Derivatization Reagents

Acylation Reagents

Acylation Reagents

Acylation, an alternative to silylation, is the conversion of compounds that contain active hydrogens (-OH, -SH and -NH) into esters, thioesters, and amides through the action of a carboxylic acid or derivative. The presence of a carbonyl group adjacent to halogenated carbons enhances electron capture detector (ECD) response.

Acylation has many benefits:

- It improves stability of compounds by protecting unstable groups.
- It may confer volatility on substances such as carbohydrates or amino acids, which have so many polar groupings that they are n and normally decompose on heating.
- It assists in separations not possible with underivatized compounds.
- Compounds are detectable at very low levels with an ECD.

Perfluoro Acid Anhydrides – Acylation reduces the polarity of amino, hydroxyl, and thiol groups to form perfluoroacyl derivatives, which are both stable and highly volatile. Fluorinated anhydride derivatives are used primarily for ECD, but also can be used for flame ionization detection (FID). They react with alcohols, phenols, and amines to produce stable derivatives. Fluorinated anhydrides are used in derivatizing samples for drug of abuse confirmation.

The anhydrides and acyl halide reagents form acid byproducts, which must be removed in GC analysis to prevent destructive effec the column. Acylations with anhydride reagents are normally performed in pyridine, tetrahydrofuran, or some other solvent capable of accepting the acid byproduct. Amine bases also may be used as catalysts/acid acceptors.

Perfluoroacylimidazoles – Perfluoroacylimidazoles offer advantages over anhydrides in preparing perfluoroacyl derivatives. The reactions are smooth and quantitative, and produce no acid byproducts that must be removed from the system before injection. Th activated amide reagents yield no acid byproducts, giving only imidazole and N-methyltrifluoroacetamide, respectively. The perfluoroacylimidiazoles react with hydroxyl groups, both primary and secondary amines, and quantitatively acylate indoles alkylam

General Acylation Reagents – N-methylbis(trifluoroacetamide) reacts with amines at room temperature. Hydroxyl derivatizations are slower; heat is recommended.

Acronyms for Acylation Reagents

ACRONYM	CHEMICAL NAME	CAS NO.
HFBA	Heptafluorobutyric anhydride	336-59-4
MBTFA	N-Methylbis (trifluoroacetamide)	685-27-8
PFPA	Pentafluoropropionic anhydride	356-42-3
TFAA	Trifluoroacetic anhydride	407-25-0
TFAI	1-(Trifluoroacetyl) imidazole	1546-79-8

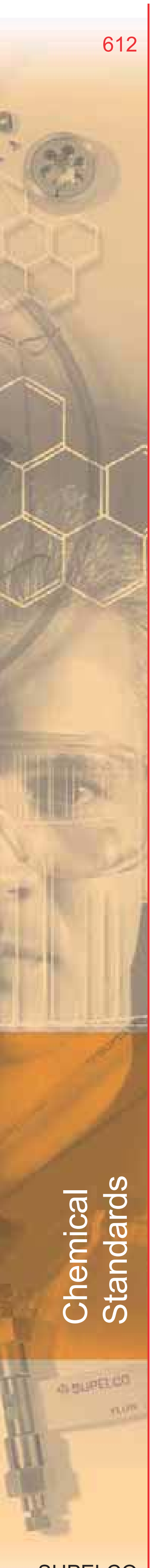
Acylation Reagents

DESCRIPTION	QTY.	CAT. NO.	PRICE
Acetic Anhydride	10 x 2mL	33085	
HFBA	10 x 1mL	33170-U	
MBTFA	5mL	394939-5ML	
PFPA	10 x 1mL	33167	
	25mL	33168	
TFAA	10 x 1mL	33165-U	
	25mL	33164	
TFAI	5mL	394920-5ML	

RELATED INFORMATION

Bulletin 909 contains detailed information on selecting a suitable derivatization reagent for most applications. Request a free copy of Bulletin 909 by phone or fax, or see our website.

