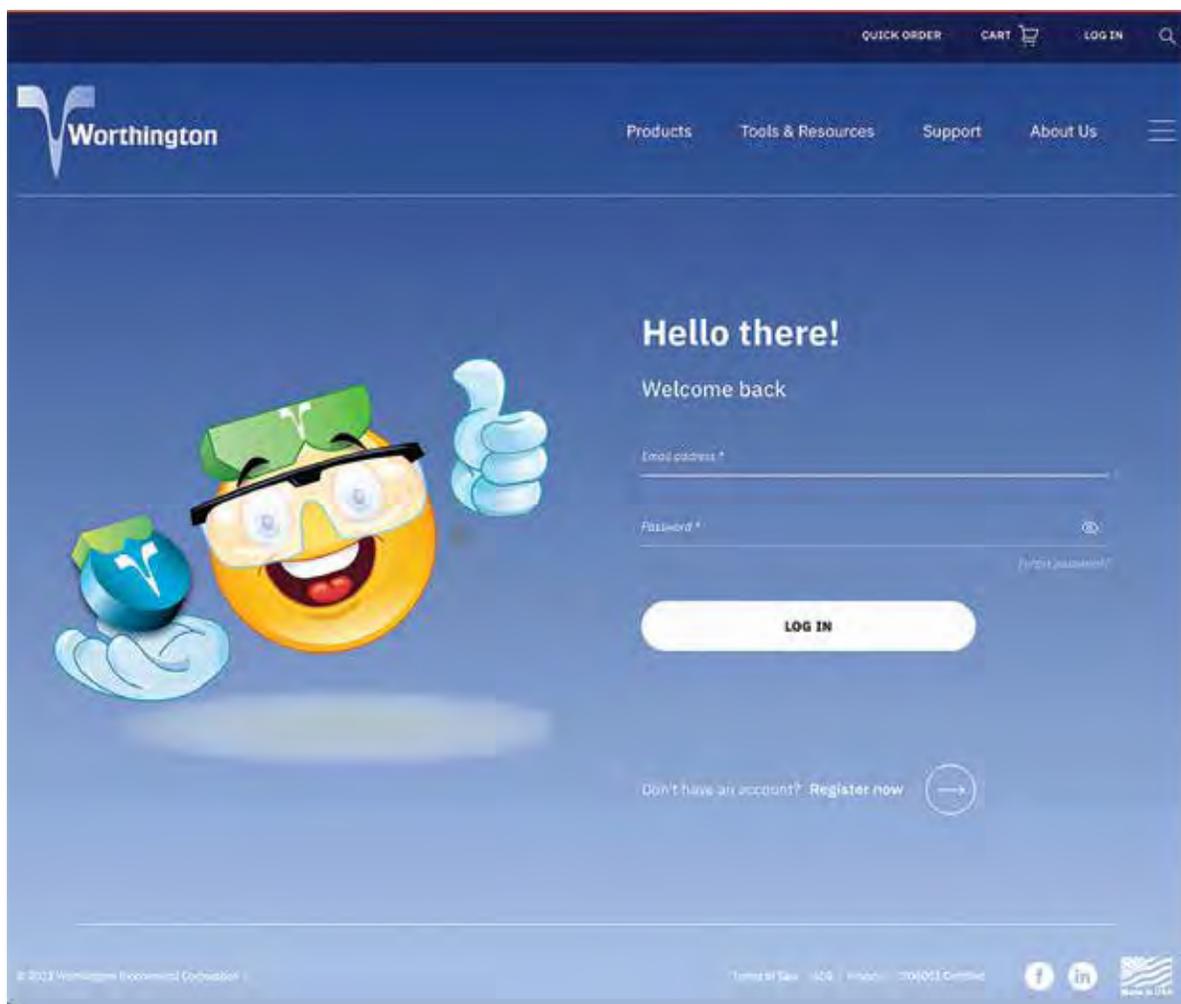
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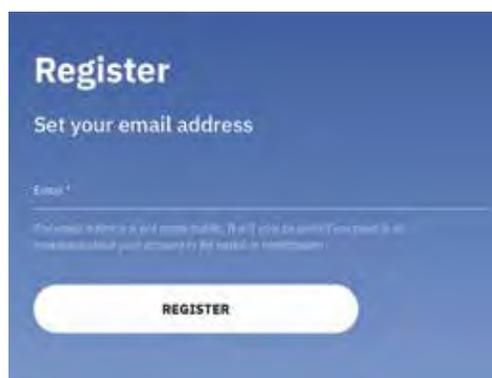
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