No.	Subject
T196909	derivatization reagents



Derivatization Reagents

Alkylation Reagents

Alkylation Reagents

Alkylation involves the addition of an alkyl group (aliphatic or aliphatic-aromatic) to an active functional (H) group. Replacement of hydrogen with an alkyl group is important because of the decreased polarity of the derivative as compared with the parent compound. This reagent is used to modify compounds containing acidic hydrogens such as carboxylic acids and phenols.

The resulting products are ethers, esters, thioethers, thioesters, n-alkyl amines, and n-alkyl amides. Alkylation of weakly acidic groups (alcohols) requires strongly basic catalysts (sodium methoxide, potassium methoxide). More acidic OH groups, as in phenols and carboxylic acids, require less basic catalysts (hydrogen chloride, boron trifluoride).

DMF-Dialkyl acetals – Dimethylformamide dialkyl acetals are used to esterify acids to their methyl esters. Hydroxyl groups are not methylated with this reagent. Carboxylic acids, phenols, and thiols quickly react to give the corresponding alkyl derivatives. N,N-dimethylformamide dimethyl acetals are moisture sensitive.

Diazoalkales – Diazomethane reacts rapidly with unesterified fatty acids in the presence of a small amount of methanol, which catalyses the reaction to form methyl esters. The yield is high and the side reactions are minimal. Diazomethane is a yellow gas which is usually used as an ethereal solution, with some methanol present; the elimination of gaseous nitrogen drives the reaction. Diazomethane is carcinogenic, highly toxic, potentially explosive, and unstable. Diazomethane is not ideal for esterification of phenolic acids because the phenolic hydroxyl groups are also methylated at a slower rate, which may lead to mixtures of partially methylated products.

Esterification and Transesterification Reagents – Esterification is the reaction of an acid with an alcohol in the presence of a catalyst to form an ester. The process involves the condensation of the carboxyl group of the acid and the hydroxyl group of the alcohol, with the elimination of water. Esterification is best done in the presence of a catalyst (e.g., hydrogen chloride), which is removed with the water.

Esterification is the most popular alkylation method. Alkyl esters offer excellent stability, and provide quick and quantitative samples for GC analysis.

Transesterification is the displacement of the alcohol from an ester by another alcohol. This has been widely used for making esters of higher alcohols from those of lower alcohols. Transesterification can be performed with an acidic or basic catalyst using methanol to react with fats and oils.

General Alkylation Reagents – Pentafluorobenzyl bromide is convenient for making esters and ethers and has been used in trace analysis. This reagent is a strong lachrymator and should be handled only in a hood. Hexacyclooctadecane and pentafluorobenzylbromide are reagents for preparing pentafluorobenzyl phenol derivatives for US EPA Method 604. Esterate-M is used in the preparation of methyl and other esters of long chain fatty acids by reaction with dimethylformamide dialkylacetals. Aldehydes and ketones are conveniently derivatized by forming oximes with o-alkylhydroxylamine HCl reagents. O-methylhydroxylamine HCl has been used with ketosteroids, prostaglandins, saccharides, aldoacids, and ketoacids. N-butylboronic acid reacts with 1,2-diols or 1,3 with α- or β-hydroxy acids to form 5- or 6-member ring nonpolar boronate derivatives. They are prepared simply by adding n-butylboronic acid to a solution of the hydroxy compound in dimethylformamide.

Acronyms for Alkylation Reagents

ACRONYM	CHEMICAL NAME	CAS NO.
Diazald	N-Methyl-N-nitroso-p-toluenesulfonamide	—
Diazald-N-methyl-^{13}C	N-Methyl-^{13}C-N-nitroso-p-toluenesulfonamide	60858-95-9
Diazald-N-methyl-^{13}C-N-methyl-d$_3$	N-Methyl-^{13}C-d$_3$-N-nitroso-p-toluenesulfonamide	102832-11-1
DMF-DBA	N,N-Dimethylformamide di-tert-butyl acetal	36805-97-7
DMF-DEA	N,N-Dimethylformamide diethyl acetal	1188-33-6
DMF-DMA	N,N-Dimethylformamide dimethyl acetal	4637-24-5
DMF-DPA	N ,N-Dimethylformamide dipropyl acetal	6006-65-1
DMP	2,2-Dimethoxypropane	77-76-9
Esterate M	2meq DMF-DMA in 1mL pyridine	—
MNNG	1-Methyl-3-nitro-1-nitrosoguanidine	70-25-7
NBB	n-Butylboronic acid	4426-47-5
PFBBr	Pentafluorobenzyl bromide	1765-40-8
TMAH	Trimethylanilinium	—

RELATED INFORMATION

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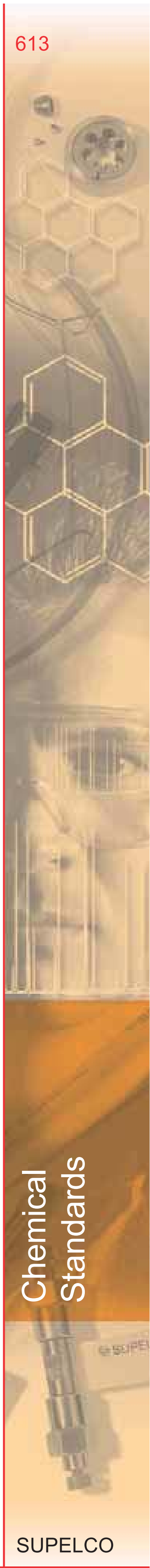
No.	Subject
T196909	derivatization reagents

Alkylation Reagents

DESCRIPTION	CAT. NO.	PRICE
DMF-Dialkylacetals		
DMF-DBA		
10 x 1mL	395005-10X1ML	
5mL	395005-5ML	
25mL	395005-25ML	
DMF-DEA (1,1-Diethoxytrimethylamine)		
10 x 1mL	394971-10X1ML	
5mL	394971-5ML	
25mL	394971-25ML	
DMF-DMA		
10 x 1mL	394963-10X1ML	
5mL	394963-5ML	
25mL	394963-25ML	
DMF-DPA		
10 x 1mL	394998-10X1ML	
5mL	394998-5ML	
25mL	394998-25ML	
Diazoalkales		
Diazald		
25g	D28000-25G	
100g	D28000-100G	
500g	D28000-500G	
1kg	D28000-1KG	
MNNG, 97%		
10g	129941-10G	
25g	129941-25G	
(Trimethylsilyl)diazomethane (2.0M solution in hexanes)		
5mL	362832-5ML	
25mL	362832-25ML	

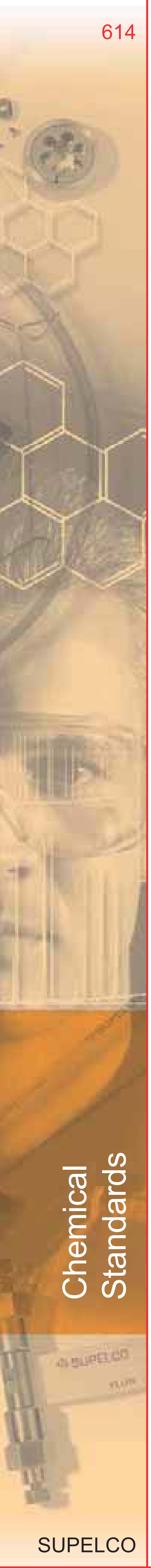
DESCRIPTION	CAT. NO.	PRICE
Esterification Reagents*		
BCl_3-2-Chloroethanol (11% w/w)		
10 x 1mL	33056-U	
BCl_3-Methanol (12% w/w)		
20 x 1mL	33353	
20 x 2mL	33089-U	
400mL	33033	
BF_3-Butanol (10% w/w)		
10 x 5mL	33126-U	
100mL	33125-U	
BF_3-Methanol (10% w/w)		
20 x 1mL	33356	
19 x 2mL	33020-U	
10 x 5mL	33040-U	
5mL	264121-5ML	
250mL	264121-250ML	
400mL	33021	
BF_3-PrOH (14% w/w)		
5g	156825-5G	
100g	156825-100G	
500g	156825-500G	
Methanolic Base		
0.5N, 30mL	33352	
0.5N, 100mL	33080	
Methanolic HCl		
0.5N, 20 x 1mL	33354	
0.5N, 10 x 5mL	33095	
3N, 20 x 1mL	33355	
3N, 10 x 3mL	33051	
3N, 400mL	33050-U	
Methanolic H_2SO_4 (10% v/v)		
6 x 5mL	506516	
TMAH, 0.2M in methanol		
10 x 1mL	33358-U	
10mL	33097-U	
General Alkylation Reagents*		
DMP (2,2-Dimethoxypropane)		
25g	33053	
Esterate M		
25mL	33140	
Hexaoxacyclooctadecane (18 crown 6)		
25g	33003-U	
O-Methoxyamine HCl		
5g	33045-U	
Pentafluorobenzyl bromide		
5g	33001	

*Product specification sheets are available for most of these reagents. Information includes properties, features and benefits, typical derivatization procedure, mechanism, toxicity, hazards, and stability. For free literature, request a copy by phone or see our Web site.



Derivatization Reagents

Silyl Reagents



Silyl Reagents*

Silyl refers to trimethylsilyl Si(CH$_3$)$_3$, or TMS. Silylation is the introduction of a silyl group into a molecule, usually in substitution for active hydrogen.

Replacement of active hydrogen by a silyl group reduces polarity of the compound and decreases hydrogen bonding. The silylated derivative is thus more volatile. Also, stability is enhanced because the number of reactive sites containing active hydrogen has been reduced. Silylated compounds are less polar, detection is enhanced, and the derivatives are thermally more stable.

The greatest use of silylation has been in GC. Many hydroxy and amino compounds regarded as nonvolatile or unstable at 200-300°C have been successfully chromatographed after silylation.

Silyl reagents are influenced by both the solvent system and the addition of a catalyst. The use of a catalyst (e.g., trimethylchlorosilane, pyridine) increases the reactivity of the silyl reagent. It is important to determine the reaction times and reaction temperatures when developing derivatization procedures. The conversion rate for the derivative must be known in order to achieve quantitative analysis of the unknown sample. The reagents generally are moisture sensitive, and are sealed to prevent deactivation from moisture during storage. These silyl reagents are suitable for general use but, if used in excess, can cause difficulties with flame ionization detectors.

The trimethylsilyl group is the most popular and versatile silyl group for GC analysis. Introduction of this group enables better GC separation and the application of special detection techniques.

Acronyms for Silylation Reagents

ACRONYM	CHEMICAL NAME	CAS NO.
BSA	N,O-Bis(trimethylsilyl)acetamide	10416-59-8
BSTFA	Bis(trimethylsilyl) trifluoroacetamide	25561-30-2
DMDCS	Dimethyldichlorosilane	75-78-5
HMDS	1,1,1,3,3,3-Hexamethyldisilazane	999-97-3
MTBSTFA	N-(tert-Butyldimethylsilyl)-N-methyltrifluoroacetamide	77377-52-7
TBDMCS	t-Butyldimethylchlorosilane	18162-48-6
TFA	Trifluoroacetic acid	76-05-1
TMCS	Trimethylchlorosilane	75-77-4
TMSDEA	Trimethylsilyldiethylamine (N,N-Diethyl-1,1,1 -trimethylsilylamine)	996-50-9
TMSI	Trimethylsilylimidazole	18156-74-6

DESCRIPTION	CAT. NO.	PRICE
BSA, DERIVATIZATION GRADE		
144 x 0.1mL	33035-U	
20 x 1mL	33036	
25mL	33037-U	
BSA + TMCS, 5:1 (SYLON BT)		
20 x 1mL	33018	
25mL	33019-U	
BSA + TMCS + TMSI, 3:2:3 (SYLON BTZ)		
144 x 0.1mL	33151	
20 x 1mL	33030	
25mL	33031-U	
BSTFA, DERIVATIZATION GRADE		
144 x 0.1mL	33084	
20 x 1mL	33024	
25mL	33027	
BSTFA + TMCS, 99:1 (SYLON BFT)		
144 x 0.1mL	33154-U	
20 x 1mL	33148	
25mL	33155-U	
50mL	33149-U	
HMDS		
30mL	33350-U	
100mL	33011	
HMDS + TMCS, 3:1 (SYLON HT)		
20 x 1mL	33046	
REACTA-SIL CONCENTRATE (HMDS:TMCS, 2:1)		
25mL	394610-25ML	
HMDS + TMCS + PYRIDINE, 3:1:9 (SYLON HTP)		
20 x 1mL	33038	
25mL	33039	
N-METHYL-N-(TRIMETHYLSILYL)TRIFLUOROACETAMIDE		
10 x 1mL	394866-10X1ML	
5mL	394866-5ML	
25mL	394866-25ML	

DESCRIPTION	CAT. NO.	PRICE
MTBSTFA, DERIVATIZATION GRADE		
10 x 1mL	394882-10X1ML	
5mL	394882-5ML	
25mL	394882-25ML	
MTBSTFA + TBDMCS, 99:1		
10 x 1mL	375934-10X1ML	
5mL	375934-5ML	
25mL	375934-25ML	
TFA		
10 x 1mL	33077	
25mL	33075	
100mL	33076	
TMCS, DERIVATIZATION GRADE		
100mL	33014	
TMSI, DERIVATIZATION GRADE		
25mL	33068-U	
TMSI + PYRIDINE, 1:4 (SYLON TP)		
20 x 1mL	33159-U	
25mL	33156-U	
T-BUTYLDIMETHYLSILYLIMIDAZOLE-DIMETHYLFORMAMIDE		
10 x 1mL	33092-U	

Silyl Reagents for Deactivating Glassware and Chromatographic Supports

Note: All Supelco glass GC columns have been silane treated.

DESCRIPTION	CAT. NO.	PRICE
DMDCS		
100mL	33009	
5% DMDCS in Toluene (Sylon CT)		
400mL	33065-U	
Rejuv-8 Silylating Agent		
25mL	33059-U	

* Product specification sheets are available for most of these reagents. Information includes properties, features and benefits, typical derivatization procedure, mechanism, toxicity, hazards, and stability. For free literature, request a copy by phone or see our Web site.

Derivatization Reagents

Sampler Kits, HPLC Reagent, Literature

Derivatization Reagent Sampler Kits for GC

Our derivatization reagent sampler kits enable you to determine the best reagent for a specific application, without the cost of purchasing, storing, and ultimately disposing of large volumes of individual reagents. Because of our purity specifications and reaction efficiency checks, we can guarantee consistently high reactivity from every lot of each reagent. Documentation detailing the chemistry and lot purity of the reagent, a tested derivatization procedure, and handling and storing recommendations is available for most reagents.

Each of our four kits incorporates a group of related reagents.

Derivatization Reagent Sampler Kits

DESCRIPTION	COMPOSITION	CAT. NO.	PRICE
Acylation Sampler Kit	3 x 1mL of each of the following (except as noted): Acetic anhydride (3 x 2mL) Heptafluorobutyric anhydride Pentafluoropropionic anhydride Trifluoroacetic anhydride	505862	
FID Alkylation Sampler Kit	3 x 1mL of each of the following: BF_3-Methanol Methanolic Base Methanolic HCl (0.5N) Methanolic HCl (3N) TMAH, 0.2M in methanol	505854	
ECD Alkylation Sampler Kit	3 x 1mL of each of the following (except as noted): BCl_3-2-Chloroethanol, 11% w/w BCl_3-Methanol, 12% w/w Hexaoxacyclooctadecane, 18 crown 6 (1 gram) Pentafluorobenzylbromide	505870	
Silylation Sampler Kit	3 x 1mL of each of the following: BSA BSTFA BSTFA + TMCS, 99:1 (Sylon BFT) HMDS + TMCS, 3:1 (Sylon HT) TMSI	505846	

RELATED INFORMATION

Free Technical Literature

Reagent	Product Specification Sheet
Acetic Acid	T497121
● BCl_3 Methanol	T496123
● BCl_3-2Chloroethanol	T496122
● BF_3 Butanol	T496124
● BF_3 Methanol	T496125
BSA	T496017
BSA + TMCS, 5:1 (Sylon BT)	T496018
BSA + TMCS + TMSI, 3:2:3 (Sylon BTZ)	T496019
BSTFA	T496020
BSTFA + TMCS, 99:1 (Sylon BFT)	T496021
DMDCS	T496022
● 5% DMDCS in Toluene (Sylon CT)	T496023
HMDS	T496024
HMDS + TMCS, 3:1 (Sylon HT)	T496025
HMDS + TMCS + Pyridine, 3:1:9 (Sylon HTP)	T496026
● Methanolic Base	T497007
● Methanolic HCl	T497099
● Methanolic Sulfuric Acid	T497018
N-t-Butyldimethylsilylimidazole	T496065
Perfluoro Acid Anhydrides	T497104
PFBBr & 18 Crown 6	T497103
● Rejuv 8	T496066
TFA	T496027
TMCS	T496028
TMSI	T496029
TMSI + Pyridine, 1:4 (Sylon TP)	T496030

Bulletin 909 contains detailed information on selecting a suitable derivatization reagent for most applications. Request a free copy of publication number T196909 by phone or see our Web site.

Certificates of Analysis, containing lot specific data, are available for many Supelco reagents free of charge. These certificates, as well as product specification sheets (see table above), contain information about the reagent: use, physical properties, benefits, typical procedures for derivatizing a compound, toxicity, hazards, storage and stability, and reaction mechanism. To obtain free copies, contact our Order Processing department, or refer to Literature, Free Technical in the index.

● Only product specification sheets are available for these reagents.

Derivatization Reagent for HPLC

Dabsyl chloride (4-Dimethylamino-azobenzene-4-sulphonyl chloride)

Precolumn reagent used in HPLC for derivatizing amino acids. Dabsyl-amino acids can be separated by reversed phase HPLC and detected in the visible region.

DESCRIPTION	QTY.	CAT. NO.	PRICE
Dabsyl chloride	500mg	502219	

Biocides

ProClin and Kathon Preservatives

ProClin and Kathon Preservatives

- Broad-spectrum antimicrobial activity controls bacteria, yeast, and fungi
- Compatible with key enzymes
- Do not inhibit antibody binding
- Excellent stability
- Effective at pH 2-8.5
- Less toxic than thimerosal
- Easy-to-use liquid formulations

ProClin and Kathon CG/ICP preservatives are highly effective biocides for controlling microorganisms in biological media. ProCl preservatives are for *in vitro* diagnostic products; Kathon preservatives are for use in research laboratories and industrial laboratories. Suitable media include reagents, control solutions, calibration solutions, buffers, and mobile phases. At concentrations as low as 0.02%, these preservatives eradicate bacteria, fungi, and yeast for extended periods of time. Both preservatives offer excellent compatibility and stability with most enzyme systems, as well as low toxicity.

ProClin and Kathon CG/ICP preservatives are an excellent choice for replacing thimerosal, sodium azide, and gentamicin as preserva

Mechanism of Action

The active components in ProClin and Kathon CG/ICP preservatives are two isothiazolones: 2-methyl-4-isothiazolin-3-one and 5-chloro-2-methyl-4-isothiazolin-3-one. These active components have a unique mechanism of action that both inhibits microbe grow and causes cell death. Within minutes after contacting a microorganism, the active components penetrate the cell membrane and inhibit specific enzymes in the cell, inhibiting growth, macromolecule synthesis, and respiration, and causing intracellular energy levels to decline rapidly. With energy production disrupted, the cell can no longer synthesize chemicals for routine operation or repa Ultimately the cell dies. The target enzymes are within the central metabolic cycle of the cell, the Krebs cycle (pyruvate dehydrogenase, α-ketoglutarate dehydrogenase, succinate dehydrogenase, NADH dehydrogenase), affording microbes little chance to develop resistance.

Biocides for *in vitro* Diagnostic Manufacturing

ProClin Evaluation Kits - The evaluation kits are designed for investigating, on a small scale, the suitability of ProClin preservatives in new product development. Each kit contains 5mL each of three different manufactured lots of ProClin preservative for testing consistency in performance from lot to lot. Also included is a Certificate of Analysis for each lot of preservative, and an instruction booklet.

CHARACTERISTICS OF PROCLIN PRESERVATIVES

	ProClin 150	ProClin 200	ProClin 300	ProClin 950
Composition				
Active Ingredients[1]	1.5%	1.5%	3.0%	9.5% [2]
Matrix	water	water	propylene glycol	dipropylene glycol
Stabilizer	23-25% Mg salts	3% Mg salts	alkyl carboxylate	none
Recommended Level of Use (as supplied, %)	0.04-0.10	0.04-0.10	0.02-0.05	0.05-0.10
Shelf Life	3 years	3 years	3 years	24 months [3]
Applications				

in vitro diagnostic kits and kit components, calibration solutions, control solutions, organic reagents.
Only ProClin 5000 recommended for use in serum-based solutions.

[1] 5-Chloro-2-methyl-4-isothiazolin-3-one and 2-methyl-4-isothiazolin-3-one.

[2] 2-Methyl-4-isothiazolin-3-one only.

[3] Recent introduction, collection of stability data is ongoing.

DESCRIPTION	QTY.	CAT. NO.	PRICE
PROCLIN EVALUATION KITS			
ProClin 150	3 x 5mL	48121	
ProClin 300	3 x 5mL	48125	
ProClin Variety Kit*	3 x 5mL	48119-U	

* Contains 5mL each of ProClin 150, ProClin 200, and ProClin 300 preservatives.

Biocides

ProClin and Kathon Preservatives

Restrictions on the Use of Biocides

The sale and use of biocides in the United States are closely regulated by federal laws.

- ProClin preservatives are labeled for use only as preservatives for *in vitro* clinical diagnostic reagents. Such *in vitro* diagnostic reagents are considered medical devices and are regulated by the US Food and Drug Administration (US FDA) under the Food, Drug & Cosmetic Ac other application is prohibited.
- Kathon CG/ICP preservatives are intended for non-medical applications only. These preservatives are regulated under the Federal Insecticide, Fungicide, and Rodenticide Act, which is administered by the US Environmental Protection Agency (US EPA). Any *in vitro* diagnostic application is prohibited.

Special Note -To help you meet regulatory compliance, a company representative will contact you prior to shipment of your first trial order.

DESCRIPTION	CAT. NO.	PRICE
PROCLIN 150 PRESERVATIVE		
50mL	48122	
400mL	48123	
3.6 liters	48124	
15 liters	48061	
PROCLIN 200 PRESERVATIVE		
50mL	48171-U	
400mL	500380	
3.6 liters	500399	
15 liters	500402	
PROCLIN 300 PRESERVATIVE		
50mL	48126	
400mL	48127	
2.0 liters	48090-U	
3.6 liters	48128	
18 liters	48060-U	
PROCLIN 950 PRESERVATIVE		
5mL	46885-U	
50mL	46878-U	
400mL	46879-U	
3.6 liters	46883-U	
17 liters	46884-U	

Biocides for All Non-Diagnostic Applications

Kathon Preservatives – 1.5% total active ingredients in water with magnesium salts as a stabilizer.
Available in North America only.

DESCRIPTION	CAT. NO.	PRICE
KATHON CG/ICP PRESERVATIVE		
23-25% Salts		
3 x 5mL*	500119	
50mL	500127	
400mL	500135	
3.6 liters	500143	
KATHON CG/ICP II PRESERVATIVE		
3-5% Salts		
50mL	48175-U	
400mL	48178-U	

* Evaluation kit: 5mL from each of 3 manufacturing lots.

RELATED INFORMATION

Literature No.	Title
T196902	ProClin Preservatives: Mechanisms and Stability
T395077	Efficacy Tests for ProClin Preservative (ARL)
T496039	ProClin 150 Preservative for Diagnostic Reagents: Product Specifications (AWT)
T498169	ProClin 200 Preservative for Diagnostic Reagents
T496050	ProClin 300 Preservative for Diagnostic Reagents: Product Specifications (AWW)
T196903	ProClin 300 Preservative for Diagnostic Reagents: Theory
T401185	ProClin 950 Preservative for Diagnostic Reagents
T196904	Determination of ppm Levels of ProClin 300 Preservatives in Water-Dilutable Samples by HPLC
T197912	Kathon CG/ICP Preservative for Media Biocide Applications (BDN)